ADDENDUM #1
DATE: 03.12.2021

TO CONTRACT DOCUMENTS ENTITLED:

PROJECT MANUAL FOR: CP210251 1st Floor Infrastructure Upgrades Serving Level 1

ADVERTISEMENT DATE: 03.04.2021

PREPARED FOR: The Curators of the University of Missouri

CONSULTANTS: CP210251
bc**DESIGN**GROUP
12101 110th Street, Suite 100
Overland Park, KS 66213
913.232.2123 x 809

Drawings and Specifications for the above noted project and the work covered thereby are herein modified as follows, and except as set forth herein, otherwise remain unchanged and in full force and effect:

DIVISION 1:

1. Section 1.A – Paragraph 3.c.6 and 3.c.7 all prices have been removed under base bid quantity.

CP210251 SPECIFICATIONS:

1. 05 5313 – Bar Grating Spec. Added spec to project manual.

CP210251 DRAWINGS:

1. Sheet G100 – Contractor access primary access is through the basement of MPC. Access from the east has been removed.
2. Sheet G101 – Note pertaining to MPC ground floor access has been added.
3. Sheet D100 – Keynote 10 added to sheet and called out on plan in stair vestibule between Missouri Psychiatric Center and Teaching Hospital.
4. Sheet D101 – Keynote 10 added to sheet and called out on plan in stair vestibule between Missouri Psychiatric Center and Teaching Hospital.
5. Sheet D102 – Keynote 10 added to sheet and called out on plan in stair vestibule between Missouri Psychiatric Center and Teaching Hospital.
6. Sheet AS101 – Keynote 19 added to legend and sheet.
7. Sheet A100 – Vending Machine sizes updated to reflect actual size.

CLARIFICATIONS, QUESTIONS, ANSWERS:

1. Please see below request to have the AKSA brand generator added as an acceptable manufacturer in the Missouri Psychiatric Center, Columbia Mo. project specifications.
    - **a.** This substitution request is denied due to not meeting MU's specification requirements.

ATTACHMENTS:

1. Section 1.A of Division 1, Spec Sections 05 5313, Drawings G100, D100, D101, A100, AS101, MEP Narrative, Spec Sections 21 0500, 22 0500, 23 0100, 23 0540, 23 3113, 23 3423, 23 7313, 23 8239, 23 8413, Drawings M000, MD401, M201, M502, M601, M602, FP101, ED100, ED700, E001, E101, E700

ISSUED BY:

Kurt Broeckelmann
bc**DESIGN**GROUP

END OF ADDENDUM #1

SECTION 1.A

BID FOR LUMP SUM CONTRACT

Date:_____

BID OF _____
(hereinafter called "Bidder") a corporation* organized and existing under laws of the State of _____
_____,
a partnership* consisting of _____,
an individual* trading as _____,
a joint venture* consisting of _____
_____.
*Insert Corporation(s), partnership or individual, as applicable.

TO: Curators of the University of Missouri Campus Facilities, Planning, Design & Construction, Room L100 (Front Reception Desk), General Services Building, University of Missouri, Columbia, MO 65211

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by bc**DESIGN**GROUP, entitled Missouri Psychiatric Center – Infrastructure Serving Level 1, Project Number CP210251, AND Missouri Psychiatric Center – Renovate 1N for Adult Assessment and Observation Unit, Project Number CP210511 BOTH dated March 4, 2021 having examined Contract Documents and site of proposed work, and being familiar with all conditions pertaining to construction of proposed project, including availability of materials and labor, hereby proposes to furnish all labor, materials and supplies to construct project in accordance with Contract Documents, within time set forth herein at prices stated below. Prices shall cover all expenses, including taxes not covered by the University of Missouri's tax exemption status, incurred in performing work required under Contract documents, of which this Bid is a part.

   Bidder acknowledges receipt of following addenda:

   Addendum No. _____Dated _____
   Addendum No. _____Dated _____
   Addendum No. _____Dated _____
   Addendum No. _____Dated _____

2. In following Bid(s), amount(s) shall be written in both words and figures. In case of discrepancy between words and figures, words shall govern.

3. BID PRICING

   a. Base Bid:
   The Bidder agrees to furnish all labor, materials, tools, and equipment required to __; all as indicated on the Drawings and described in these Specifications for sum of:

   _____
   _____DOLLARS ($_____).

   b. Additive Alternate Bids:

   Above Base Bid may be changed in accordance with following Alternate Bids as Owner may elect. Alternates are as described in Section 1.H of Project Manual. Alternates are written in a priority order, but Owner is not required to accept or reject in order listed. This is a one (1) contract project, therefore, Alternates shall be studied by each Bidder to determine effect on Bids of Contractor and each Subcontractor and/or Material supplier.

(1) Additive Alternate No. 1: CP210251: Tracing Electrical circuits –Trace and provide AutoCAD documentation of existing branch circuits in existing panelboards on life safety branch of new essential electrical system for Missouri Psychiatric Center building as indicated in Note 1 on electrical one-line drawing (E501).
All for sum of:

_____
_____DOLLARS ($_____).

c. Unit Prices:

(1) For changing specified quantities of work from those indicated by Contract Drawings and Specifications, upon written instructions of Owner, the following Unit Prices shall prevail in accordance with General Conditions.

(2) The following Unit Prices include all labor, overhead and profit, materials, equipment, appliances, bailing, shoring, shoring removal, etc., to cover all work.

(3) The following Unit Prices are required where applicable to particular Base Bid and/or Alternate being submitted.

(4) Only a single Unit Price shall be given and it shall apply for either MORE or LESS work than that indicated on Drawings and called for in Specifications as indicated to be included in Base Bid and/or Alternates. In the event that more or less units than so indicated is actually furnished, Change Orders will be issued for increased or decreased amounts as approved by the Owner.

(5) Bidder understands that the Owner will not be liable for any Unit Price or any amount in excess of Base Bid and any Alternate(s) accepted at time of award of Contract, except as expressed in written Change Orders duly executed and delivered by Owner's Representative.

(6) CP210251:

Asbestos Pipe Insulation
Base Bid quantity = 1600 LF $__/LF

Asbestos header insulation
Base Bid quantity = 50 SF $___/SF

Asbestos Floor Tile & Mastic
Base Bid quantity = 80 SF $___/SF

Asbestos wire insulation – Room 18 and Teaching Hospital
Base Bid quantity = 400 LF $___/LF

Asbestos Pipe & Pipe Fitting Insulation – Teaching Hospital
Base Bid quantity = 120 LF $___/LF

Univ. Waste - Fluorescent light tubes
Base Bid quantity = 260 units $___/unit

Univ. Waste - light ballasts
Base Bid quantity = 28 units $___/unit

Univ. Waste - Exit Signs
Base Bid quantity = 15 units $___/unit

Univ. Waste - Fire Extinguishers
Base Bid quantity = 5 units $___/unit

Univ. Waste - water coolers
Base Bid quantity = 4 units $___/unit

Univ. Waste - Electronic Wastes
Base Bid quantity = 15 units $___/unit

(7) CP210511:

Floor Patching / Leveler as defined in Section(s) 09 6513, 09 6516, and 09 6519.16.

Base Bid quantity = 275 CF $___/CF

Asbestos TSI
Base Bid quantity = 656 LF $___/LF

Asbestos Ceiling Debris
Base Bid quantity = 10 SF $___/SF

Asbestos Wiring on Fluorescent lights
Base Bid quantity = 1 unit $___/Total

d. Allowance:

(1) Bidder shall include in the base bid sum for each project, CP210251 AND CP210511, an allowance of $2,500 above and beyond work included in the Base Bid for firestopping existing penetrations discovered after completion of demolition inside the hospital buildings. This allowance shall not include firestopping of any new penetrations required by new work. This allowance amount shall not include contractor's overhead and profit. The Contractor shall include overhead and profit on the allowance amount in his bid.

(2) Unused monies from any/all allowances shall be returned to the Owner by way of a formal change order at the conclusion of the project

4. PROJECT COMPLETION

a. Contract Period - Contract period begins on the day the Contractor receives unsigned Contract, Performance Bond, Payment Bond, and "Instructions for Execution of Contract, Bonds, and Insurance Certificates." Bidder agrees to complete project CP210251 within two hundred thirty-six (236) calendar days from receipt of aforementioned documents and to complete project CP210511 within two hundred forty-nine (249) calendar days from receipt of aforementioned documents. Fifteen (15) calendar days have been allocated in construction schedule for receiving aforementioned documents from Bidder.

b. Commencement - Contractor agrees to commence work on this project after the "Notice to Proceed" is issued by the Owner. "Notice to Proceed" will be issued within seven (7) calendar days after Owner receives properly prepared and executed Contract documents listed in paragraph 4.a. above.

c. Refer to Special Scheduling Requirements in Special Conditions for specific scheduling requirements.

5. SUBCONTRACTOR LIST:

Bidder hereby certifies that the following subcontractors will be used in performance of Work:

NOTE: Failure to list subcontractors for each category of work identified on this form or listing more than one subcontractor for any category of work without designating the portion of work performed by each shall be grounds for rejection of bid. List name, city, and state of designated subcontractor, for each category of work listed in Bid For Lump Sum Contract. If work within a category will be performed by more than one subcontractor, Bidder shall provide name, city, and state of each subcontractor and specify exact portion of work to be performed by each. If acceptance/non-acceptance of Alternates will affect designation of a subcontractor, Bidder shall provide information, for each affected category, with this bid form. If Bidder intends to perform any designated subcontract work by using Bidder's own employees, then Bidder shall list their own name, city, and state. The bidder may petition the Owner to change a listed subcontractor only within 48 hours of the bid opening. See Information For Bidders Section 16 List of Subcontractors for requirements.

Work to be performed	Subcontractor Name,	City, State
FM/UL Certified Fire stopping Contractor		
Electrical		
Mechanical		

6. SUPPLIER DIVERSITY PARTICIPATION GOALS

a. The Contractor shall have as a goal, subcontracting with Minority Business Enterprise (MBE) of ten percent (10%), with Service Disabled Veteran Owned Business (SDVE) of three percent (3%); and with Women Business Enterprise (WBE), Disadvantage Business Enterprise (DBE), and/or Veteran Owned Business of ten percent (10%) of awarded contract price for work to be performed.

b. Requests for waiver of this goal shall be submitted on the attached Application For Waiver form. A determination by the Director of Facilities Planning & Development, UM, that a good faith effort has not been made by Contractor to achieve above stated goal may result in rejection of bid.

c. The Undersigned proposes to perform work with following Supplier Diversity participation level:

MBE PERCENTAGE PARTICIPATION: _____ percent (__%)
SDVE PERCENTAGE PARTICIPATION: _ _ percent (_%)
WBE, DBE, and/or VETERAN PERCENTAGE PARTICIPATION:_____ percent (__%)

d. A Supplier Diversity Compliance Evaluation form shall be submitted with this bid for each diverse subcontractor to be used on this project.

7. BIDDER'S ACKNOWLEDGMENTS

a. Bidder declares that he has had an opportunity to examine the site of the work and he has examined Contract Documents therefore; that he has carefully prepared his bid upon the basis thereof; that he

has carefully examined and checked bid, materials, equipment and labor required thereunder, cost thereof, and his figures therefore. Bidder hereby states that amount, or amounts, set forth in bid is, or are, correct and that no mistake or error has occurred in bid or in Bidder's computations upon which this bid is based. Bidder agrees that he will make no claim for reformation, modifications, revisions or correction of bid after scheduled closing time for receipt of bids.

b. Bidder agrees that bid shall not be withdrawn for a period of sixty (60) days after scheduled closing time for receipt of bids.

c. Bidder understands that Owner reserves right to reject any or all bids and to waive any informalities in bidding.

d. Accompanying the bid is a bid bond, or a certified check, or an irrevocable letter of credit, or a cashier's check payable without condition to "The Curators of the University of Missouri" which is an amount at least equal to five percent (5%) of amount of largest possible total bid herein submitted, including consideration of Alternates.

e. Accompanying the bid is a Bidder's Statement of Qualifications. Failure of Bidder to submit the Bidder's Statement of Qualifications with the bid may cause the bid to be rejected. Owner does not maintain Bidder's Statements of Qualifications on file.

f. It is understood and agreed that bid security of two (2) lowest and responsive Bidders will be retained until Contract has been executed and an acceptable Performance Bond and Payment Bond has been furnished. It is understood and agreed that if the bid is accepted and the undersigned fails to execute the Contract and furnish acceptable Performance/Payment Bond as required by Contract Documents, accompanying bid security will be realized upon or retained by Owner. Otherwise, the bid security will be returned to the undersigned.

8. BIDDER'S CERTIFICATE

Bidder hereby certifies:

a. His bid is genuine and is not made in interest of or on behalf of any undisclosed person, firm or corporation, and is not submitted in conformity with any agreement or rules of any group, association or corporation.

b. He has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid.

c. He has not solicited or induced any person, firm or corporation to refrain from bidding.

d. He has not sought by collusion or otherwise to obtain for himself any advantage over any other Bidder or over Owner.

e. He will not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin in connection with performance of work.

f. By virtue of policy of the Board of Curators, and by virtue of statutory authority, a preference will be given to materials, products, supplies, provisions and all other articles produced, manufactured, mined or grown within the State of Missouri. By virtue of policy of the Board of Curators, preference will also be given to all Missouri firms, corporations, or individuals, all as more fully set forth in "Information For Bidders."

9. BIDDER'S SIGNATURE

Note: All signatures shall be original; not copies, photocopies, stamped, etc.

Authorized Signature	Date
Printed Name	Title
Company Name	
Mailing Address	
City, State, Zip	
Phone No.	Federal Employer ID No.
Fax No.	E-Mail Address
Circle one: Individual Partnership Corporation Joint Venture	
If a corporation, incorporated under the laws of the State of_____	
Licensed to do business in the State of Missouri? ____yes _____no	

(Each Bidder shall complete bid form by manually signing on the proper signature line above and supplying required information called for in connection with the signature. Information is necessary for proper preparation of the Contract, Performance Bond and Payment Bond. Each Bidder shall supply information called for in accompanying "Bidder's Statement of Qualifications.")

END OF SECTION

pSECTION 05 5313 - **BAR GRATINGS**

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal bar gratings.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Clips and anchorage devices for gratings.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ohio Gratings, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Mechanical platforms: Uniform live load of 40 lbf/sq. ft. or concentrated live load of 300 lbf, whichever produces the greater stress.
2. Limit live load deflection to L/360 or 1/4 inch, whichever is less.

2.3 METAL BAR GRATINGS

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual."

B. Welded Steel Grating [BG-1]:

1. Bearing Bar Spacing: 1-3/16 inches o.c.
2. Bearing Bar Depth: 3/4 inch
3. Bearing Bar Thickness: 3/16 inch
4. Crossbar Spacing: 4 inches

5. Traffic Surface: **As indicated**.
6. Steel Finish: Galvanized

2.4 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36.

B. Steel Bars for Bar Gratings: ASTM A36 or steel strip, ASTM A1011 or ASTM A1018.

C. Wire Rod for Bar Grating Crossbars: ASTM A510.

2.5 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.

2.6 FABRICATION

A. Cut, drill, and punch material 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.

B. Fit exposed connections accurately together to form hairline joints.

2.7 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

B. Fit exposed connections accurately together to form hairline joints.

3.2 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

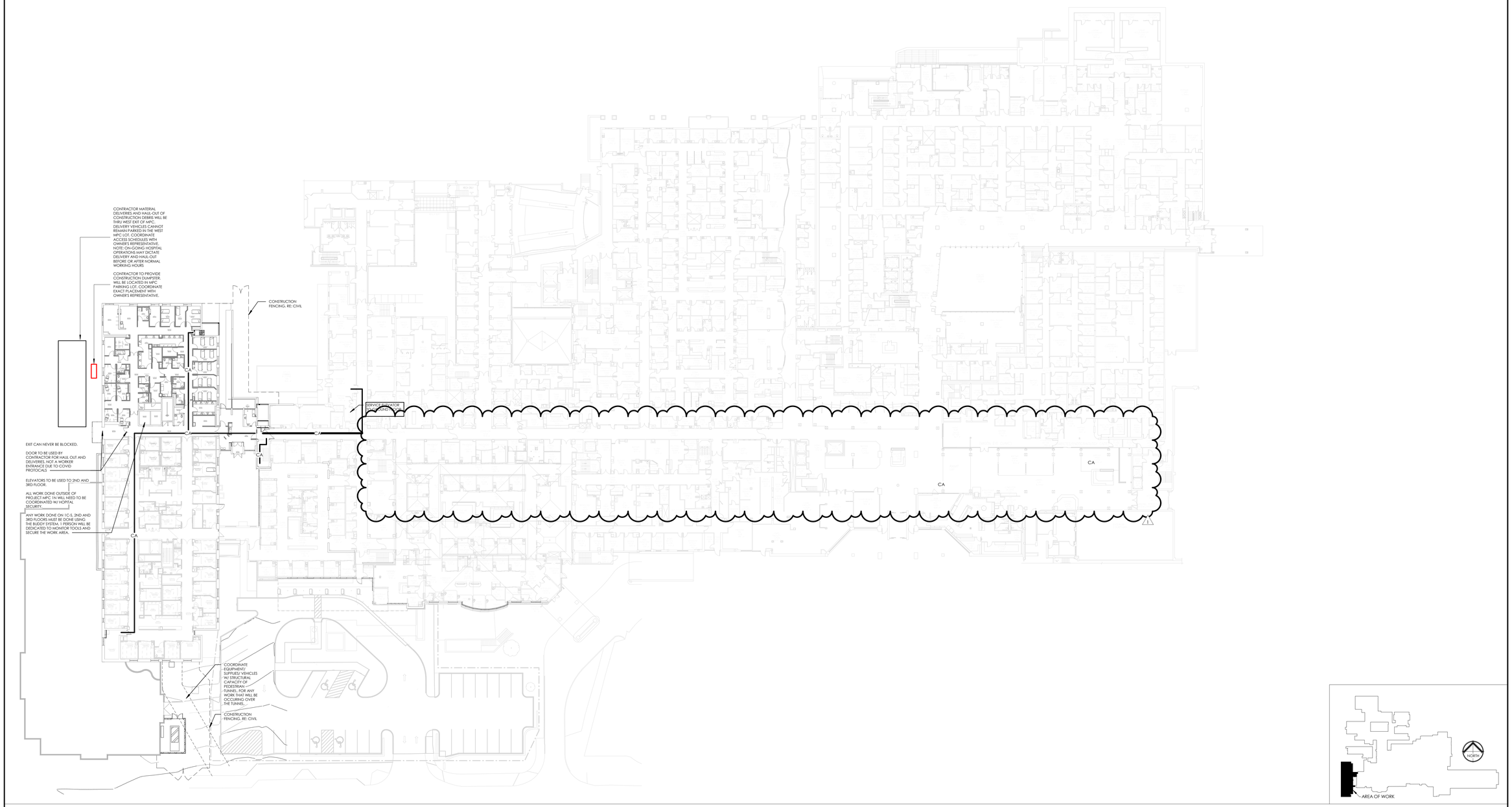
B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: 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 to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

END OF SECTION 055313



1 FIRST FLOOR CONTRACTOR ACCESS
1" = 30'-0"

KEYPLAN

bcDESIGNGROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number
A-2011037290

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD. BLDG. 1,
COLUMBIA, MO 65203
573.447.0292

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

Issue Date: 02.25.2021

#	Issue:	Date:
1	Addendum #1	03.12.2021

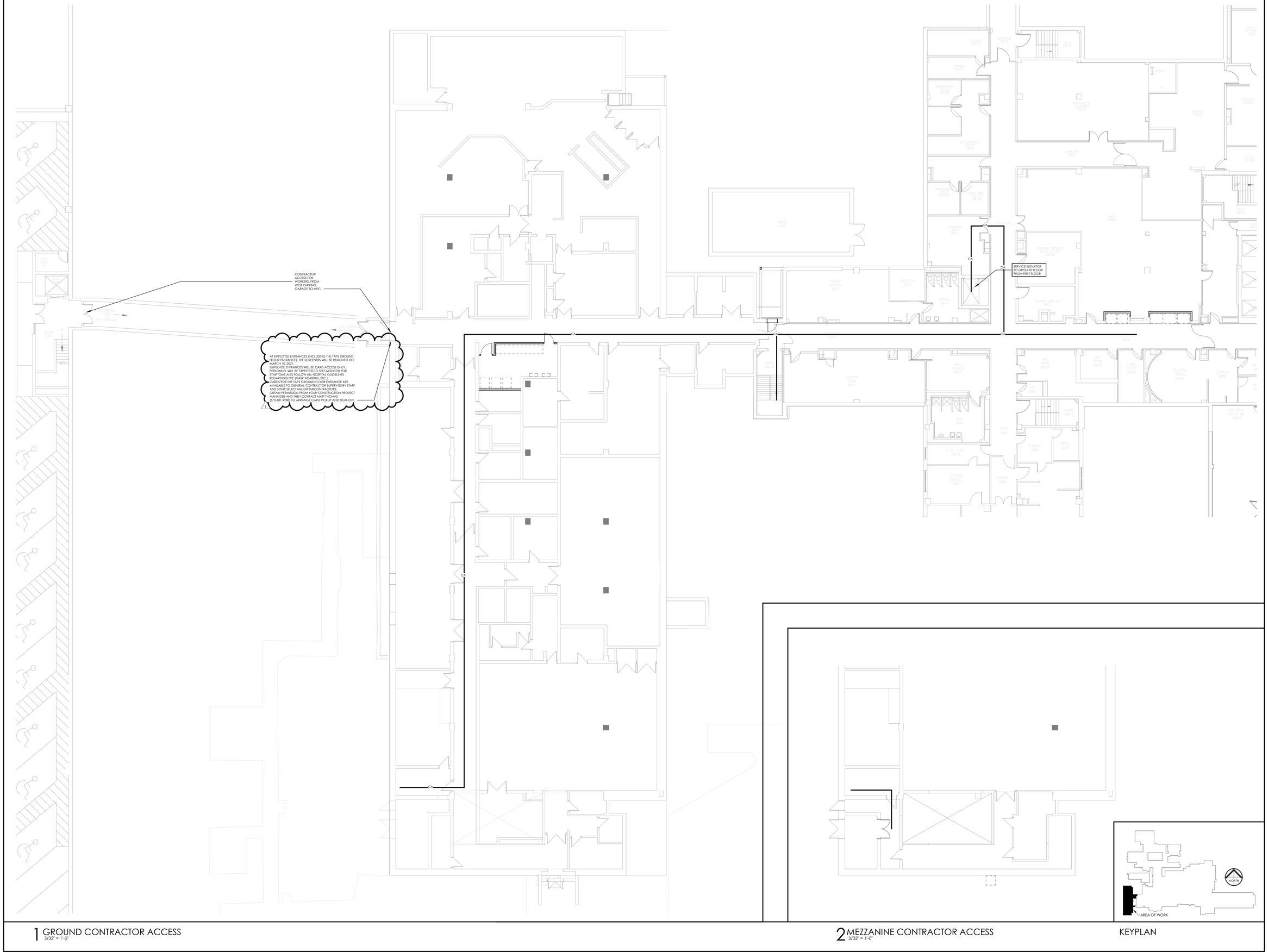
Drawn by: Author

bcdg Project #: 12275.42
MU Project #: CP210251

G100

CONTRACTOR ACCESS PLAN

BID SET



1 GROUND CONTRACTOR ACCESS
3/32" = 1'-0"

2 MEZZANINE CONTRACTOR ACCESS
3/32" = 1'-0"

KEYPLAN

bcdesignGROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number
A-2011037299

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD. BLDG. 1,
COLUMBIA, MO 65203
573.447.0292

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

Issue Date: 02.25.2021

#	Issue:	Date:
1	Addendum #1	03.12.2021

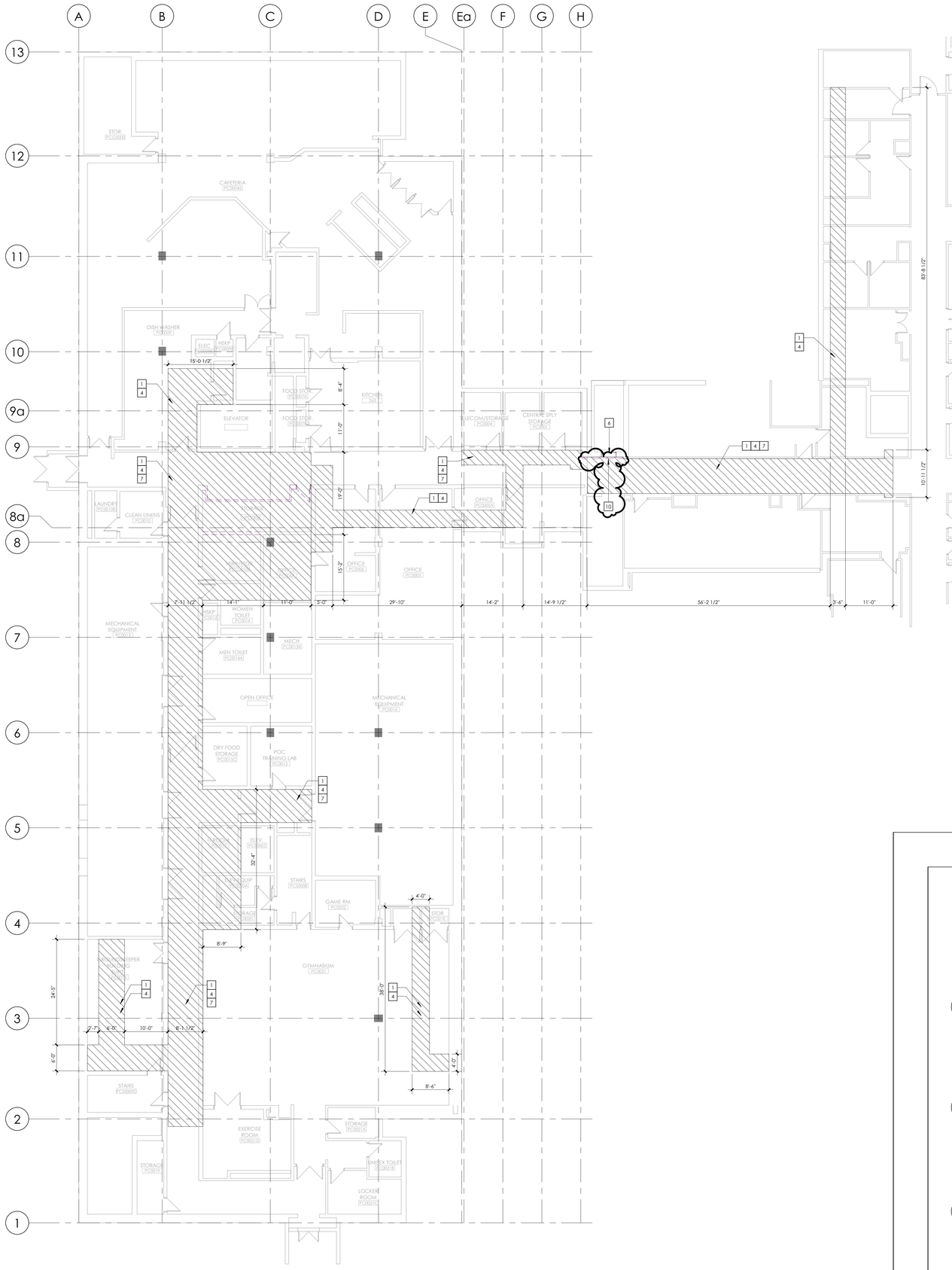
Drawn by: Author

bcdg Project #: 12275.42
MU Project #: CP210251

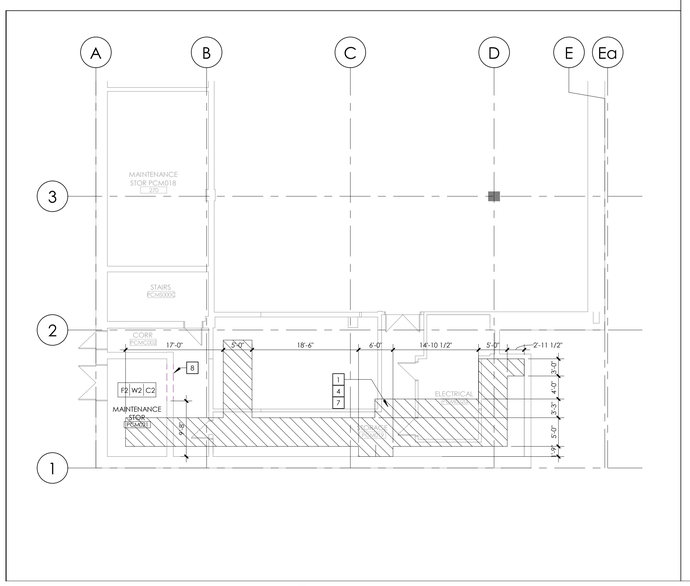
G101

CONTRACTOR ACCESS PLAN

BID SET



1 BASEMENT FLOOR PLAN DEMO
3/32" = 1'-0"



2 MEZZANINE DEMO PLAN
3/32" = 1'-0"

DEMOLITION PLAN LEGEND

- DEMO & REMOVE EXISTING WALL
- EXISTING WALL TO REMAIN
- EXISTING DOOR & FRAME TO REMAIN
- DEMO AND REMOVE EXISTING DOOR, FRAME, AND HARDWARE
- # KEYNOTE TAG

FLOOR/WALL/CEILING NOTES F# W# C#

FLOOR

F1 - REMOVE EXISTING FLOOR, BASE, GLUE, ETC. TO SLAB. PATCH, PRIME, AND PREPARE SUB-FLOOR TO RECEIVE NEW FLOORING AS SCHEDULED.
F2 - EXISTING FLOOR TO REMAIN
F3 - SPECIAL CONDITION - REFER TO KEYNOTE

WALL

W1 - REMOVE EXISTING WALL COVERINGS, PAINT, ETC., PATCH, PREP, AND PRIME WALL TO RECEIVE NEW FINISHES AS SCHEDULED
W2 - EXISTING WALL TO REMAIN
W3 - SPECIAL CONDITION - REFER TO KEYNOTE

CEILING

C1 - REMOVE EXISTING CEILING, HANGERS, ETC. TO BOTTOM OF STRUCTURE. EXERCISE EXTREME CAUTION AS TO NOT DISTURB SYSTEMS INTENDED TO REMAIN.
C2 - EXISTING CEILING TO REMAIN
C3 - SPECIAL CONDITION - REFER TO KEYNOTE

GENERAL DEMOLITION PLAN NOTES

1. CONTRACTOR SHALL CONTACT PLANT OPERATIONS DAILY TO PROVIDE ACTIVITIES AND SHUTDOWN REPORTS. ALL SITE USE SHALL BE COORD, AND APPROVED IN ADVANCE BY OWNER.
2. CONTRACTOR IS TO FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO BEGINNING WORK. REPORT ANY DISCREPANCIES TO ARCHITECT IN WRITING PRIOR TO BEGINNING WORK IN THE AFFECTED AREAS.
3. CONTRACTOR TO VERIFY ALL EXISTING HOSPITAL SYSTEMS CURRENTLY INSTALLED IN THE CONSTRUCTION AREA. ALL DEVICES TO REMAIN SHALL BE CHECKED AND IN WORKING CONDITION WHEN PROJECT IS COMPLETE.
4. CONTRACTOR SHALL EMPLOY REASONABLE MEANS TO CONTAIN DUST, DEBRIS, AND NOISE DUE TO DEMOLITION AND NEW CONSTRUCTION. REFER TO SPECS.
5. ALL WALL MOUNTED ITEMS, ETC., SHALL BE REMOVED & REINSTALLED AS INDICATED THROUGHOUT THE DRAWINGS OR TURNED OVER TO THE OWNER FOR SALVAGE U.N.O.
6. CONTRACTOR SHALL PATCH TO MATCH SURROUNDING FINISHES. ANY AREAS DAMAGED AS A RESULT OF, OR CAUSED BY, THE WORK INDICATED THROUGHOUT THE CONTRACT DOCUMENTS.
7. WHERE REMOVAL OF EXISTING WALL PARTITIONS, EQUIPMENT, ETC.,DISRUPTS OR DISTURBS EXISTING ELECTRICAL, MECHANICAL, OR PLUMBING SERVICES TO AREAS NOT DESIGNATED AS CONSTRUCTION AREAS, CONTRACTOR SHALL PROVIDE TEMPORARY CONNECTIONS AS REQUIRED TO ENSURE UNINTERRUPTED SERVICE TO SAID AREAS. NOTE: NO SERVICE IS TO BE SHUT DOWN WITHOUT PRIOR APPROVAL BY OWNER.
8. CONTRACTOR IS TO REMOVE COMPLETELY EXISTING CONSTRUCTION, AS SHOWN HEREIN, WHICH CONFLICTS WITH THE INTENT OF THE NEW CONSTRUCTION. U.N.O.
9. OWNER WILL BE RESPONSIBLE FOR REMOVING AND STORING ITEMS SUCH AS FURNITURE, PLAQUES, ARTWORK, MOVEABLE EQUIPMENT, ETC.,
10. REFER TO MEP DRAWINGS FOR ADDITIONAL DEMOLITION WORK. PATCH & MATCH SURROUNDING MATERIALS WHERE ITEMS ARE REMOVED AT WALLS, CEILINGS AND FLOORS. MAINTAIN FIRE RATINGS WHERE DEMOLISHED ITEMS PENETRATED FIRE RATED WALLS AND FLOORS.
11. REMOVE AND REPLACE CEILING TILES AS NECESSARY FOR DEMOLITION AND NEW CONSTRUCTION. REPLACE DAMAGED TILES AS REQUIRED.
12. CONTRACTOR TO REMOVE, CLEAN AND STORE ALL PLUMBING FIXTURES SHOWN TO BE REMOVED. ALL FIXTURES TO BE TURNED OVER TO OWNER, U.N.O.

DEMOLITION KEYNOTES:

1. REMOVE CEILING AS NECESSARY TO REMOVE EXISTING MEP WORK ABOVE IN HATCHED AREA. FOLLOW HOSPITAL INFECTION CONTROL STANDARDS FOR CONSTRUCTION DEBRIS CONTAINMENT. REPLACE CEILING AFTER COMPLETE AND REPLACE ANY TILES DAMAGED FROM CONSTRUCTION TO MATCH EXISTING.
2. SAW CUT WALL OPENING AND DEMO TO CREATE AN OPENING FOR MECHANICAL SYSTEM RE: MECH FOR EXACT LOCATION AND SIZE. FOR STRUCTURAL BRACING AT OPENINGS RE: STRUCT.
3. REPAIR SOD TO ORIGINAL CONDITION. REPAIR/REPLACE ANY DAMAGED LANDSCAPING OR CONCRETE FROM CONSTRUCTION.
4. AREA OF DISTURBANCE ABOVE CEILING FOR ROUTING OF MEP SYSTEMS. AREA INCLUDES BOTH LAY-IN DRYWALL CEILING TYPES. EXISTING CEILING MOUNTED DEVICES SHALL BE TEMPORARILY REMOVED TO ACCOMMODATE ABOVE CEILING WORK. REINSTALL DEVICES IN ORIGINAL LOCATIONS. DEVICES SHALL FUNCTION AS THEY DID PRIOR TO CONSTRUCTION.
5. DEMO AND REMOVE ENTIRE CURTAIN WALL SYSTEM.
6. REMOVE GLASS FROM EXISTING WINDOW. FRAME TO REMAIN IN PLACE
7. CORRIDOR WORK TO OCCUR IN SECTIONS DURING THE EVENINGS TO MINIMIZE DISRUPTION TO VA-MU HOSPITAL CIRCULATION. COORDINATE ALL CORRIDOR WORK WITH OWNER REPRESENTATIVE.
8. SAW CUT NEW OPENING IN EXISTING WALL. DO NOT OVERCUT CORNERS. CONTRACTOR SHALL FIELD VERIFY THE EXISTING WALL IS 12" CONCRETE PRIOR TO CUTTING THE NEW OPENING. IF THE WALL IS NOT 12" CONCRETE, CONTACT BOB D. CAMPBELL & CO. FOR FURTHER INSTRUCTION.
9. CORE DRILL FLOOR FOR PENETRATIONS RE:MEP
10. DEMO AND REMOVE FURRING AND DRYWALL TO ACCESS EXISTING WINDOWS.

KEYPLAN

bcdDESIGNGROUP
100 East Park Street, Suite 202
Olathe, KS 66062
913.232.2123
MO Certificate of Authority Number
A-2011033799

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD, BLDG. 1, COLUMBIA, MO 65203
573.447.0292

MPC 1st Floor Infrastructure Upgrades Serving Level 1

University of Missouri, Columbia, Missouri

Project Title:
CP210251

Issue Date: 02.25.2021

#	Issue:	Date:
1	Addendum #1	03.12.2021

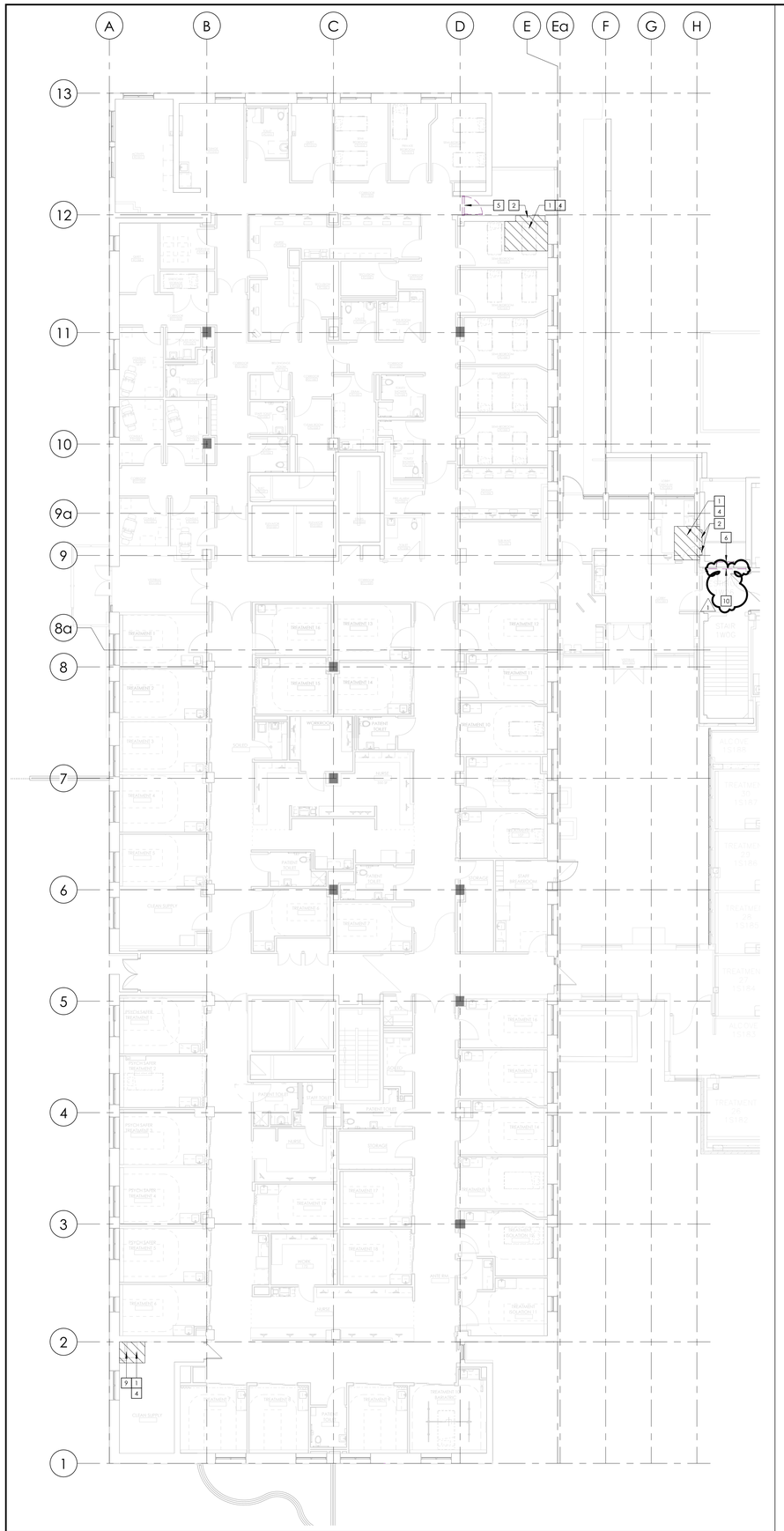
Drawn by: Author

Project Number: 12275.40

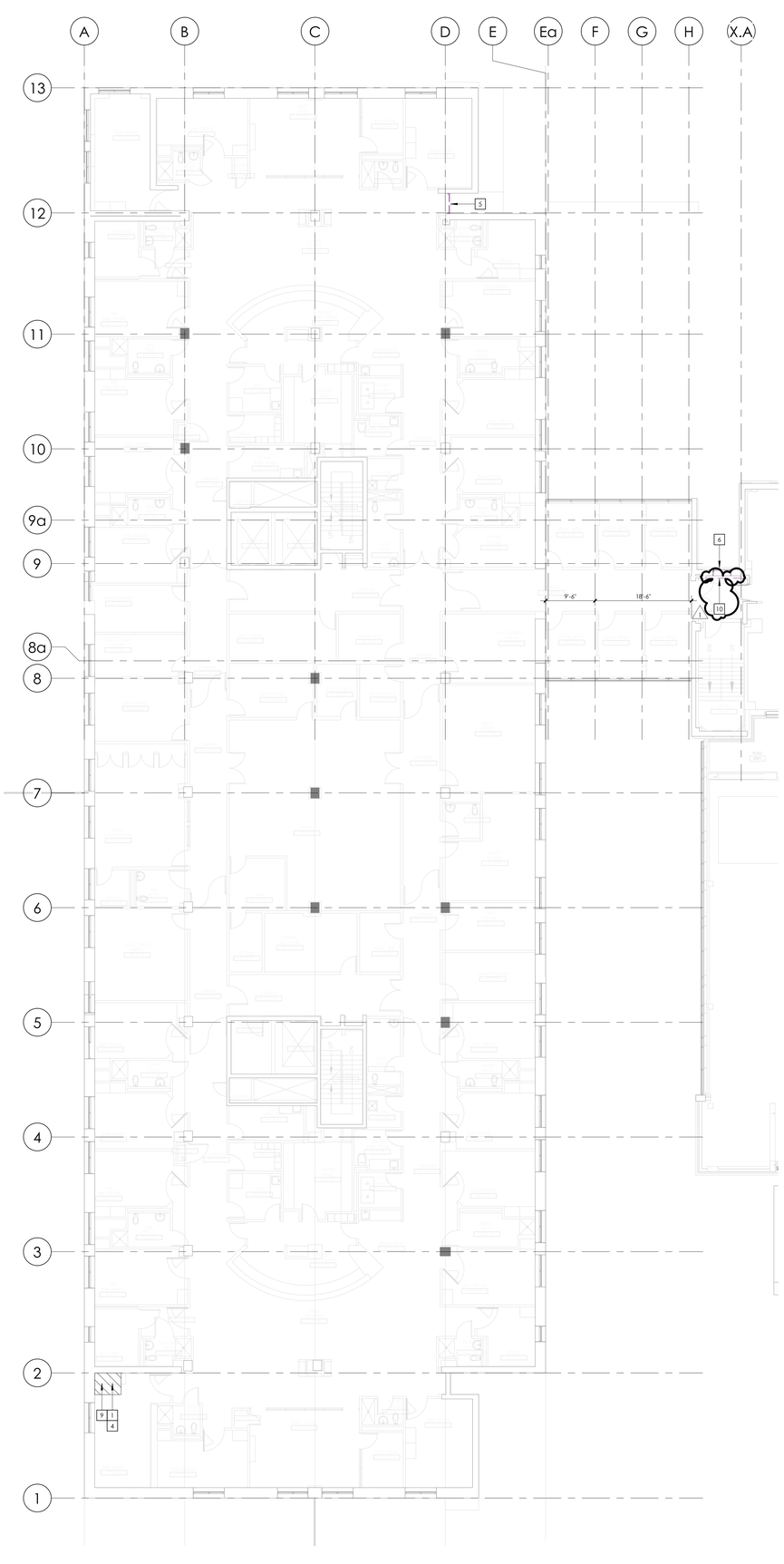
D100

GROUND FLOOR DEMO PLAN

BID SET



1 FIRST FLOOR DEMO
3/32" = 1'-0"



2 SECOND FLOOR DEMO PLAN
3/32" = 1'-0"

DEMOLITION PLAN LEGEND

DEMO & REMOVE EXISTING WALL

EXISTING WALL TO REMAIN

EXISTING DOOR & FRAME TO REMAIN

DEMO AND REMOVE EXISTING DOOR, FRAME, AND HARDWARE

KEYNOTE TAG

FLOOR/WALL/CEILING NOTES F#W#C#

FLOOR

F1 - REMOVE EXISTING FLOOR, BASE, GLUE, ETC., TO SLAB. PATCH, PRIME, AND PREPARE SUB-FLOOR TO RECEIVE NEW FLOORING AS SCHEDULED.
F2 - EXISTING FLOOR TO REMAIN
F3 - SPECIAL CONDITION - REFER TO KEYNOTE

WALL

W1 - REMOVE EXISTING WALL COVERINGS, PAINT, ETC. PATCH, PREP, AND PRIME WALL TO RECEIVE NEW FINISHES AS SCHEDULED.
W2 - EXISTING WALL TO REMAIN
W3 - SPECIAL CONDITION - REFER TO KEYNOTE

CEILING

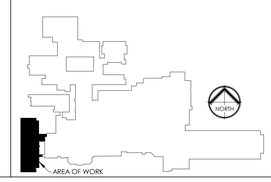
C1 - REMOVE EXISTING CEILING, HANGERS, ETC., TO BOTTOM OF STRUCTURE. EXERCISE EXTREME CAUTION AS TO NOT DISTURB SYSTEMS INTENDED TO REMAIN.
C2 - EXISTING CEILING TO REMAIN
C3 - SPECIAL CONDITION - REFER TO KEYNOTE

GENERAL DEMOLITION PLAN NOTES

1. CONTRACTOR SHALL CONTACT PLANT OPERATIONS DAILY TO PROVIDE ACTIVITIES AND SHUTDOWN REPORTS. ALL SITE USE SHALL BE COORD. AND APPROVED IN ADVANCE BY OWNER.
2. CONTRACTOR IS TO FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO BEGINNING WORK. REPORT ANY DISCREPANCIES TO ARCHITECT IN WRITING PRIOR TO BEGINNING WORK IN THE AFFECTED AREAS.
3. CONTRACTOR TO VERIFY ALL EXISTING HOSPITAL SYSTEMS CURRENTLY INSTALLED IN THE CONSTRUCTION AREA. ALL DEVICES TO REMAIN SHALL BE CHECKED AND IN WORKING CONDITION WHEN PROJECT IS COMPLETE.
4. CONTRACTOR SHALL EMPLOY REASONABLE MEANS TO CONTAIN DUST, DEBRIS, AND NOISE DUE TO DEMOLITION AND NEW CONSTRUCTION. REFER TO SPECS.
5. ALL WALL MOUNTED ITEMS, ETC., SHALL BE REMOVED & REINSTALLED AS INDICATED THROUGHOUT THE DRAWINGS OR TURNED OVER TO THE OWNER FOR SALVAGE U.N.O.
6. CONTRACTOR SHALL PATCH TO MATCH SURROUNDING FINISHES. ANY AREAS DAMAGED AS A RESULT OF, OR CAUSED BY, THE WORK INDICATED THROUGHOUT THE CONTRACT DOCUMENTS.
7. WHERE REMOVAL OF EXISTING WALL PARTITIONS, EQUIPMENT, ETC., DISRUPTS OR DISTURBS EXISTING ELECTRICAL, MECHANICAL, OR PLUMBING SERVICES TO AREAS NOT DESIGNATED AS CONSTRUCTION AREAS, CONTRACTOR SHALL PROVIDE TEMPORARY CONNECTIONS AS REQUIRED TO ENSURE UNINTERRUPTED SERVICE TO SAID AREAS. NOTE: NO SERVICE IS TO BE SHUT DOWN WITHOUT PRIOR APPROVAL BY OWNER.
8. CONTRACTOR IS TO REMOVE COMPLETELY EXISTING CONSTRUCTION, AS SHOWN HEREIN, WHICH CONFLICTS WITH THE INTENT OF THE NEW CONSTRUCTION. U.N.O.
9. OWNER WILL BE RESPONSIBLE FOR REMOVING AND STORING ITEMS SUCH AS FURNITURE, PLAQUES, ARTWORK, MOVEABLE EQUIPMENT, ETC.
10. REFER TO MEP DRAWINGS FOR ADDITIONAL DEMOLITION WORK. PATCH & MATCH SURROUNDING MATERIALS WHERE ITEMS ARE REMOVED AT WALLS, CEILINGS AND FLOORS. MAINTAIN FIRE RATINGS WHERE DEMOLISHED ITEMS PENETRATED FIRE RATED WALLS AND FLOORS.
11. REMOVE AND REPLACE CEILING TILES AS NECESSARY FOR DEMOLITION AND NEW CONSTRUCTION. REPLACE DAMAGED TILES AS REQUIRED.
12. CONTRACTOR TO REMOVE, CLEAN AND STORE ALL PLUMBING FIXTURES SHOWN TO BE REMOVED. ALL FIXTURES TO BE TURNED OVER TO OWNER. UNO.

DEMOLITION KEYNOTES:

1. REMOVE CEILING AS NECESSARY TO REMOVE EXISTING MEP WORK ABOVE IN HATCHED AREA. FOLLOW HOSPITAL INFECTION CONTROL STANDARDS FOR CONSTRUCTION DEBRIS CONTAINMENT. REPLACE CEILING AFTER COMPLETE AND REPLACE ANY TILES DAMAGED FROM CONSTRUCTION TO MATCH EXISTING.
2. SAW CUT WALL OPENING AND DEMO TO CREATE AN OPENING FOR MECHANICAL SYSTEM RE: MECH FOR EXACT LOCATION AND SIZE. FOR STRUCTURAL BRACING AT OPENINGS RE: STRUCT.
3. REPAIR SOD TO ORIGINAL CONDITION. REPAIR/REPLACE ANY DAMAGED LANDSCAPING OR CONCRETE FROM CONSTRUCTION.
4. AREA OF DISTURBANCE ABOVE CEILING FOR ROUTING OF MEP SYSTEMS. AREA INCLUDES BOTH LAY-IN DRYWALL CEILING TYPES. EXISTING CEILING MOUNTED DEVICES SHALL BE TEMPORARILY REMOVED TO ACCOMMODATE ABOVE CEILING WORK. REINSTALL DEVICES IN ORIGINAL LOCATIONS. DEVICES SHALL FUNCTION AS THEY DID PRIOR TO CONSTRUCTION.
5. DEMO AND REMOVE ENTIRE CURTAIN WALL SYSTEM.
6. REMOVE GLASS FROM EXISTING WINDOW. FRAME TO REMAIN IN PLACE
7. CORRIDOR WORK TO OCCUR IN SECTIONS DURING THE EVENINGS TO MINIMIZE DISRUPTION TO VA-MU HOSPITAL CIRCULATION. COORDINATE ALL CORRIDOR WORK WITH OWNER REPRESENTATIVE.
8. SAW CUT NEW OPENING IN EXISTING WALL. DO NOT OVERCUT CORNERS. CONTRACTOR SHALL FIELD VERIFY THE EXISTING WALL IS 12" CONCRETE PRIOR TO CUTTING THE NEW OPENING. IF THE WALL IS NOT 12" CONCRETE, CONTACT BOB D. CAMPBELL & CO. FOR FURTHER INSTRUCTION.
9. CORE DRILL FLOOR FOR PENETRATIONS REMOVE.
10. DEMO AND REMOVE FURRING AND TYP BOARD TO ACCESS EXISTING WINDOWS.



KEYPLAN

bcdesignGROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number
A-2011037299

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

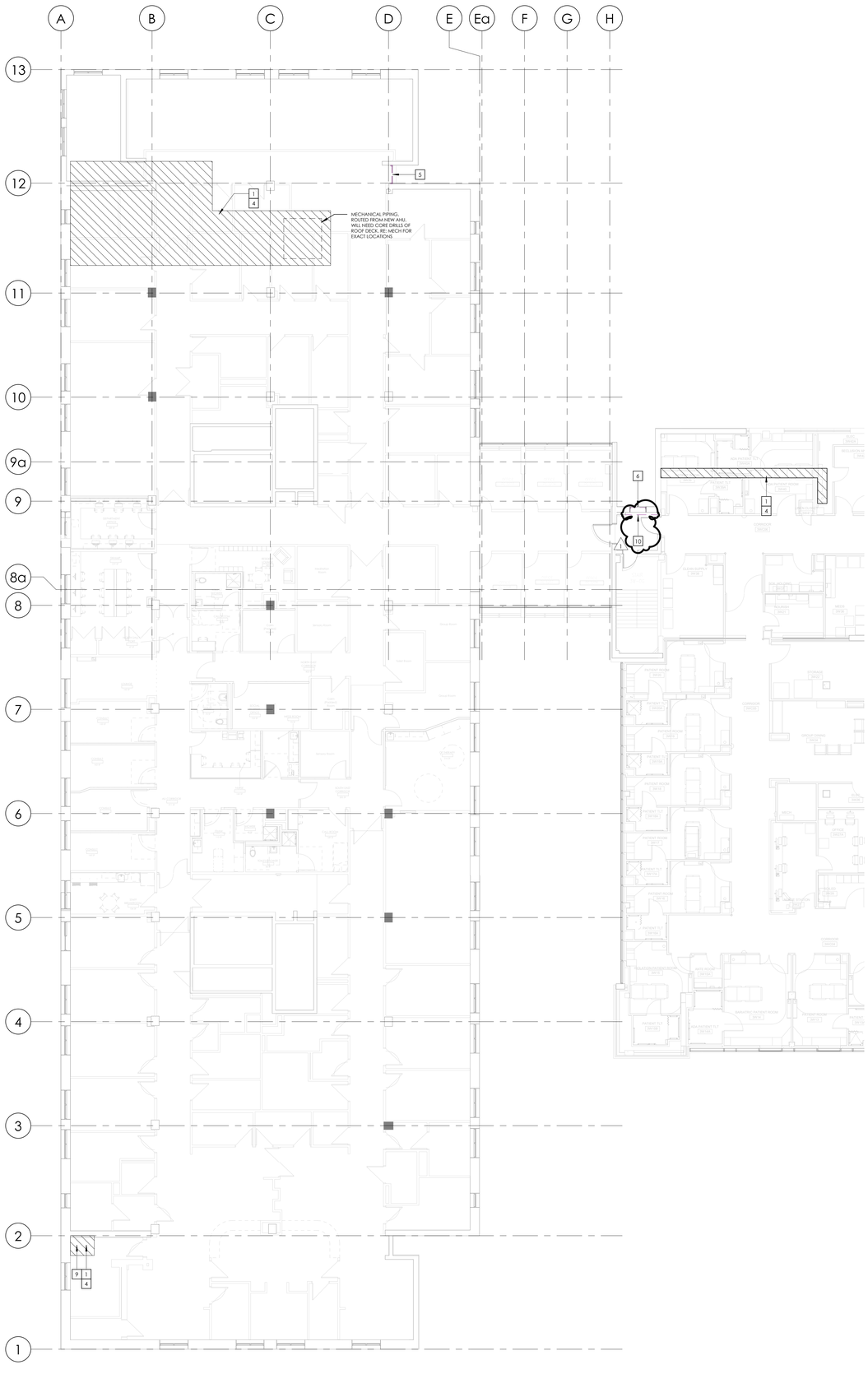
Issue Date:	02.25.2021
#	Issue:	Date:
1	Addendum #1	03.12.2021

Drawn by: Author

bcdg Project #: 12275.42
MU Project #: CP210251

D101
FIRST AND SECOND FLOOR DEMO PLANS

BID SET



1 THIRD FLOOR DEMO PLAN
3/32" = 1'-0"

12' 6' 0' 12'

DEMOLITION PLAN LEGEND

- DEMO & REMOVE EXISTING WALL
- EXISTING WALL TO REMAIN
- EXISTING DOOR & FRAME TO REMAIN
- DEMO AND REMOVE EXISTING DOOR, FRAME, AND HARDWARE
- # KEYNOTE TAG

FLOOR/WALL/CEILING NOTES F# W# C#

FLOOR

F1 - REMOVE EXISTING FLOOR, BASE, GLUE, ETC., TO SLAB. PATCH, PRIME, AND PREPARE SUB-FLOOR TO RECEIVE NEW FLOORING AS SCHEDULED.
F2 - EXISTING FLOOR TO REMAIN
F3 - SPECIAL CONDITION - REFER TO KEYNOTE

WALL

W1 - REMOVE EXISTING WALL COVERINGS, PAINT, ETC.. PATCH, PREP, AND PRIME WALL TO RECEIVE NEW FINISHES AS SCHEDULED
W2 - EXISTING WALL TO REMAIN
W3 - SPECIAL CONDITION - REFER TO KEYNOTE

CEILING

C1 - REMOVE EXISTING CEILING, HANGERS, ETC., TO BOTTOM OF STRUCTURE. EXERCISE EXTREME CAUTION AS TO NOT DISTURB SYSTEMS INTENDED TO REMAIN.
C2 - EXISTING CEILING TO REMAIN
C3 - SPECIAL CONDITION - REFER TO KEYNOTE

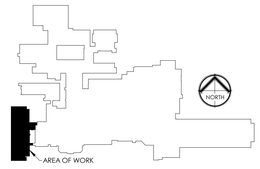
GENERAL DEMOLITION PLAN NOTES

1. CONTRACTOR SHALL CONTACT PLANT OPERATIONS DAILY TO PROVIDE ACTIVITIES AND SHUTDOWN REPORTS. ALL SITE USE SHALL BE COORD. AND APPROVED IN ADVANCE BY OWNER.
2. CONTRACTOR IS TO FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO BEGINNING WORK. REPORT ANY DISCREPANCIES TO ARCHITECT IN WRITING PRIOR TO BEGINNING WORK IN THE AFFECTED AREAS.
3. CONTRACTOR TO VERIFY ALL EXISTING HOSPITAL SYSTEMS CURRENTLY INSTALLED IN THE CONSTRUCTION AREA. ALL DEVICES TO REMAIN SHALL BE CHECKED AND IN WORKING CONDITION WHEN PROJECT IS COMPLETE.
4. CONTRACTOR SHALL EMPLOY REASONABLE MEANS TO CONTAIN DUST, DEBRIS, AND NOISE DUE TO DEMOLITION AND NEW CONSTRUCTION. REFER TO SPECS.
5. ALL WALL MOUNTED ITEMS, ETC., SHALL BE REMOVED & REINSTALLED AS INDICATED THROUGHOUT THE DRAWINGS OR TURNED OVER TO THE OWNER FOR SALVAGE U.N.O.
6. CONTRACTOR SHALL PATCH TO MATCH SURROUNDING FINISHES, ANY AREAS DAMAGED AS A RESULT OF, OR CAUSED BY, THE WORK INDICATED THROUGHOUT THE CONTRACT DOCUMENTS.
7. WHERE REMOVAL OF EXISTING WALL PARTITIONS, EQUIPMENT, ETC. DISRUPTS OR DISTURBS EXISTING ELECTRICAL, MECHANICAL, OR PLUMBING SERVICES TO AREAS NOT DESIGNATED AS CONSTRUCTION AREAS, CONTRACTOR SHALL PROVIDE TEMPORARY CONNECTIONS AS REQUIRED TO ENSURE UNINTERRUPTED SERVICE TO SAID AREAS. NOTE: NO SERVICE IS TO BE SHUT DOWN WITHOUT PRIOR APPROVAL BY OWNER.
8. CONTRACTOR IS TO REMOVE COMPLETELY EXISTING CONSTRUCTION, AS SHOWN HEREIN, WHICH CONFLICTS WITH THE INTENT OF THE NEW CONSTRUCTION, U.N.O.
9. OWNER WILL BE RESPONSIBLE FOR REMOVING AND STORING ITEMS SUCH AS FURNITURE, PLAQUES, ARTWORK, MOVEABLE EQUIPMENT, ETC.
10. REFER TO MEP DRAWINGS FOR ADDITIONAL DEMOLITION WORK. PATCH & MATCH SURROUNDING MATERIALS WHERE ITEMS ARE REMOVED AT WALLS, CEILINGS AND FLOORS. MAINTAIN FIRE RATINGS WHERE DEMOLISHED ITEMS PENETRATED FIRE RATED WALLS AND FLOORS.
11. REMOVE AND REPLACE CEILING TILES AS NECESSARY FOR DEMOLITION AND NEW CONSTRUCTION. REPLACE DAMAGED TILES AS REQUIRED.
12. CONTRACTOR TO REMOVE, CLEAN AND STORE ALL PLUMBING FIXTURES SHOWN TO BE REMOVED. ALL FIXTURES TO BE TURNED OVER TO OWNER, UNO.

DEMOLITION KEYNOTES:

1. REMOVE CEILING AS NECESSARY TO REMOVE EXISTING MEP WORK ABOVE IN HATCHED AREA. FOLLOW HOSPITAL INFECTION CONTROL STANDARDS FOR CONSTRUCTION DEBRIS CONTAINMENT. REPLACE CEILING AFTER COMPLETE AND REPLACE ANY TILES DAMAGED FROM CONSTRUCTION TO MATCH EXISTING.
2. SAW CUT WALL OPENING AND DEMO TO CREATE AN OPENING FOR MECHANICAL SYSTEM RE: MECH FOR EXACT LOCATION AND SIZE. FOR STRUCTURAL BRACING AT OPENINGS RE: STRUCT.
3. REPAIR SOD TO ORIGINAL CONDITION. REPAIR/REPLACE ANY DAMAGED LANDSCAPING OR CONCRETE FROM CONSTRUCTION.
4. AREA OF DISTURBANCE ABOVE CEILING FOR ROUTING OF MEP SYSTEMS. AREA INCLUDES BOTH LAY-IN DRYWALL CEILING TYPES. EXISTING CEILING MOUNTED DEVICES SHALL BE TEMPORARILY REMOVED TO ACCOMMODATE ABOVE CEILING WORK. REINSTALL DEVICES IN ORIGINAL LOCATIONS. DEVICES SHALL FUNCTION AS THEY DID PRIOR TO CONSTRUCTION.
5. DEMO AND REMOVE ENTIRE CURTAIN WALL SYSTEM.
6. REMOVE GLASS FROM EXISTING WINDOW. FRAME TO REMAIN IN PLACE
7. CORRIDOR WORK TO OCCUR IN SECTIONS DURING THE EVENINGS TO MINIMIZE DISRUPTION TO VA-MU HOSPITAL CIRCULATION. COORDINATE ALL CORRIDOR WORK WITH OWNER REPRESENTATIVE.
8. SAW CUT NEW OPENING IN EXISTING WALL. DO NOT OVERCUT CORNERS. CONTRACTOR SHALL FIELD VERIFY THE EXISTING WALL IS 12" CONCRETE PRIOR TO CUTTING THE NEW OPENING. IF THE WALL IS NOT 12" CONCRETE, CONTACT BOB D. CAMPBELL & CO. FOR FURTHER INSTRUCTION.
9. CORE DRILL FLOOR FOR PENETRATIONS REMEP
10. DEMO AND REMOVE WIRING AND GYP BOARD TO ACCESS EXISTING WINDOWS.

KEYPLAN



bcdesigngroup
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number
A-2011037290

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD. BLDG. 1,
COLUMBIA, MO 65203
573.447.0292

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

Issue Date: 02.25.2021

#:	Issue:	Date:
1	Addendum #1	03.12.2021

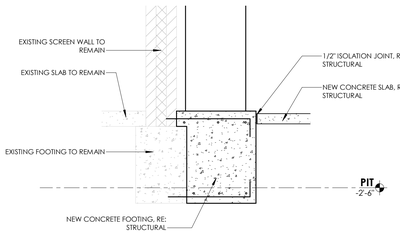
Drawn by: Author

bcdg Project #: 12275.42
MU Project #: CP210251

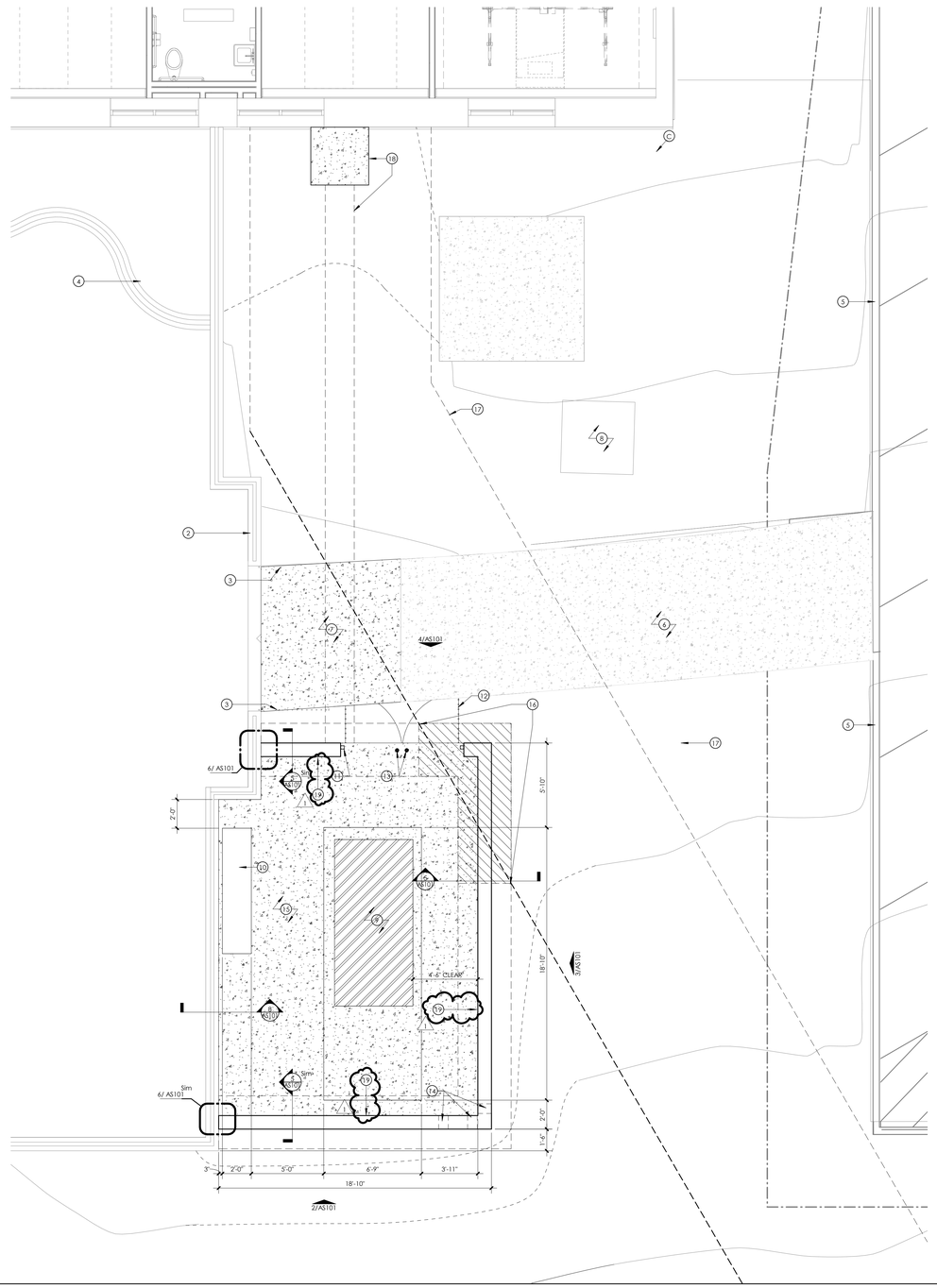
D102

THIRD FLOOR DEMO PLAN

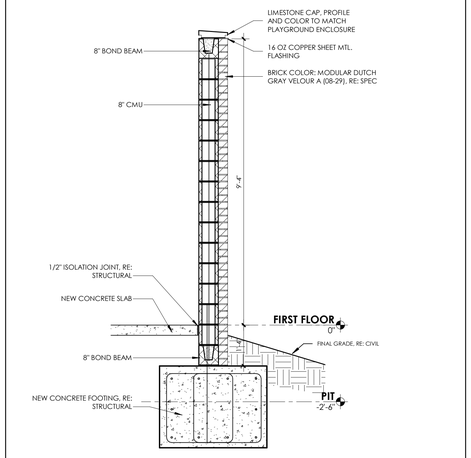
BID SET



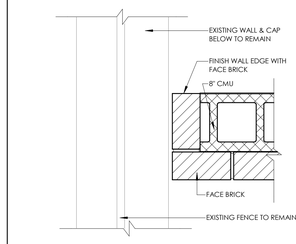
8 SECTION
1/2" = 1'-0"



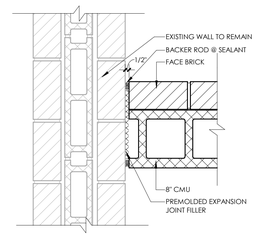
1 ENLARGED PLAN OF GENERATOR
1/4" = 1'-0"



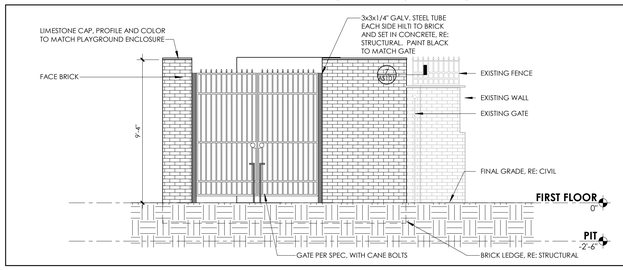
5 GENERATOR WALL SECTION
1/2" = 1'-0"



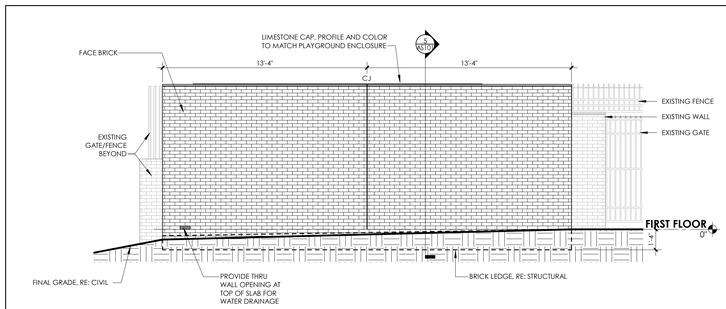
7 PLAN DETAIL
1 1/2" = 1'-0"



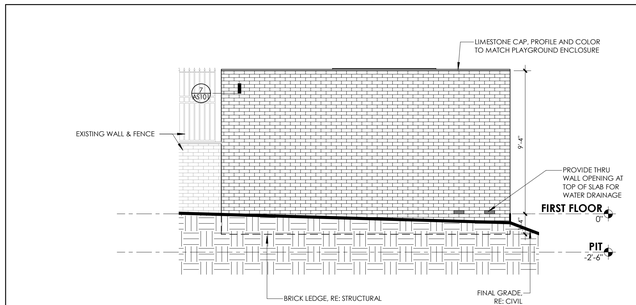
6 GENERATOR PLAN DETAIL
1 1/2" = 1'-0"



4 NORTH GENERATOR ELEVATION
1/4" = 1'-0"



3 EAST GENERATOR ELEVATION
1/4" = 1'-0"



2 SOUTH GENERATOR ELEVATION
1/4" = 1'-0"

GENERAL SITE PLAN NOTES

1. SITE SHALL BE KEPT IN A NEAT & CLEAN MANNER W/ DRIVES BRUSHED AS NECESSARY.
2. ANY WORK OUTSIDE OF CONSTRUCTION FENCE SHALL BE COORDINATED WITH OWNER PRIOR TO BEGINNING THE WORK.
3. CONTRACTORS SHALL PATCH, REPAIR, OR REPLACE ANY ITEMS DAMAGED DURING CONSTRUCTION.
4. RE: CIVIL & MEP FOR SITE UTILITIES.
5. RE: PHASING PLANS FOR CONSTRUCTION LIMITS & TEMPORARY FACILITIES.

SITE PLAN KEYNOTES:

1. REPAIR SODE TO ORIGINAL CONDITION. REPAIR/REPLACE ANY LANDSCAPING OR CONCRETE DAMAGED DURING CONSTRUCTION.
2. EXISTING PLAYGROUND PERIMETER MASONRY WALL TO REMAIN.
3. EXISTING PLAYGROUND ACCESS GATE TO REMAIN.
4. EXISTING RAISED PLANTER TO REMAIN.
5. EXISTING CONCRETE CURB TO REMAIN.
6. EXISTING CONCRETE WALKWAY TO PARKING LOT TO REMAIN.
7. REMOVE AND REPLACE PORTION OF CONCRETE WALKWAY FOR NEW UTILITY LINES TO GENERATOR; RE: MEP + CIVIL.
8. EXISTING TUNNEL VAULT ACCESS HATCH TO REMAIN.
9. NEW GENERATOR ON SKID MOUNTED FUEL TANK, RE: MEP. PROVIDE CONCRETE HOUSEKEEPING PAD, RE: STRUCTURAL.
10. NEW OUTDOOR TEMPORARY GENERATOR AND LOAD BANK, RE: MEP.
11. 3x3x1/4" GALV. STEEL TUBE EACH SIDE HILTI TO BRICK AND SET IN CONCRETE, RE: STRUCTURAL. PAINT BLACK TO MATCH GATE.
12. 4'-0" PAIR GATE DOORS PER SPEC WITH HEAVY DUTY EXTERIOR GRADE CANE BOLTS
13. HEAVY DUTY EXTERIOR GRADE CANE BOLT RECEIVER
14. PROVIDE OPENING THRU WALL FOR DRAINAGE. SLOPE CONCRETE WITHIN WALL TO AVOID STANDING WATER. PROVIDE 1/8" X 8" X 18" STEEL PLATE TO SUPPORT BRICK.
15. SLOPE CONCRETE TO DRAIN THRU OPENINGS IN SE CORNER OF ENCLOSURE.
16. VOID FORM OR COMPRESSIBLE FOAM. RE: STRUCTURAL.
17. EXISTING PEDESTRIAN TUNNEL BELOW. RE: CIVIL FOR LOCATION AND DEPTH.
18. NEW ELECTRICAL DUCT BANK W/ CONCRETE PAD. RE: CIVIL AND ELECTRICAL
19. CMU ON INTERIOR OF GENERATOR ENCLOSURE TO BE PAINTED. PROVIDE FULL COLOR RANGE OPTIONS TO OWNER FOR SELECTION AND APPROVAL.

bcDESIGNGROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number A-2011037290

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD. BLDG. 1,
COLUMBIA, MO 65203
573.447.0292

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

Issue Date: 02.25.2021

No.	Issue:	Date:
1	Addendum #1	03.12.2021

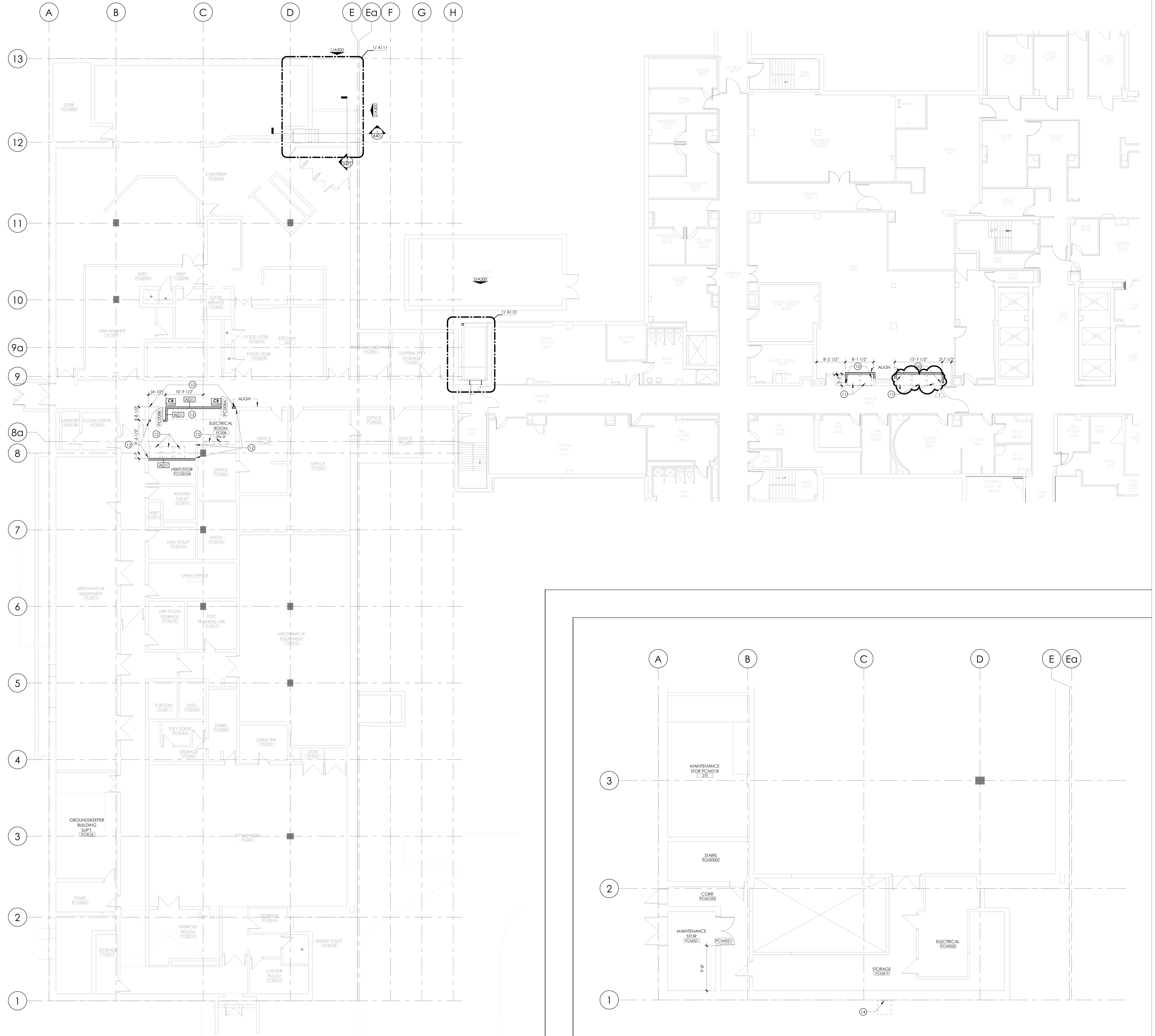
Drawn by: Author

bcdg Project #: 12275.42
MU Project #: CP210251

AS101

GENERATOR PLAN, ELEVATIONS AND SECTIONS

BID SET



1 GROUND
3/32" = 1'-0"

2 MEZZANINE
1/8" = 1'-0"

FLOOR PLAN LEGEND:

TAG DESCRIPTION — 12/A101 SIM — DRAWING NUMBER, DENOTES SIMILAR DRAWING, CONDITION, SHEET NUMBER

- NEW DOOR
- EXISTING DOOR
- NEW WALL
- EXISTING WALL
- ROOM NAME 2403.25 — ROOM NUMBER
- Ref A12/A101 — ELEVATION TAGS
- XXX A101 SIM — BUILDING SECTION TAG
- SIM 12/ A101 — ENLARGED DRAWING TAG
- # — PLAN KEYNOTE
- E### — EQUIPMENT TAG
- 101 — DOOR TAG
- XXXX — PARTITION WALL TAG
- XX — GLAZING TAG

GENERAL FLOOR PLAN NOTES

1. ALL NEW INTERIOR PARTITIONS ARE TO BE 'AIDN' UNLESS NOTED OTHERWISE. **RE: COVER**
2. ALL DIMENSIONS ARE TO FACE OF FINISHED WALL. GC TO NOTIFY ARCHITECT OF ANY DISCREPANCIES PRIOR TO BEGINNING WORK IN THE AFFECTED AREAS.
3. DIMENSIONS SHOWN IN ITALICS ARE CRITICAL AND MUST BE MAINTAINED.
4. INSTALL METAL STRAP BLOCKING AT ALL ITEMS SHOWN TO BE MOUNTED TO WALLS, INCLUDING BUT NOT LIMITED TO WALL STOPS, CASEWORK, & GRAB BARS. STRAPS SHALL EXTEND A MINIMUM OF 3 STUDS, TYPICAL.
5. ALL OFCI ITEMS LOCATIONS ARE TO BE COORDINATED WITH THE OWNER.

FLOOR PLAN KEYNOTES:

1. STRUCTURAL STEEL. RE: STRUCTURAL
2. MAINTENANCE PLATFORM W/ GUARDRAIL
3. ROOF CRICKET.
4. ROOF TYPE: PVC ROOFING ON TAPERED INSULATION ON STRUCTURAL STEEL DECK. PATCH EXISTING ROOF AS REQUIRED WHERE NEW ROOF TIES IN
5. GRADE BEAMS BELOW. RE: STRUCTURAL
6. SHAFT WALL TO ALIGN WITH THE EXISTING FLOOR SLAB
7. ALL DUCTS AND PIPES RE: MEP
8. SLOPE ROOF TO EXISTING DRAIN AT D,11
9. SLOPE ROOF TO EXISTING DRAIN AT CENTER OF LOBBY ROOF
10. PAINT TO MATCH ADJACENT EXISTING CONDITIONS. COORDINATE WITH MU FOR PAINT COLORS.
11. RELOCATED VENDING MACHINES, OFOI.
12. ELECTRICAL EQUIPMENT, FOR LOCATIONS, SIZE AND TYPE RE: ELECTRICAL
13. EXISTING WALL TO BE PART OF NEW 1 HR FIRE RATING PER CODE PLAN G100/G101. EXISTING WALL CONDITION INCLUDES 3-5/8" METAL STUDS TO DECK AND 1 LAYER GYP. BD. TO 6" ABOVE CEILING EA. SIDE. WALL & EXISTING PENETRATIONS ARE NOT FIRE CAULKED. CONTRACTOR TO CONSTRUCT WALL TO MEET UL465 PER PARTITION SCHEDULE.
14. LOCATION FOR NEW DUCT BANK PENETRATION THROUGH WALL. RE: CIVIL AND ELECTRICAL
15. ADD FURRING AS REQUIRED TO COVER BACK SIDE OF SHAFT WALL FOR NEW FINISH.
16. CUT BACK 6" SQUARE FROM BUILDING FACE OF EXISTING GROUND CONDITION TO PREPARE FOR NEW LIGHTING ROD AND PVC PROTECTOR. RE: ELECTRICAL FOR EXACT LOCATIONS OF ALL GROUND CONDUCTORS.

KEYPLAN

bcDESIGNGROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number A-2011037290

Project Team:
ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

Issue Date: 02.25.2021

#	Issue:	Date:
1	Addendum #1	03.12.2021

Drawn by: ET
bcdg Project #: 12275.42
MU Project #: CP210251

A100

GROUND/MEZZANINE LEVEL FLOOR PLAN

BID SET

Ross&Baruzzini
6 South Old Orchard, Saint Louis, MO 63119
P: 314.918.8383

Addendum 1

PROJECT:	MPC 1st Floor Infrastructure Upgrades Serving Level 1
PROJECT NO:	MU Project No.: CP210251 / R&B Project No.: 10197
DATE:	March 12, 2021
BY:	Jacob Dyer, Marissa Sexton, Mitch Spillman
RE:	Addendum 1
DWG REF:	See Below
SPEC REF:	See Below
CC:	Central File

The following additions, revisions and modifications are hereby made part of the contract documents, which shall be amended accordingly. Acknowledge receipt of addenda on bid form. Failure of your acknowledgement of receipt of this addendum may result in rejection of your offer.

INSTRUCTIONS

General

Specifications:

- Front End Doc
  - Added Condensate Trap drawing to submittal Log
  - Updated Closeout Log to include the following:
    - 23 21 13 Extra Materials
    - 23 21 23 Extra Materials
    - 23 34 23 Extra Materials
    - 23 41 00 Extra Materials
    - 23 73 13 Extra Materials
    - 23 82 39 Extra Materials
    - 23 84 13 Warranty

Mechanical

Specifications:

- Added seismic spec section reference to section 1.2 in the following mechanical specifications sections. This was the only revision for the sections listed below.
  - 23 05 13
  - 23 05 19
  - 23 05 23

    - 23 41 00
- 23 01 00
    - Added section 1.6 - Coordination Drawings
- 23 05 40
    - Added Seismic Language throughout
- 23 31 13
    - Added Seismic Language throughout
- 23 34 23
    - Added Seismic Language throughout
    - Modified language in section 2.3
    - Modified language in section 1.1
- 23 73 13
    - Added Condensate Trap drawing to required submittals
- 23 82 39
    - Removed language from sections 1.1 and 2.1.
- 23 84 13
    - Added Seismic Langauge to section 1.2 and 3.1

Drawings:

- M000:
    - Added General Note indicating minimum equipment clearances shall not be infringed upon.
- MD401:
    - Added domestic makeup water piping to show for demolition at the return pump inlet.
    - Added domestic makeup water demolition keynote
- M201:
    - Removed domestic makeup water pipe connection shown on new work flow diagram to reflect makeup water demolition revision on sheet MD401
    - Added air dirt separator
    - Added Detail Callout
- M502:
    - Added Air Dirt Separator Piping Detail
    - Added pipe through exterior wall detail
- M601:
    - Modified Air dirt separator note in pump schedule
    - Modified exhaust fan airflow/static pressure
- M602:
    - Added Air Dirt Separator Schedule

Electrical

ED100:

- Revised electrical duct bank to be removed to show two separate electrical ducts for clarification.
- Revised keyed note #2 and #4.
- Added keyed note #12 to floorplan.

ED700:

- Added suggested General Sequence of Work note to drawing.

- Revised keyed note #2.

E001:

- Added keyed note #11 to clarify security camera location intent.

E101:

- Revised Keyed note #1 and #11.
- Added Keyed note #17 to floorplan.
- Revised card reader locations at Electrical Room PC008.
- Added life safety circuit for electrical room PC008 receptacles.

E700:

- Revised keyed note #16.
- Added 20A circuit breaker to 'DP-PCG EQ1' for circuit breaker shunt trip power.
- Added suggested General Sequence of Work note to drawing.

Plumbing & Fire Protection

Specifications:

- 210500
  - Added section 1.6 – Coordination Drawings
- 220500
  - Added section 1.6 – Coordination Drawings

Drawings:

- ADDED sheet FP101
- ADDED dry-barrel sidewall sprinkler heads to both new mechanical shafts.

SIGNED: Jacob Dyer, Marissa Sexton, Mitch Spillman

SECTION 21 0500 **- COMMON WORK RESULTS FOR FIRE SUPPRESSION**

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. Sleeves.
3. Escutcheons.
4. Fire-suppression equipment and piping demolition.
5. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe 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 in chases.

E. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 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.

1.5 COORDINATION

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

B. Prepare and submit Coordination Drawings as further described herein. The Engineer shall receive one copy of all coordination drawings supplied to the Owner as required in this specification. It is the responsibility of the Contractor to coordinate the work as

outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.

C. Coordination shall be drawn to a scale of ¼" = 1'0" or larger. 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:

D. Planned piping layout, including valve and specialty locations and valve-stem movement. Include all piping including but not limited to Plumbing piping, HVAC piping, and fire protection piping. Include ceiling and wall-mounted access doors and panels required to provide access to valves and other operating devices.

1. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.6 ELECTRONIC MEDIA AND FILES

A. Electronic media files of the contract drawings in AutoCAD or PDF format and copies of the specifications in PDF format may be requested.

B. Complete and return a signed "Electronic File Transmittal" form provided by Ross & Baruzzini upon request for electronic media.

C. Obtain approval from the appropriate Design Professional for use of their part of the documents if the information requested includes information prepared by other than Ross & Baruzzini.

D. The electronic contract documents may be used for preparation of shop drawings and record drawings only. The information may not be used in whole or in part for any other project.

E. The drawings prepared by Ross & Baruzzini for bidding purposes may not be used directly for raceway layout drawings or coordination drawings.

F. The use of these documents does not allow relief from the responsibility for coordination of work with other trades and verification of space available for the installation.

G. The information is provided to expedite the project with no guarantee by Ross & Baruzzini as to the accuracy or correctness of the information provided. Ross & Baruzzini accepts no responsibility or liability for the use of the provided information.

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 21 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 21 piping Sections for special joining materials not listed below.

2.4 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.5 ESCUTCHEONS

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

B. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish (in finished areas exposed to view).

C. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish (in finished areas exposed to view).

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove fire-suppression 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. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

C. 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 21 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 above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

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

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

K. Install escutcheons for penetrations of walls, ceilings, and floors in finished areas exposed to view.

L. Sleeves are not required for core-drilled holes.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Steel Pipe Sleeves: For pipes smaller than NPS 6.

3. Seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 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.

3.4 CUTTING AND PATCHING

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay. Perform cutting and patching in accordance with the following:

B. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

C. Perform cutting, fitting, and patching of fire protection equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Install equipment and materials in existing structures.

D. Cut, remove and legally dispose of selected fire protection equipment, components, and materials as indicated, including but not limited to removal of fire protection piping and other fire protection items made obsolete by the new Work.

E. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for fire protection installations. Perform cutting by skilled mechanics of trades involved.

F. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

G. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

H. Repair cut surfaces to match adjacent installations.

I. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to make a fire protection installation, so as to maintain an equivalent insulation or fire rating as existed without said fire protection installation

END OF SECTION 21 0500

SECTION 22 0500 - **COMMON WORK RESULTS FOR PLUMBING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Sleeves.
4. Escutcheons.
5. Plumbing demolition.
6. Equipment installation requirements common to equipment sections.
7. Painting and finishing.
8. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe 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 in 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.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 QUALITY ASSURANCE

A. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 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.

1.6 COORDINATION

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

B. Prepare and submit Coordination Drawings as further described herein. The Engineer shall receive one copy of all coordination drawings supplied to the Owner as required in this specification. It is the responsibility of the Contractor to coordinate the work as outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.

C. Coordination shall be drawn to a scale of ¼" = 1'0" or larger. 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:

1. Planned piping layout, including valve and specialty locations and valve-stem movement. Include all piping including but not limited to Plumbing piping, HVAC piping, and fire protection piping. Include ceiling and wall-mounted access doors and panels required to provide access to valves and other operating devices.

D. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.7 ELECTRONIC MEDIA AND FILES

A. Electronic media files of the contract drawings in AutoCAD or PDF format and copies of the specifications in PDF format may be requested.

B. Complete and return a signed "Electronic File Transmittal" form provided by Ross & Baruzzini upon request for electronic media.

C. Obtain approval from the appropriate Design Professional for use of their part of the documents if the information requested includes information prepared by other than Ross & Baruzzini.

D. The electronic contract documents may be used for preparation of shop drawings and record drawings only. The information may not be used in whole or in part for any other project.

E. The drawings prepared by Ross & Baruzzini for bidding purposes may not be used directly for raceway layout drawings or coordination drawings.

F. The use of these documents does not allow relief from the responsibility for coordination of work with other trades and verification of space available for the installation.

G. The information is provided to expedite the project with no guarantee by Ross & Baruzzini as to the accuracy or correctness of the information provided. Ross & Baruzzini accepts no responsibility or liability for the use of the provided information.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

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

2.2 PIPE, TUBE, AND FITTINGS

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

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

2.4 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.5 ESCUTCHEONS

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

B. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated (in finished areas exposed to view).

C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated (in finished areas exposed to view).

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing 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. Equipment to Be Removed: Disconnect and cap services and remove equipment.
3. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
4. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. 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 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, 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 above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

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

J. Install piping to allow application of insulation.

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

L. Install escutcheons for penetrations of walls, ceilings, and floors in finished areas exposed to view:

M. Sleeves are not required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

3. Seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

P. Verify final equipment locations for roughing-in.

Q. 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 22 Sections specifying piping systems.

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

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

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

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

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

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

END OF SECTION 22 0500

SECTION 23 0100 – **BASIC MECHANICAL REQUIREMENTS**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:

1. Submittals.
2. Material and Equipment Selection.

~~4.~~3. Record documents.
~~5.~~4. Maintenance manuals.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 23.

1.3 CONTRACTOR'S SUBMITTAL RESPONSIBILITIES

A. General: Follow the procedures specified in Division 01. In addition to the requirements specified in Division 01, comply with the following:

1. Increase by two (2) the quantity of print copies required by Division 01 for submittals, if paper submittals are used. (Paperless electronic submittals are preferred.)
2. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number. Transmit via email. Include PDF transmittal form. Include information in email subject line as to project name, project number, submittal number, and applicable specification section number.
3. Submit line-by-line specification verification for equipment other than the "basis of design" as further described in the following article "Material and Equipment Selection".

B. General: Submittals are not requested for all products covered in the specifications. Submit only the data requested under the submittals portion of each specification section or where indicated in a Submittal Log, if included within Division 01. Un-requested submittals will not be processed, reviewed or returned and the contractor will be notified that the submittal will not be reviewed by the engineer of record.

1. Non-requirement of submittals, when so noted, is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.
2. Any deviation from specified items is considered a substitution. If the contractor desires to use other than specified items, then a formal request for substitution must be submitted prior to bid date (no exceptions), in accordance with the procedures and time limitations set forth in Division 01. Where not defined in Division 01, requests for substitutions shall be submitted no less than ten (10) working days prior to bid

date. Review of substitution requests by the Engineer shall be done at the expense of the contractor. Charges for this substitution review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

C. It is the responsibility of the Contractor to ensure that all submittals have been reviewed for total completeness and accuracy as to the requirements of the specifications and drawings before being submitted to the Engineer for review.

1. One comprehensive submittal shall be provided for each individual specification section. All required submittal information called for in each individual specification section shall be included in the submittal.
2. The Engineer of Record shall not be responsible for informing the contractor on items that have not been included and are necessary for a complete review of the required submittal information for a specification section.
3. The Engineer of Record shall have the option of returning any submittal, unmarked, if all required documentation called for in the specifications has not been provided in the submittal.
4. The Engineer of Record shall review each submittal no more than two (2) times and return to the contractor with the appropriate disposition.
5. If the Engineer of Record is required to review a submittal a second time, it shall be limited to review of the changed information, clearly highlighted by the submitter, and/or confirmation of documentation only and it shall be returned to the contractor with the appropriate disposition.
6. If the submittal is required to be reviewed a third time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.

D. Operation and Maintenance Manuals: All items required for insertion into each Operation and Maintenance (O&M) Manual are called out in the submittals portion of each specification section or in a Submittal Log, if included within Division 01. It is the responsibility of the Contractor to ensure that the O&M submittal has been reviewed and includes all the requirements of the specifications. The Engineer of Record shall review the submittal for the Operation and Maintenance Manual one (1) time and return to the contractor with the appropriate disposition.

1. If the submittal is required to be reviewed a second time, it shall be done at the expense of the contractor. Charges for this additional submittal review shall be calculated based on the Engineer's standard hourly rates, as defined in their contract with the Owner.
2. Submittals for the Operation and Maintenance Manual must be original documentation.
3. Photo copies of marked up Operations and Maintenance submittals are not acceptable.

E. Coordination Drawings: Prepare and submit Coordination Drawings as further described herein and as indicated in the Special Conditions. The Engineer shall receive one copy of all coordination drawings supplied to the Owner as required in this specification. It is the responsibility of the Contractor to coordinate the work as outlined herein. Receipt by the Engineer of a copy of the coordination drawings is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the coordination proposed.

F. Refer to Division 01 and each individual Division 23 Section for additional submittal requirements.

~~DEFINITIONS~~

~~. LEED-NC: Leadership in Energy and Environmental Design for New Construction, as defined by the United States Green Building Council.~~

~~1.6~~1.4 REFERENCED STANDARDS

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers. Guideline 4-2008 (RA 2013) *Preparation of Operating and Maintenance Documentation for Building Systems*. Atlanta, GA: ASHRAE, 1993.

~~A. Sheet Metal and Air Conditioning Contractors' National Association. *IAQ Guidelines for Occupied Buildings Under Construction*. Chapter 3. Chantilly, VA: SMACNA, 1995.~~

~~A. United Facilities Criteria (UFC) 4-010-01. *DoD Minimum Antiterrorism Standards for Buildings*. United States Corps of Engineers Protective Design Center. Omaha, NE: December 12, 2018.~~

~~A. United Facilities Criteria (UFC) 4-510-01. *Design: Medical Military Facilities*. United States Corps of Engineers: May 30, 2019, Including Change 1, June 21, 2019.~~

~~1.7 BUY AMERICAN ACT~~

~~. The Contractor shall use only domestic construction materials and components in performing under these specifications in accordance with the Buy American Act (41 USC 10a-10d), or shall submit waivers for same as permitted thereunder.~~

~~. Each material or component must be manufactured in the United States and the cost of the domestic sub-components must exceed 50% of the cost of all the components unless one or more exceptions apply under the Buy American Act.~~

~~. Comply by either certifying that the materials purchased for the project meet the criteria or apply for a waiver. Document compliance by one of these methods as part of each product's shop drawing submittal.~~

~~1.11~~1.5 MATERIAL AND EQUIPMENT SELECTION

A. Product Options: The specification of each item of major mechanical equipment required for the project may include a list of manufacturers, with one "basis of design" manufacturer, type, and model identified by virtue of their listing in the equipment schedule on the Drawings. Where several manufacturers in addition to the "basis of design" manufacturer are listed in the specifications, it shall be understood that the words "or approved equal by" are implied to precede each of the other manufacturer's names.

1. The manufacturers other than the "basis of design" may be furnished at the contractor's option in lieu of the "basis of design" product, provided that the selected manufacturer's product is equal in all material and functional respects. In addition to submittal requirements that may be specified in this section, submit a line-by-line written verification of the applicable specification section(s) identifying

compliance with or variations from the specified features, materials, performance, capacities, weight, size, durability, energy consumption and efficiency, warranty, and visual impact (if exposed to view by other than maintenance persons). The burden of proof of manufacturer/product equality is on the contractor.

2. Where a product is not scheduled on the drawings and, therefore, where no "basis of design" is indicated, selection among all of the listed manufacturers and products is at the contractor's option, subject to the requirements of the Contract Documents.
3. Products of manufacturers not listed in the Contract Documents are considered Substitutions and are not permitted, except as provided under the General and Supplementary Conditions and Division 01 Specifications. Full compliance with Division 01 section "Product Substitutions" is mandatory for acceptance of products or manufacturers not listed.

B. Listing of a manufacturer does not imply approval of that manufacturer's standard product or products. Rather, listing of a manufacturer indicates only a general acceptance of that manufacturer's name and reputation. Final approval is subject to full compliance with these Contract Documents.

C. Model numbers identified on the Drawings notwithstanding, all equipment must comply with the requirements of these Contract Documents. Do not assume that a manufacturer's standard product is acceptable as is. For example, one or more custom modifications, custom colors or finishes, manufacturer's options, and/or accessories may be required to meet the specified requirements.

D. Where drawings indicate sizes, profiles, connections, and dimensional requirements of material and equipment, these are based on the "basis of design" manufacturer, type and model indicated. In the event that equipment of power, dimensions, capacities, layout, connections, and/or ratings differing from the "basis of design" are selected by the contractor and approved by the Owner's representative, any necessary adjustments are the contractor's responsibility. All connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, pipe and duct sizes, pipe and duct layout, and the like shall be adjusted by the contractor to suit the equipment provided. No additional costs will be approved for these changes. Should revisions to the design because of contractor's selection of manufacturer, type, or model other than the "basis of design" require additional review and/or redesign by an Architect or Engineer, the contractor shall reimburse the Owner for Owner's added professional fee expenses.

E. Where two or more materials are listed in the "Part 2 – Products" subsection of any Division 23 section, do not assume that the selection of materials is the contractor's option. Refer to "Part 3 – Execution" subsection of that same Division 23 section for an explanation of which specific material(s) shall be used for which specific application(s). For example, Part 2 may list several types and grades of piping, and Part 3 will describe which type and grade of pipe to use for a given application.

~~1.12~~1.6 COORDINATION DRAWINGS

A. Prepare project coordination drawings to a scale of ¼" = 1'0" or larger. 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:

1. Planned piping layout, including valve and specialty locations and valve-stem movement. Include all piping including but not limited to HVAC piping, plumbing piping, and fire protection piping. Include ceiling and wall-mounted access doors and panels required to provide access to valves and other operating devices.
2. Planned ductwork layout, including terminal units, dampers and specialty locations, with terminal unit and damper operator clearances. Include ceiling and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
3. Clearances for installing and maintaining insulation.
4. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
5. Equipment and accessory service connections and support details.
6. Exterior wall and foundation penetrations.
7. Fire-rated wall and floor penetrations.
8. Sizes and location of required concrete pads and bases.
9. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
10. Floor plans, elevations, and details to indicate penetrations in floors, walls, ceilings and roofs, and their relationship to other penetrations and installations.
11. Ceiling plans showing coordination of mechanical, electrical, structural, ceiling suspension assembly, lighting, security, communications, fire alarm, plumbing, and fire protection work within allotted space.
12. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, access panels, special moldings, and other ceiling-mounted items.
13. Floor plans and sections of fan rooms and mechanical rooms; show layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

~~1.13~~1.7 ELECTRONIC MEDIA AND FILES

A. Electronic media files of the contract drawings in AutoCAD or PDF format and copies of the specifications in PDF format may be requested.

B. Complete and return a signed "Electronic File Transmittal" form provided by Ross & Baruzzini upon request for electronic media.

C. Obtain approval from the appropriate Design Professional for use of their part of the documents if the information requested includes information prepared by other than Ross & Baruzzini.

D. The electronic contract documents may be used for preparation of shop drawings and record drawings only. The information may not be used in whole or in part for any other project.

E. The drawings prepared by Ross & Baruzzini for bidding purposes may not be used directly for raceway layout drawings or coordination drawings.

F. The use of these documents does not allow relief from the responsibility for coordination of work with other trades and verification of space available for the installation.

G. The information is provided to expedite the project with no guarantee by Ross & Baruzzini as to the accuracy or correctness of the information provided. Ross & Baruzzini accepts no responsibility or liability for the use of the provided information.

~~1.14~~1.8 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:

1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Indicate actual inverts and horizontal locations of all underground piping.
3. Valve location diagrams, complete with valve tag chart. Refer to Division 23 Section "Basic Mechanical Materials and Methods."
4. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
5. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
6. Contract Modifications, actual equipment and materials installed.

~~1.15~~1.9 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 01. In addition to the requirements specified in Division 01, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.
5. Facsimiles or photo copies are not allowed as submittals for operating and maintenance manuals. Submittals for operating and maintenance manuals must be on original manufacturer printed stock.

B. In addition to the above, comply with ASHRAE Guideline 4-2008 (RA 2013) *Preparation of Operating and Maintenance Documentation for Building Systems*.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. During construction, meet or exceed the recommended Design Approaches of SMACNA *IAQ Guideline for Occupied Buildings under Construction*.

B. Protect stored on-site or installed absorptive materials from moisture damage. Materials directly exposed to moisture via precipitation, water leaks, or condensation shall be removed from the jobsite and replaced.

~~3.2 CONSTRUCTION IAQ MANAGEMENT~~

~~A. General Intent: Perform Construction IAQ Management as further described herein, as required to achieve LEED-NCv4 Credit EQc3 for "Construction Indoor Air Quality Management Plan."~~

~~B. Temporary Ventilation: The contractor shall provide temporary ductwork and fan systems to exhaust the construction areas, providing negative pressures in relation to adjacent non-construction (occupied) areas, of 0.05-inch w.c. adjustable. This exhaust ductwork shall be routed through openings to the exterior, such as windows, and discharged at a location 25 feet or more removed from pedestrian walkways, roadways, other air intakes, doors, or windows serving occupied areas. The temporary exhaust fan(s) shall be installed in a draw-through arrangement to limit air leakage downstream of the fans back into the space(s).~~

~~1. Temporary exhaust fans shall be sized for approximately 0.5 cfm per square foot of construction zone served.~~

~~2. All ductwork shall be of galvanized construction, furnished and installed per Division 23 Section "Metal Ducts" and sealed per Seal Class A.~~

~~C. Construction Zone Pressure Monitoring: Provide monitor consisting of a transmitter module and two sensing probes with stainless steel trim plates. Mount reference probe in an adjacent, non-construction zone hallway, six inches above the floor, and construction zone probe six inches above the floor in the construction zone near the main entry into the construction zone. Transmitter module, powered by 24 VAC, shall be microprocessor based and include an air velocity sensor, 4-20ma analog output, SPDT alarm relay output, and RS-485 digital communications link. Flow measurement accuracy over the range selected shall be plus or minus 10 feet per minute and a resolution of one foot per minute; pressure measurement accuracy over the selected range shall be one percent of the set span with resolution of 0.001 inches of water column or better. Subject to compliance with specifications, example of acceptable device is Model SPM-5100 by Tek-Air Systems, Inc. or approved equal~~

~~1. Construction Zone Alarm Status Display: A wall-mounted display module with LED display and audible alarm horn and mute (acknowledge) button. Display module~~

shall mount on a standard 4-inch by 4-inch electrical box, with tamper-proof screws.

2. Provide a transformer as required for low voltage control power.

D. If permanent building ductwork and air handling equipment are used for temporary ventilation during construction, filtration media with a MERV-8 or better shall be used at each and every return air opening for the duration of operation. Refer to Division 23 Section "Air Filters" for filter requirements.

1. Shut down or damper-off the return side of the HVAC system in areas of heavy construction or demolition. Seal return system openings with plastic where major activity occurs.
2. Repair all leaks in ducts and air handling equipment promptly.
3. Erect temporary barriers between work areas and non-work areas.
4. Provide and operate temporary ventilation to maintain slightly negative air pressurization in heavy work areas, to minimize tendency of dust, debris, and contaminants from migrating to non-work areas.

E. Building Flush Out: After construction ends but prior to occupancy, conduct a minimum two-week building flush-out using permanent building ductwork and air handling equipment. Flush-out shall be made with 100% outdoor air and MERV-13 or better filtration media. If extremes of cold, hot, or humid weather are anticipated during flush-out, participate with design professional in formulating a climate control plan.

F. Replace all filtration media immediately prior to occupancy, using MERV-13 or better filtration media. Refer to Division 23 Section "Air Filters" for filter requirements.

G. Document Construction IAQ Management activities. Such documentation shall include, as a minimum:

1. List each air filter used during construction. Include the MERV value, manufacturer name and model number, and a designation of where used on this project.
2. List each air filter installed at the end of construction. Include the MERV value, manufacturer name and model number, and a designation of where used on this project.
3. Provide 18 photographs (six photographs taken on three different occasions during construction), along with identification of the SMACNA approach featured by each photograph, in order to show consistent adherence to the SMACNA Guideline.

END OF SECTION 23 0100

SECTION 23 0540 – **MECHANICAL VIBRATION ISOLATION**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes vibration isolation pads, mounts, hangers, and vibration isolation bases for mechanical, HVAC, plumbing, and fire protection services.

1.2 RELATED DOCUMENTS

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

B. Section 20 0800 "Seismic Protection," Section 23 0100 "Basic Mechanical Requirements," and Section 23 0500 "Basic Mechanical Materials and Methods" all apply to the work of this Section as if fully repeated herein.

C. The following Sections contain requirements that relate to this Section:

1. Division 20 Section "Seismic Protection" for seismic restraints, snubbers, cables, and coordination with vibration controls.

2. Division 23 Section "Basic Mechanical Materials and Methods" for flexible pipe connectors.
3. Division 23 Section "Hangers and Supports" for pipe hanger restraints.
4. Division 23 Section "Metal Ducts" for flexible duct connectors.
5. Other Division 21 through 28 Sections for equipment that is to be mounted on vibration isolation.

1.3 SUBMITTALS

A. Product Data: types, styles, materials, and finishes for each type of isolator specified. Include load deflection curves for each vibration isolation device.

B. Shop Drawings: Signed and sealed by a qualified 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. Include the following:

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

C. Welding certificates.

D. Manufacturer Seismic Qualification Certification: Submit certification that all specified equipment will withstand seismic forces identified in Division 20 Section "Seismic Protection."

1.4 QUALITY ASSURANCE

A. Single-Source: All vibration isolation devices shall be the product of a single manufacturer.

B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code – Steel."

1.5 COORDINATION

A. Coordinate layout and installation of vibration isolation devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Sections.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in Division 20 Section "Seismic Protection." Single-source responsibility is required; the contractor shall furnish products under Division 20 Section "Seismic Protection" and under this Section by the same manufacturer.

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

~~1. California Dynamics Corp.~~
~~2. Kinetics Noise Control, Inc.~~
~~3. Mason Industries, Inc.~~
~~4. Tolco division of Eaton/Cooper.~~
~~5. Vibration Eliminator Co., Inc.~~
~~6. Vibro-Acoustics, Inc.~~
~~7. The VMC Group; Amber/Booth, Korfund, and VMC brands.~~

C. Model numbers by Mason Industries, Inc. are listed below to establish the level of quality required; equal products by other listed manufacturers are acceptable under the "Material and Equipment Selection" terms of Division 23 Section "Basic Mechanical Requirements."

D. All neoprene referred to hereinafter shall be oil resistant, compounded for not greater than 65 durometer, minimum tensile strength of 2000 psi, minimum elongation of 300%, and maximum compression set at 25% of the original deflection.

E. Where exposed to the atmosphere, all steel shall be hot dipped galvanized unless noted otherwise.

F. All hardware shall be cadmium plated, and all springs shall be neoprene coated.

2.2 VIBRATION ISOLATORS

A. Elastomeric Isolator Pads (Schedule Designation Type 1): Oil and water resistant and factory cut to sizes that match requirements of the equipment supported. Load range from 10 to 50 psig (69 to 345 kPa) and a deflection not less than 0.08-inch per 1-inch (2 mm per 25 mm) of thickness. Do not exceed a loading of 50 psig (345 kPa). Neoprene arranged in single or multiple layers, molded with a non-slip ribbed or waffled pattern, and steel baseplates of sufficient stiffness to provide uniform loading over the pad area. Provide 5/16-inch minimum thickness. Provide 1/16-inch galvanized steel plate between multiple layers. Model MBSW by Mason Industries, Inc.

B. Elastomeric Mounts (Schedule Designation Type 2): Double-deflection type, with molded, neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range. Model ND by Mason Industries, Inc.

C. Restrained Elastomeric Mounts (Schedule Designation Type 2R): All-directional elastomeric mountings with seismic restraint. Model RBA/RCA by Mason Industries, Inc.

1. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Spring Isolators (Schedule Designation Type 3): Freestanding, laterally stable, open-spring-type isolators. Design and install such that ends of springs remain parallel. Model SLF by Mason Industries, Inc.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 1.2 times the rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to ½-inch- (13-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig (690 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Restrained Spring Isolators (Schedule Designation Type 4): Same as Spring Isolators specified above, plus the following: Welded steel housing with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Provide adjustable equipment mounting and leveling bolt. Unit shall be capable of supporting equipment at a fixed elevation during equipment erection. Model SLR by Mason Industries, Inc.

F. Elastomeric Hangers (Schedule Designation Type 2H): Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range. Model HD by Mason Industries, Inc.

G. Spring Hangers (Schedule Designation Type 3H): Combination coil-spring and elastomeric-insert hanger with spring and insert in compression. Model 30N by Mason Industries, Inc.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

H. Spring Hangers with Vertical-Limit Stop (Schedule Designation Type 3HR): Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop. Model PC30N by Mason Industries, Inc.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

I. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of ½-inch thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

J. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes separated by a minimum of ½-inch thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.3 AIR-MOUNTING SYSTEMS

2.4 VIBRATION ISOLATION EQUIPMENT BASES

A. Steel Base (Schedule Designation Type B): Factory-fabricated, welded, structural-steel bases and rails. Model WFSL by Mason Industries, Inc.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps. Include equipment static loadings, power transmission, component misalignment, and cantilever loadings.
2. Structural Steel: Fabricate bases to shapes required, with welded structural-steel shapes, plates, and bars conforming to ASTM A 36 (ASTM A 36M). Include support brackets to anchor base to isolation units. Include prelocated equipment anchor bolts and auxiliary motor slide bases or rails. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

B. Inertia Base (Schedule Designation Type C): Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete. Model BMK/KSL by Mason Industries, Inc.

1. Design Criteria: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Configure the size and shape to accommodate equipment supported. Size to accommodate supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment. Weld reinforcing bars to the structural frame.
3. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.5 RESTRAINED VIBRATION ISOLATION SEISMIC ROOF-CURB RAILS

A. Description (Schedule Designation Type D): Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand 125-mph (56-m/s) wind impinging laterally against side of equipment. Model RSC by Mason Industries, Inc.

B. Lower Support Assembly: Sheet-metal "Z" section containing adjustable and removable steel springs that support upper floating frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist wind and seismic forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2-inches (50 mm) of rigid, glass-fiber insulation on inside of assembly.

C. Overall Height: Minimum 36-inches (450 mm).

D. Elastomeric Isolator Pads: Schedule Designation Type 1 as specified above.

E. Restrained Spring Isolators: Schedule Designation Type 4 as specified above, plus shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

F. Snubber Bushings: All-directional, elastomeric snubber bushings at least ¼-inch (6 mm) thick.

G. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

H. Accessories: Provide the following accessories where scheduled, noted, or otherwise indicated on Drawings:

1. Integrated Pitch Corrections: Where shimming cannot compensate for unusual roof deck pitch, provide Integrated Pitch Corrections. Provide a level isolation curb with lower members that follow the pitch in the roof.
2. Plenum Curb: Tight fitted sheet metal siding shall be welded to the curb in place of expanded metal, creating a return air plenum. For system designs requiring both discharge and return air plenums, and airtight plenum divider shall be incorporated. Flexibly seal siding and dividers at the bottom and around the upper floating curb section with foam rubber and thermal insulation.
3. Tall Curb: Steel posts shall be welded underneath each spring location raising the spring housing and upper floating curb member to the required height, up to a maximum of 36-inches.
4. Access and Duct Openings: Framed horizontal openings with angle iron and cover plates.
5. Acoustical Package: The floating member of the roof curb shall have a perimeter angle cross members to support two layers of 5/8-inch waterproof gypsum board laid on with staggered joints. Gypsum board must surround ducts to provide a continuous sound break. This acoustical barrier shall be caulked to minimize sound transmission. Where the mechanical arrangement makes attachment to the floating member unfeasible, the barrier shall be attached at the highest practical elevation of the fixed curb with provision for 1-inch thick closed cell neoprene flexible seals around the ductwork. A four-inch layer of 1.5 density fiberglass shall cover the entire solid roof surface under the unit. Ductwork shall be lined with sound absorbent material coated with a dampening compound such as Mason Industries MDC-10. Complete instructions shall be provided by the spring isolation curb manufacturer. Mason Industries, Inc. Model RSC-dB.
6. Flexible Duct Supports: Provide a steel frame fixed to the upper floating steel member. Locate directly beneath the equipment's duct opening. The frame shall be dimensioned to exactly match the opening and shall use a foam rubber gasket to seal against the unit's bottom.

2.6 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for finish painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements, installation tolerances, and other conditions affecting performance. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Install vibration control products in accordance with manufacturer's written instructions. Positive attachment of vibration control products to the isolated equipment is required. Positive attachment of vibration control products to the structure or floor is required. Do not rely on friction or gravity as a means of attachment.

C. Install roof curbs, equipment supports, and roof penetrations as specified in Division 07 Section "Roof Accessories."

D. Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure. Seismic snubbers are specified in Division 20 Section "Seismic Protection," whose requirements apply to the work of this Section as if fully reproduced herein.

E. Install resilient bolt isolation washers on equipment anchor bolts.

3.2 EQUIPMENT BASES

A. Fill concrete inertia bases, after installing base frame, with 3000-psi (20.7-MPa) concrete; trowel to a smooth finish. Cast-in-place concrete materials and placement requirements are specified in Division 03.
1.

3.3 ADJUSTING

A. Adjust isolators after piping systems have been filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Attach thrust limits at centerline of thrust and adjust to a maximum of ¼-inch (6-mm) movement during start and stop.

D. Adjust active height of spring isolators.

E. Adjust snubbers according to manufacturer's written recommendations.

F. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

G. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.4 CLEANING

A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 01.

3.6 VIBRATION ISOLATOR SCHEDULE

A. Select and provide specific types of Vibration Isolators as scheduled below ; if not scheduled, then as listed in Table 47, Chapter 49 of the *2019 ASHRAE Handbook of HVAC Applications*.

B. All of the Vibration Isolators Scheduled are field-supplied and field-installed external to the respective equipment unit. See each individual Division 23 specification section for additional factory-installed Vibration Isolators internal to each respective equipment unit.

C. Supported or Suspended Equipment: <Insert name and schedule designation.

1. Equipment Location: <Insert room number.
2. Isolator Type: <Insert generic name or designation used in Part 2.
3. Base Type: <Insert generic name or designation used in Part 2.
4. Minimum Deflection: <Insert minimum deflection in inches (mm).

END OF SECTION 23 0540

SECTION 23 3113 – **METAL DUCTS**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa). Metal ducts include the following:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

1.2 RELATED DOCUMENTS

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

B. Section 20 0800 "Seismic Protection," Section 23 0100 "Basic Mechanical Requirements," and Section 23 0500 "Basic Mechanical Materials and Methods" all apply to the work of this Section as if fully repeated herein.

C. The following Sections contain requirements that relate to this Section:

1. Division 07 Sections "Penetration Firestopping" for fire-resistant sealants for use around duct penetrations and fire-damper installations in fire-rated floors, partitions, and walls.
2. Division 08 Section "Access Doors and Frames" for wall- and ceiling-mounted access doors and for access to concealed ducts.
3. Division 08 Section "Louvers and Vents" for intake and relief louvers and vents connected to ducts and installed in exterior walls.
4. Division 23 Section "Mechanical Insulation."
5. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset FRP ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
6. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
7. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
8. Division 23 Section "Air Terminals" for temperature control terminal units.
9. Division 23 Section "Diffusers, Registers and Grilles."
10. Division 23 Section "HVAC Instrumentation and Controls" for automatic control dampers and actuators.
11. Division 23 Section "Testing, Adjusting and Balancing" for air balancing and final adjusting of manual volume dampers.

1.3 DEFINITIONS

A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C168.

1.4 PERFORMANCE REQUIREMENTS

A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by the design professional. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

B. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA *HVAC Duct Construction Standards – Metal and Flexible* and performance requirements and design criteria indicated in Part 3 of this Section.

C. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA *HVAC Duct Construction Standards – Metal and Flexible* and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." Seismic force factors are specified in Division 20 Section "Seismic Protection."

D. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2016.

1.5 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.
4. Manufactured ductwork and duct fittings (if applicable).
5. MSDS (Material Safety Data Sheet) for each adhesive and sealant furnished.
6. Sheet metal thicknesses.
7. Joint and seam construction and sealing.
8. Reinforcement details and spacing.
9. Materials, fabrication, assembly, and spacing of hangers and supports.

B. Shop Drawings: CAD-generated and drawn to 1/4-inch equals 1 foot scale. Show fabrication and installation details for metal ducts as follows:

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 and pressure classes.
4. Elevations of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Duct accessories, including access doors and panels.

12. Hangers and supports, including methods for duct and building attachment, **seismic restraints,** and vibration isolation.

C. Coordination Drawings: Comply with Division 23 Section "Basic Mechanical Requirements" for Coordination Drawings. Include reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components and ceiling suspension assembly members.
3. Other systems installed in same space as ducts.
4. Structural members to which duct will be attached.
5. Size and location of initial access modules for acoustical tile.
6. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
7. Penetrations of smoke barriers and fire-rated construction.
8. Ceiling-mounting items and/or items penetrating finished ceiling, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Welding certificates: Copies of certificates indicating welding procedures and personnel, to comply with requirements in "Quality Assurance" below.

E. Field quality-control test reports: Indicate and interpret test results for compliance with performance requirements.

F. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.6 QUALITY ASSURANCE

A. 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 D1.2/D1.2M, "Structural Welding Code – Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. NFPA Compliance: Comply with NFPA 90A-2018 *Standard for the Installation of Air Conditioning and Ventilating Systems*.

C. AMCA Compliance: All spiral ducts shall bear the AMCA Certified Ratings Program seal for Air Leakage.

D. Comply with NFPA 96 *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations* for range hood ducts, unless otherwise indicated.

E. ASHRAE Compliance: Applicable requirements in ASHRAE Standard 62.1-2016, Section 5 - "Systems and Equipment" and Section 7 – "Construction and System Start-Up."

F. ASHRAE Compliance: Applicable requirements in ASHRAE Standard 90.1-2016, Section 6.4.4 – "HVAC System Construction and Insulation."

1.7 REFERENCES

A. ANSI/SMACNA Standard 001-2008 *Seismic Restraint Manual; Guidelines for Mechanical Systems*, as published by the Sheet Metal and Air Conditioning Contractors National Association. 3rd ed. Chantilly, VA: SMACNA, 2008. All references to this document throughout this Section refer to this specific edition.

B. ANSI/SMACNA Standard 006- *HVAC Duct Construction Standards – Metal and Flexible*, as published by the Sheet Metal and Air Conditioning Contractors' National Association. Most current ed. Chantilly, VA: SMACNA, 2005. All references to this document throughout this Section refer to this specific edition.

C. ANSI/SMACNA Standard 016-2012 *HVAC Air Duct Leakage Test Manual*, as published by the Sheet Metal and Air Conditioning Contractors' National Association. 2nd ed. Chantilly, VA: SMACNA, 2012. All references to this document throughout this Section refer to this specific edition.

D. ACR 2006: National Air Duct Cleaners Association. *Assessment, Cleaning, & Restoration of HVAC Systems.* 4th ed. Washington, DC: NADCA, 2006. All references to this document throughout this Section refer to this specific edition.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.

C. Delivery, storage, and handling of ductwork, fittings, and accessories shall adhere to requirements listed in specification 230500 "Basic Materials and Methods", Section 1.6 "Delivery, Storage, and Handling"

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Field-Applied Duct Sealant Materials:

   a. Ductmate, Inc.
   b. H.B. Fuller Construction Products Inc. (Childers and/or Foster brands)
   c. Hardcast, Inc.
   d. McGill Air Seal Corporation.

2. Optional Manufactured Duct Slide-on Flange System:

   a. Ductmate, Inc.
   b. Nexus Inc.

c. Ward Industries, Inc.

3. Optional Round Duct Coupling System:

a. Lindab, Inc. "Spirosafe"
b. Sheet Metal Connectors, Inc.
c. Spiramir Corp.
d. Stamped Fittings Inc. "The Edge"

2.2 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA *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. Sheet Gage: SMACNA standards notwithstanding, no material thinner than 26-gage is permitted for spiral-seam round duct, and no material thinner than 24-gage is permitted for all other ducts.

C. Galvanized Sheet Steel: Comply with ASTM A653 / A653M.

1. Galvanized Coating Designation: G60 (Z180) or G90 (Z275).
2. Finishes for Surfaces Exposed to View: Mill-phosphatized.

D. Carbon-Steel Sheets: Comply with ASTM A1008 / A1008M or ASTM A366 / A366M, cold-rolled sheets; commercial quality with oiled, matte finish for exposed ducts.

E. Reinforcement Shapes and Plates: ASTM A36 / A36M, steel plates, shapes, and bars; black and galvanized.

F. Tie Rods: Comply with Articles 2.5 through 2.9, including all accompanying Tables and Figures, of the SMANCA HVAC Duct Construction Standards.

2.3 SEALANT MATERIALS

A. Two-Part Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal; Hardcast® Two-Part Sealing System, Uni-Cast® by McGill AirSeal Corporation, or equal.

B. One-Part Sealing System: Flexible, adhesive sealant, fiber-reinforced, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts. Examples of acceptable products include Uni-Mastic 181 by McGill, Foster 32-19, and Childers CP-146.

C. Water-Based Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

D. Formed-on Duct Connectors: Flange shop roll-formed onto edge of ductwork, with corner closures, cleats and gaskets for seal; TDC or TDF constructed per SMACNA T-25a or T-25b.

1. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
2. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.
3. Contractor's Option: Proprietary manufactured slide-on duct connectors by Ductmate, Ward, or Nexus meeting the above requirements will be accepted wherever formed-on duct connectors are required by these specifications.

2.4 RECTANGULAR DUCT FABRICATION

A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA *HVAC Duct Construction Standards – Metal and Flexible*. Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, deflection limits, and joint types and intervals, except where more stringent requirements are specified herein.

B. All sheet metal shall be a minimum of 24-gage thickness in any case. Use 24-gage sheet metal where SMACNA allows thinner material.

C. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

D. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359-inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of unbraced panel area, unless ducts are lined.

F. Pressure Classification: See Schedule in Part 3 of this Section.

G. Seal Classification: See Schedule in Part 3 of this Section.

H. Longitudinal Seams: Contractor's choice of Pittsburgh lock (SMACNA Figure 2-2 Type L-1) or Button Punch Snap Lock (SMACNA Figure 2-2 Type L-2) shall be used on all longitudinal seams. See "Seam and Joint Sealing" in Part 3 of this Section for further requirements.

I. Duct sizes shown on plans are actual sheet metal sizes and have been sized to account for the thickness of internal duct liner, if any.

J. Contractor is free to alter the indicated sizes of rectangular duct to suit field conditions, provided that revised size is selected for friction loss no greater than that of indicated size. No prior approval by the Engineer is required for equal-friction duct size changes unless proposed size has an aspect ratio greater than 4 to 1.

K. All changes of direction shall be fabricated as elbows in accordance with SMACNA Figure 4-2 except that RE-4, RE-9 and RE-10 are prohibited. RE-6 is limited to a change-of-direction angle of 45 degrees or less.

L. Divided flow branches shall be Type 1 or Type 2 per SMACNA Figure 4-5. Type 3 divided flow branches are permitted only where expressly shown. Seek Engineer's approval of Type 3 where space and/or layout clearances prohibit Type 1 or Type 2.

M. Branch connections shall be per SMACNA Figure 4-6, except that straight taps are not permitted on any ducts 2-inch pressure class or above. Straight-tap "spin-in" fittings are permitted on ½-inch and 1-inch pressure class ductwork only.

N. Offsets and transitions shall be per SMACNA Figure 4-7, except that offset Type 2 (mitered) is limited to an angle of 45° or less.

O. Fittings at obstructions shall be per SMACNA Figure 4-8, except that Figure D is not permitted. Use Figure 4-8.B in lieu of Figure 4-8.D. Seek Engineer's approval of Figure 4-8.D where space and/or layout clearances prohibit use of Figure 4-8.B.

2.5 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Section is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Contractor's Option: The contractor is permitted to furnish spiral lock-seam round or flat-oval ductwork anywhere rectangular duct is indicated, provided the Contractor's coordination drawings demonstrate that adequate ceiling clearances and space required by other trades will permit round ductwork. If this option is chosen, round duct sizes shall be selected by the Contractor according to "equal friction" with respect to the rectangular sizes shown.

C. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA *HVAC Duct Construction Standards – Metal and Flexible* except that 26-gage is the thinnest material acceptable.

D. Longitudinal-seam round ducts ("stovepipe") of a minimum 24-gage thickness, will be permitted on ½-inch and 1-inch pressure classifications only; and only if the Seal Class specified in Part 3 of this Section can be achieved.

E. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA *HVAC Duct Construction Standards – Metal and Flexible* except that 24-gage is the thinnest material available. With approval of Engineer, contractor may substitute flat oval duct where round duct is indicated, provided that revised size is selected for friction loss no greater than that of indicated size.

F. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA *HVAC Duct Construction Standards – Metal and Flexible*, with metal thicknesses specified for longitudinal-seam straight ducts.

G. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

H. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1½ times duct diameter. Adjustable-angle elbow fittings are not permitted. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA *HVAC Duct Construction Standards – Metal and Flexible* unless otherwise indicated.
2. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.

3. 90-Degree, 2-Piece, Mitered Elbows: Use only if approved by the Engineer where space restrictions do not permit using radius elbows. Fabricate with turning vanes.
4. Round Elbows 8 Inches (200 mm) and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
5. Round Elbows 9 through 14 Inches (225 through 355 mm) in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
6. Round Elbows Larger Than 14 Inches (355 mm) in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.

2.6 HANGERS AND SUPPORTS

A. General: Support all ductwork in accordance with Chapter 5 of SMACNA *HVAC Duct Construction Standards – Metal and Flexible* except where more stringent requirements are specified herein.

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 (100 mm) thick.
2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

C. Hanger Materials: Galvanized sheet steel or threaded steel rod. Primary duct hanger systems consisting of cable or wire are not acceptable; use steel angles, straps, and/or threaded rods.

1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
2. Strap and Rod Sizes: Comply with SMACNA *HVAC Duct Construction Standards – Metal and Flexible* for steel sheet width and thickness and for steel rod diameters.

D. All supporting material surfaces in direct contact with supported ductwork (or flexible duct, or duct insulation, as applicable) shall be designed to maintain a minimum of one-inch (25 mm) contact width along full length of contact.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes complying with ASTM A36.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.7 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: As defined in Division 20 Section "Seismic Protection."

B. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips. Use ASTM A492, stainless-steel cables where attached to stainless steel ducts.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Reinforcing steel angle clamped to hanger rod is also acceptable.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.8 SHOP PRIME PAINT

A. All aluminum and galvanized steel ductwork that will be installed exposed to view in finished spaces shall be shop-primed to accept field paint.

B. Primer for galvanized steel ducts shall be galvanized metal primer with total dry film thickness of 1.2 mils; such as Moore #155 or equal. Coordinate brand and selection with the party responsible for performance of Division 09 Painting Sections.

C. Primer for aluminum shall be acrylic- or alkyd-based metal primer specifically recommended by the manufacturer for use over aluminum, with total dry film thickness of 1.4 mils; such as Moore #163 or equal. Coordinate brand and selection with the party responsible for performance of Division 09 Painting Sections.

PART 3 - EXECUTION

3.1 DUCT PRESSURE CLASS SCHEDULE

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Constant-volume Supply Ducts: 2-inch wg (500 Pa).
2. Variable-volume Supply Ducts upstream of VAV boxes: 3-inch wg (750 Pa).
3. Variable-volume Supply Ducts downstream of VAV boxes: 1-inch wg (250 Pa).
4. Outdoor Air Ducts: 2-inch wg (500 Pa), positive or negative pressure as applicable.
5. Return Ducts: 2-inch wg (500 Pa), positive or negative pressure as applicable.
6. Transfer Ducts: 1/2-inch wg (125 Pa).
7. Exhaust Ducts: 2-inch wg (500 Pa), positive or negative pressure as applicable.

3.2 DUCT MATERIAL SCHEDULE

A. All ducts shall be galvanized steel unless otherwise noted.

3.3 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA *HVAC Duct Construction Standards – Metal and Flexible* unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet (3.7 m) unless interrupted by fittings.

C. Install ducts with fewest possible joints. Install fabricated fittings for changes in directions, size, and shape and for connections.

D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12-inches (300 mm), with a minimum of 3 screws in each coupling.

E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

F. Install ducts with a clearance of 1-inch (25 mm), plus allowance for insulation thickness.

G. Final Clean

1. Ductwork systems shall be installed at the site to maintain "shop" or "mill" (free of mill oil) conditions. The ductwork shall be cleaned as necessary to maintain these conditions.
2. Cleaning shall be performed using a 20% isopropyl alcohol to wipe down all interior surfaces upon installation.
3. Interior surfaces must be dust free and exterior surfaces must be free of foreign substances
4. Cover all ends of installed ductwork at the end of each workday, or when work is suspended for any length of time (i.e. breaks, lunch, etc.)
5. The contractor shall insure all ends are covered on both stored and installed ductwork.
6. If installed prior to roofing, protect ductwork from water infiltration.

H. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

I. Install duct accessories as required by Division 23 Section "Duct Accessories."

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Drawings are diagrammatic in nature. Not necessarily all fittings and offsets are shown. Provide all required fittings and offsets as required by field conditions and coordination with the work of other trades, whether specifically shown or not, for a complete and functional installation.

L. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

M. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

N. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1½ inches (38 mm).

O. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Penetration Firestopping."

P. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic forces as further described in Division 20 Section "Seismic Protection."

Q. Protect duct interiors from the elements and foreign materials throughout construction. Follow SMACNA's "Duct Cleanliness for New Construction." Deliver ducts with shop-applied impervious protective covering over all open ends. Maintain protective end coverings through shipping, storage, and handling to prevent entrance of dirt, debris, and moisture. Elevate stored ducts above grade. As ductwork is installed, remove protective end covering as each successive segment is connected, but with protective end covering maintained over open ends remaining exposed.

R. Paint interiors of metal ducts that do not have duct liner, for 24-inches (600 mm) upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 Painting Sections.

3.4 SEAM AND JOINT SEALING SCHEDULE

A. General: Ducts noted as welded in the Duct Material Schedule above shall be made liquid-tight with all joints and seams full-penetration welded continuously along the entire length of the seam or joint. Otherwise, seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA *HVAC Duct Construction Standards – Metal and Flexible* except where more stringent requirements are specified herein.

B. Seal externally insulated ducts before insulation installation.

C. Seal Class Schedule: Seal Class A and Leakage Class 6 is required for all ducts except as noted below.

1. Spiral lock-seams need not be sealed.
2. Transfer air ducts and transfer air boots need not be sealed.

D. Rectangular Duct: Sealant materials and methods shall be at contractor's option, chosen from among the products specified in Part 2 of this Section; provided that the above seal class and leakage class schedule is met.

E. Round or Flat Oval Duct: Transverse joints shall be made with a SMACNA RT-1 interior slip coupling beaded at center, fastened to duct with screws; in addition, apply Two-Part Sealing System continuously around exterior side of joint.

1. Contractor's Option: Furnish prefabricated round duct connection system consisting of self-sealing gasketed fittings. Round duct joints made with this type of fitting do not require the additional sealant specified above, provided that specified seal class is achieved.

3.5 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA *HVAC Duct Construction Standards – Metal and Flexible*.

B. Support horizontal ducts within 24-inches (600 mm) of each elbow and within 48-inches (1200 mm) of each branch intersection.

C. Support vertical ducts at one- or two-story intervals (i.e., 12 feet (3.66 m) to 24 feet (7.32 m).

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

E. Install concrete inserts before placing concrete.

F. Install powder-actuated concrete fasteners after concrete is placed and completely cured. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4-inches (100 mm) thick.

G. Repair any building insulation or building fireproofing materials, whether new or existing, that are removed or scraped away in order to attach hangers and supports, so as to maintain an equivalent insulation or fire rating as existed without said hanger or support attachment.

H. Provide seismic bracing and restraints as further described in Division 20 Section "Seismic Protection."

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."

B. Comply with SMACNA *HVAC Duct Construction Standards – Metal and Flexible* for branch, outlet and inlet, and terminal unit connections.

3.7 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's *HVAC Air Duct Leakage Test Manual* and prepare test reports:

1. 25% of all outdoor ducts.
2. 25% of all indoor ducts if design pressure rating is greater than 3-inch w.g.

B. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

C. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

D. Maximum Allowable Leakage: Comply with requirements for Leakage Class 6.

E. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.8 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.
2. Disconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
5. Clean coils and coil drain pans according to ACR 2006. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

F. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

3.9 CLEANING EXISTING SYSTEMS

A. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Use existing service openings where possible.
2. Create other openings to comply with duct standards.
3. Disconnect flexible ducts as needed for cleaning and inspection.
4. Reseal rigid fiberglass duct systems according to NAIMA recommended practices.
5. Remove and reinstall ceiling sections to gain access during the cleaning process.

B. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or larger) particles.
2. When venting vacuuming system to the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to ACR 2006. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide operative drainage system for washdown procedures.
7. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present. Apply biocidal agents according to manufacturer's written instructions after removal of surface deposits and debris.

F. Cleanliness Verification:

1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
2. Visually inspect metal ducts for contaminants.
3. Where contaminants are discovered, re-clean and reinspect ducts.

G. Gravimetric Analysis: At discretion and expense of Owner, sections of metal duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.

1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal duct system shall be re-cleaned and re-verified.

H. Verification of Coil Cleaning: Cleaning must restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

END OF SECTION 23 3113

This page left intentionally blank.

SECTION 23 3423 – **FANS AND VENTILATORS**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Utility set fans.
2. ~~In-line centrifugal fans.~~ Centrifugal Induction Fan-Stack Assembly

1.2 RELATED DOCUMENTS

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

B. Section 20 0800 "Seismic Protection," Section 23 0100 "Basic Mechanical Requirements," and Section 23 0500 "Basic Mechanical Materials and Methods" all apply to the work of this Section as if fully repeated herein.

C. The following Sections contain requirements that relate to this Section:

1. Division 23 Section "Motors" specifies the motors required for use with fans.
2. Division 23 Section "Mechanical Vibration Isolation" for vibration hangers and supports.
3. Division 23 Section "Duct Accessories" for duct flexible connectors.
4. Division 23 Section "HVAC Instrumentation and Controls" for control devices.
5. Division 26 Section "Variable Frequency Drives" for variable speed motor controllers.

D. Products furnished, but not installed, under this Section include roof curbs for roof-mounted exhaust fans.

E. Stand-alone fans are specified herein. Refer to other Division 23 Sections for fans which are an integral part of packaged equipment.

F. Specialty laboratory exhaust fans are specified in Division 23 Section "Laboratory Mechanical Systems."

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level, unless noted otherwise.

B. Operating Limits: Classify according to AMCA 99-16.

C. Fan Unit Schedule: The following information is specified in an equipment schedule on the Drawings.

1. Fan performance data including capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
2. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

C. 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.

D. Wiring Diagrams: Detail wiring for power and control systems, and differentiating clearly between manufacturer-installed and field-installed wiring.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For fans and ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

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

B. AMCA Compliance: All fans and ventilators shall bear the AMCA Certified Ratings Program seal for Air and Sound Performance. In addition, compliance with either one or both of the following two subparagraphs is required.

1. All fans and ventilators shall bear the AMCA Certified Ratings Program seal for Fan Efficiency Grade (FEG).
2. All fans and ventilators shall bear the AMCA Certified Ratings Program seal for Fan Energy Index (FEI).

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

E. UL Listing: For kitchen grease exhaust applications, provide only fans which are specifically UL-Listed under UL 762 for the removal of smoke and grease laden vapors, tested and listed by UL to operate continuously at 300°F and continue operation during grease flare-up test.

F. UL Listing: For smoke exhaust applications, provide only fans which are specifically UL-Listed as "Power Ventilators for Smoke Control Systems" which includes UL 705 "Power Ventilators" and UL 793 "Automatically Operated Roof Vents for Smoke and Heat;" tested and listed by UL to operate for 4 hours at 500°F and 15 minutes at 1000°F.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, if required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Sections.

1.8 EXTRA MATERIALS

A. Furnish one complete set of belts for each belt-driven unit that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS APPLICABLE TO ALL FANS AND VENTILATORS

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

1. Acme Engineering & Mfg. Corp.
2. Carnes Company.
3. Greenheck Inc.
4. Hartzell Fan, Inc.
5. JenCo Fan.
6. Loren Cook Company.
7. PennBarry, division of Air System Components.
8. Twin City Fan Company.

B. Single Source: All fans of any given type shall all be provided by the same manufacturer.

C. Motors: Refer to Division 23 Section "Motors" for general requirements for factory-installed motors, whose requirements apply to the work of this Section as if fully repeated herein.

1. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
2. Enclosure Type: Open drip-proof, where satisfactorily housed; guarded drip-proof, where subject to contact by employees, maintenance staff, or building occupants.
3. Motor Sizes: Minimum size as indicated, but larger if necessary so driven load will not require motor to operate in service factor range at design point, and larger if necessary so driven load will not require motor to operate beyond the service factor at any point on the fan curve.
4. Provide inverter-ready or inverter-duty motors with shaft grounding rings as specified in Division 23 Section "Motors" everywhere variable speed drives are indicated.

D. Factory Finishes: Provide as follows.

1. Sheet Metal Parts: Prime coat before final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly. Finish shall pass a 1,000-hour salt spray test conducted per ASTM B117 method.
3. Aluminum Parts: No finish required.

E. Sound-Power Level Ratings: Comply with AMCA 301-14 *Methods for Calculating Fan Sound Ratings from Laboratory Test Data*. Factory test fans according to AMCA 300-14 *Reverberant Room Method for Sound Testing of Fans*.

F. Wheel Balance: Factory-balance all fan wheels in accordance with AMCA Standard 204-05 (R2012) *Balance Quality and Vibration Levels for Fans*.

G. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to ASHRAE Standard 51-2016 (ANSI/AMCA Standard 210-2016) *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating*.

H. Fan Capacities and Characteristics: As scheduled on the Drawings.

2.2 UTILITY SET FANS

A. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories; suitable for outdoor unsheltered locations.

B. Housing: Bolted and welded construction utilizing corrosion-resistant fasteners, with side sheets fastened with a deep lock seam or welded to scroll sheets.

1. Housing Material: 14-gauge minimum thickness steel.
2. Housing Material: 0.100-inch minimum thickness aluminum.
3. Housing Discharge Arrangement: Field-adjustable to eight standard positions.

C. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.

1. Blade Materials: Aluminum.
2. Blade Type: Backward inclined.

D. Fan Shaft: Fan Shaft: AISI C-1045 hot rolled steel and accurately turned, ground, and polished; keyed to wheel hub and designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

E. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{10} of 200,000 hours.

F. Required Accessories:

1. Inlet and Outlet: Flanged.
2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
3. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.
4. Drain Connections: NPS ¾ (DN 20) threaded coupling drain connection installed at lowest point of housing.
5. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
6. Discharge Dampers: Assembly with parallel blades constructed of two plates formed around and to shaft, channel frame, sealed ball bearings, with blades linked outside of airstream to single control lever of same material as housing.
7. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
8. Any other accessories as indicated via Schedule on Drawings.

G. Roof Equipment Support: Pate Model ES-5b; galvanized steel; mitered and welded corners; 1½-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; 1½-inch (40-mm) wood nailer; and galvanized steel counterflashing.

1. Configuration: Built-in raised cant and mounting flange.
2. Overall Dimensions: 5½-inch wide by 13½-inch high; length to suit fan mountings.
3. Pitch Mounting: Manufacture curb for roof slope, so that fan is installed level.

2.3 CENTRIFUGAL INDUCTION STACK FANS

A. Description: Centrifugal induction stack fans consist of a centrifugal fan, a roof curb with side duct inlet connection, Induced outside air mixing dampers, and a vertical stack and nozzle selected to achieve the scheduled effective stack height (min. 15'-0")~~In-line centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories. Provide direct-drive or belt-drive as indicated via Schedule on Drawings.~~

B. Housing: 18-gauge galvanized steel bolted construction, corrosion-resistant fasteners, access doors, straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gaskets.

C. Fan Wheels: Aluminum, backward-inclined blades welded to cast aluminum hub.

D. Direct-Driven Units: Motor mounted in airstream; factory wired to disconnect switch located on outside of fan housing.

~~E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing.~~

1. Service Factor Based on Fan Motor Size: 1.4.
2. Sheaves: Precision-machined cast iron type, keyed and securely attached to the wheel and motor shafts; resiliently-mounted to housing, with final alignment and belt adjustment made after installation.
3. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.

F. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{10} of 40,000 hours.

G. Required Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: ½- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
6. Vibration Isolators: Restrained spring isolators having a static deflection of 1 inch (25 mm).
7. Any other accessories as indicated via Schedule on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the fans and ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fans and ventilators level and plumb, and in accordance with manufacturer's written instructions.

B. Install fans and ventilators using vibration isolators. Vibration- and seismic-control devices are specified in Division 20 Section "Seismic Protection" and Division 23 Section "Mechanical Vibration Isolation."

~~C. Install fans and ventilators using vibration isolators. Vibration control devices are specified in Division 23 Section "Mechanical Vibration Isolation."~~

D. Roof-Mounted Fans: Place fan or ventilator onto roof curb and center. In cases where the gap between the 2 components is larger than ¾-inch (19 mm), install a wood filler strip on all 4 sides between the fan curb cap and the roof curb.

1. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
2. Positively attach roof-mounting fan's curb cap to the roof curb using a minimum of two lag screws, anchor bolts, or other suitable metal fasteners per side. Use cadmium-plated hardware of at least ¼-inch; larger if recommended by manufacturer.

E. See Division 23 Section "Basic Mechanical Materials and Methods" for additional anchorage and concrete base requirements.

F. Install units with clearances for service and maintenance.

G. Label units according to requirements specified in Division 23 Section "Basic Mechanical Materials and Methods."

3.3 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."

B. Coordinate ducts, pipes, conduit, and other work adjacent to fans and ventilators to allow service and maintenance clearance in accordance with manufacturer's installation instructions.

C. Connect wiring and ground equipment according to Division 26 Sections.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

D. Testing, Adjusting and Balancing is the work of Division 23 Section "Testing, Adjusting, and Balancing", which shall include adjustment of fan to indicated rpm. After initial testing and balancing, the work of this Section shall include pulley/sheave replacement to meet operating conditions indicated. Remove, size, select, and install the proper pulley/sheave sizes, to match specified performance.

1. Exception: Pulley/sheave replacement is not required for fans whose speed is controlled by a variable frequency drive, provided that specified performance can be met with speed controller at or below 100% output.
2. Exception: Pulley/sheave replacement is not required where pulley/sheave is adjustable in pitch.

3.5 CLEANING

A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide the services of a factory-authorized field service representative to inspect the installation of fans, including duct and electrical connections, and to report the results in writing. The field service representative shall perform, or shall witness the contractor's performance of, the following field tests and inspections and prepare test reports.

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
10. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
11. Shut unit down and reconnect automatic temperature-control operators.
12. Remove and replace malfunctioning units and retest as specified above.
13. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fans and ventilators. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

B. Review data in maintenance manuals. Refer to Division 01.

C. Schedule training with Owner, through Architect, with at least seven days' advance notice.

D. Demonstrate operation of fans and ventilators. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each fan and ventilator.

END OF SECTION 23 3423

SECTION 23 7313 – **MODULAR PACKAGED AIR-HANDLING UNITS**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged modular air-handling units with coils for outdoor installations as further described herein.

1.2 RELATED DOCUMENTS

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

B. Section 20 0800 "Seismic Protection," Section 23 0100 "Basic Mechanical Requirements," and Section 23 0500 "Basic Mechanical Materials and Methods" all apply to the work of this Section as if fully repeated herein.

C. The following Sections contain requirements that relate to this Section:

1. Division 23 Section "Motors."
2. Division 23 Section "Humidifiers" for steam grid and evaporative humidifiers to be factory-installed in factory-packaged air-handling units specified in this Section.
3. Division 23 Section "Duct Accessories" for dampers used as an integral part of factory-packaged air-handling units specified in this Section.
4. Division 23 Section "Air Filters" for filters used as an integral part of factory-packaged air-handling units specified in this Section.
5. Division 23 Section "HVAC Instrumentation and Controls" for temperature controls, wiring, devices, components, and actuators for dampers furnished under this Section.
6. Division 26 Section "Variable Frequency Drives" for motor controllers utilized to vary the speed of the fan motors in response to a temperature control signal.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data: For each type of modular packaged air-handling unit indicated. Include the following:

1. Certified fan-performance curves with system operating conditions indicated.
2. Certified fan-sound power ratings.
3. Certified coil-performance ratings with system operating conditions indicated.
4. Motor ratings, electrical characteristics, and motor and fan accessories.
5. Material gages and finishes.
6. Filters with performance characteristics.
7. Dampers, including housings, linkages, and operators.
8. Leakage class rating as determined via ASHRAE Standard 111.
9. Product data for all specified accessories.

C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

D. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

E. Coordination Drawings: Submit with Shop Drawings. Show mechanical-room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

F. Submit Condensate Trap as-built detail with shop drawings

G. Source quality-control reports.

H. Field quality-control reports.

I. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain modular packaged air-handling units through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of factory-packaged air-handling units and are based on the specific system and model indicated. Refer to Division 23 Section "Basic Mechanical Requirements" for guidelines concerning the use of other systems or models.

C. NFPA Compliance: Factory-packaged air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A *Installation of Air Conditioning and Ventilating Systems*.

D. AHRI Certification: Air-handling unit and component product lines shall be factory-tested according to the applicable portions of AHRI 430 and shall be listed and bear the label of the Air-Conditioning Heating and Refrigeration Institute.

E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2016, Section 6 – "Heating, Ventilating, and Air-Conditioning."

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2016, Section 5 – "Systems and Equipment" and Section 7 – "Construction and Startup."

G. Fan Performance Ratings: Rate according to ASHRAE Standard 51-2016 (ANSI/AMCA Standard 210-2016) *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating*. In addition, all airfoil fans shall comply with AMCA standard 99-2408-69 and 99-2401-82 and shall bear the AMCA Seal.

H. Sound Power Level Ratings: Rate according to AHRI 260-2017 *Sound Rating of Ducted Air Moving and Conditioning Equipment*.

I. Air-Handling Unit Casing Leakage Ratings: Rate and publish leakage ratings for air-handling unit product line in accordance with ASHRAE Standard 111-2008 *Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems*. All units furnished for this project shall comply with ASHRAE 111-2008 Class 6 leakage rating.

J. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.

K. UL and NEMA Compliance: Provide motors required as part of air-handling units that are listed and labeled by UL and comply with applicable NEMA standards.

L. Comply with NFPA 70 for components and installation.

M. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled. The terms "Listed" and "Labeled" are defined in the National Electrical Code, Article 100.

1.5 COORDINATION

A. Coordination: Coordinate layout and installation of factory-packaged air-handling units with piping and ductwork and with other installations.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver air-handling unit as a factory-assembled module with shipping splits only as necessary and with protective crating and covering. All unit openings shall be tightly covered with shrink-wrap or similar means to protect against moisture, dirt, and dust penetration throughout delivery, storage, shipping, and handling.

B. Lift and support units with manufacturer's designated lifting or supporting points.

C. Air handling units and rooftop units are to be inspected for dirt and debris prior to any filter installation or startup and shall be cleaned as necessary. Use 10% Isopropyl Alcohol solution to wipe down the interior surfaces of air handling units.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Furnish additional sets as specified in Division 23 Section "Air Filters."
2. Gaskets: Furnish one (1) additional complete set for each access door.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Aaon, Inc.
2. Buffalo Air Handling.
3. Carrier Global Corp.
4. Nortek Air Solutions, LLC; including Governair, Mammoth, Temtrol, Venmar, Ventrol, and Webco brands.
5. Daikin Applied.
6. Engineered Air.
7. Trane Technologies plc.

2.2 MANUFACTURED UNITS

A. General Description: Factory-assembled, 2-inch solid double-wall units consisting of variable speed plenum fan array, motor and drive assembly, coils, humidifier, dampers, plenums, filters, and condensate pans. Unless otherwise depicted on Drawings, configuration in order of airflow shall be return fan section, economizer section, mixing section, filter section, heating coil, humidifier section, access section, cooling coil, supply fan section.

B. Pressure Class: Meet requirements of this Specification at all of the following water column static pressure conditions:

1. Exterior Cabinet Wall: 6-inch positive and 4-inch negative water column static pressure differential across casing of the air-handling unit; or the largest static pressure capability of the unit fan(s) at any point on their operating curve; whichever is greater.

2. Internal Cabinet Walls between the Economizer and Mixing Box Sections: 10-inch static pressure differential (i.e., 4-inch positive and 6-inch negative) water column across this internal compartment wall of the air-handling unit; or the largest static pressure capability of the unit's supply and return fans at any point on their operating curves; whichever is greater.

3. Structural Performance: Casing panels shall be self-supporting and capable of withstanding static pressures indicated above, without panel joints exceeding a deflection of L/200 where "L" is the unsupported span length within completed casings.
4. Leakage Performance: As specified in Part 1 of this Section.

2.3 CABINET

A. Materials: Formed and reinforced G-90 mill galvanized steel wall and top panels, fabricated to allow access to and removal of internal fans, coils, other parts, and components, without affecting the structural integrity of the unit, with joints between sections sealed.

1. Outer Casing: Galvanized steel, 16-gage; 18-gage permitted in unit nominal cross-section sizes 40 sf and smaller. Factory finish paint the entire outer casing. Finish shall pass a 672-hour salt spray test based on ASTM B117.

2. Inner Casing: Galvanized steel, 20-gage solid in all sections.
3. Option: 22-gage external/internal casing thickness will be acceptable in lieu of the above requirements if applied as part of an engineered panel construction using closed-cell insulation, and if the assembly meets pressure and rigidity requirements specified elsewhere in this section.

4. Floor Plate: Galvanized steel, 18-gage solid.

B. Roof: Pitched at ¼-inch per foot, minimum, with no low spots that could puddle water. Roof edges shall overhand the side panels by at least 2-inches. Roof and sidewall seams shall be continuously caulked and covered with seam caps.

C. Insulation: Glass-fiber insulation, complying with ASTM C612and NFPA 90A.

1. Thermal Performance: k-value 0.26 BTU-in/(hr-sf-degF) at 75°F mean temperature.
2. Thickness: 2 inches, 3-pound density.
3. Option: Closed-cell injected polyurethane foam insulation of at least 2-pound density and R-12 thermal performance will also be acceptable.
4. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50, when tested according to ASTM C411.
5. Location and Application: Encased between outside and inside casing.

D. Access Doors: Same materials and finishes as cabinet and complete with hinges, latches, handles, and gaskets. All doors shall have direction of swing chosen to provide a seating head pressure against the door gasket.

1. The following locations, and other unit sections as indicated on Drawings, shall have access doors sized and located to allow periodic maintenance and inspections. Access doors shall be on the same side of the unit as the coil connections unless indicated otherwise. Provide access doors at fan section (motor side), access sections, coil sections, humidifier section, damper sections, and filter sections.

2. Latches: Minimum of two (2) wedge-lever-type latches per door, operable from inside and outside.
3. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge.
4. Gasket: Neoprene, applied around entire perimeters of panel frames.
5. Size: At least 18 inches clear width when open by full height of unit casing but need not be taller than 60 inches. Width of access doors may be reduced at side-access filter racks only, provided that door is sized large enough to permit direct slide-in and slide-out of filters.
6. Not Acceptable: Access panels which do not remain attached to the unit when opened.

E. Drain Pans: Readily cleanable, formed sections of stainless-steel sheet complying with ASHRAE Standard 62.1. Fabricate pans in sizes and shapes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) when units are operating at maximum catalogued face velocity across cooling coil. Pans shall be sloped in two planes at a minimum of two percent slope for complete drainage to a single outlet without standing water regardless of whether the fan is on or off.

1. Double-Wall Construction: Fill space between walls with 2-inches insulation and seal moisture tight.
2. Drain Connection: Same side of unit as coil connection side, unless noted otherwise. Factory pre-pipe without trapping to exterior of unit at a location above (not through) the specified unit base rail. Locate at lowest point of pan and size to prevent overflow, but not smaller than NPS 1¼ (DN 32) in any case. Terminate with threaded nipple.

3. Units with stacked coils shall have an intermediate drain pan or drain trough to collect condensate from top coil.
4. All portions of the drain pan, including intermediate pans and any hardware subject to contact with condensate, shall be constructed of Type 304 stainless steel.
5. Fasteners: All fasteners exposed to weather shall be corrosion resistant.
6. Length: Extend drain pan long enough downstream from leaving face to comply with ASHRAE 62.1-2016 Paragraph 5.10.4; but not less than 10-inches of drain pan shall be exposed beyond the leaving edge of the cooling coil in any case.
7. Depth: A minimum of 2 inches deep.

F. Access Sections: Provide access sections as indicated on drawings and/or schedules. Access sections shall meet all cabinet construction requirements specified elsewhere in this Section.

1. In addition, access sections which immediately follow (in order of airflow) a humidifier or cooling coil section shall include a drain pan constructed as described in "Drain Pan" paragraphs above.
2. Exception: Galvanized steel will be accepted in lieu of stainless steel for access section drain pan construction.
3. Exception: NPS-1 (DN 25) drain outlet connection will be accepted in lieu of NPS 1¼ (DN 32) for access section drain pans.

2.4 FAN SECTION

A. Fan-Section Construction: Fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan scroll, wheel, shaft, bearings, and motor on structural-steel frame, with frame mounted on base with vibration isolation.

1. Install fans on housed spring vibration isolators, minimum 2-inch (50-mm) static deflection, with seismic snubbers. Vibration isolators shall be Mason Industries Model SLF or equal.
2. Install duct flexible connector at point of connection of fan discharge to the unit cabinet.

B. Fans, General: All fans shall be housed, double-width, double-inlet type with airfoil blades; unless another type of fan is expressly indicated on Drawings or elsewhere in these Specifications.

C. Centrifugal Fan Housings: Formed- and reinforced-steel panels to make curved scroll housings with shaped cutoff, spun-metal inlet bell, and access doors or panels to allow entry to internal parts and components.

1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.

2. Performance Class: AMCA 99-2408, Class I, II or III as scheduled; Class I if not otherwise indicated. If the fan selection indicates an operating point within 10 percent of the maximum operational rpm limit for the fan class indicated by the selection point, the fan manufacturer shall provide a fan of the next-higher class designation.
3. Horizontal Flanged Split Housing: Bolted construction.

4. Plug Fans: With steel cabinet. Fabricate without fan scroll and volute housing.

D. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.

E. Plenum "Plug" Fans: Permitted only where expressly indicated on Drawings or elsewhere in these Specifications. Steel construction with smooth-curved inlet flange, heavy backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws. Fabricate without fan scroll and volute housing. Single-width, single-inlet style.

1. Plenum Fan Arrays: Where an array of more than one fan is indicated on Drawings, such array shall be a contained array as defined in AHRI 430; consisting of steel or aluminum frame with inlet cone and structural framing around each fan built into an array of multiple fans. Provide backdraft dampers at each fan to prevent short circuiting of flow if one fan is not operating.

F. Coatings: [Thermoplastic vinyl] [Epoxy] [Zinc] [Synthetic resin] [Phenolic] [Polytetrafluoroethylene] [Vinyl ester] [Hot-dip galvanized] [Powder-baked enamel]; <Insert manufacturer's name; trade name>.

G. Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

H. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing; rated for duty at maximum fan speed.

1. Tapered roller bearings with double-locking collars meeting the above requirements will be acceptable.
2. Pre-lubricated and sealed-type ball bearings meeting the above requirements will also be acceptable.
3. Selected for L10 = 200,000 hours.

4. Bearing Rating Life: ABMA 9, L_{10} of 40,000 hours.
5. Bearing lubrication lines and grease fittings shall be extended to, and mounted adjacent to, unit access door(s) for easy accessibility.

I. Belt Drives: Not Permitted.

J. Piezometer Ring Fan Inlet Airflow Sensor:

1. Provide each individual fan with airflow measurement integral to fan inlet cones for continuous measurement of air volume flow rate.
2. Multiple pressure sensor points strategically placed along the circumference of the inlet cone and internally connected to an averaging ring manifold located behind the inlet cone.

3. Sensor points shall not protrude beyond the surface of the inlet cone nor be adversely affected by particle contamination present in the airstream.
4. Sensor shall produce steady, non-pulsating signals to achieve accuracy within 5 percent of actual airflow when fan is operating within its stable range.
5. Sensor shall be non-intrusive and not impact fan performance nor acoustics.
6. Product shall be a standard offering of the fan manufacturer and include published literature with supporting test data to validate sensor performance.
7. Include output transducer with selectable 4-20 mA or 0-10 VDC proportional signal.

K. Fan-Section Source Quality Control:

1. Sound Power Level Ratings: Comply with AMCA 301 *Methods for Calculating Fan Sound Ratings from Laboratory Test Data*. Rate fans according to AMCA 300 *Reverberant Room Method for Sound Testing of Fans*. Fans shall bear AMCA-certified sound ratings seal.
2. Sound Power Level Ratings: Comply with AHRI 260-2001 *Sound Rating of Ducted Air Moving and Conditioning Equipment*. Rate fans according to AMCA 300 *Reverberant Room Method for Sound Testing of Fans*.
3. Establish ratings for flow rate, pressure, power, air density, rotation speed, and efficiency according to ASHRAE Standard 51-2016 (ANSI/AMCA Standard 210-2016) *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating*.

2.5 MOTORS

A. General: Refer to Division 23 Section "Motors" for general requirements, which are fully applicable to the work of this Section as if repeated herein.

B. Motor Sizes: Minimum size as indicated, but larger if necessary so driven load will not require motor to operate in service factor range at design point, and larger if necessary so driven load will not require motor to operate beyond the service factor at any point on the fan curve.

C. Location: Motor, drive, and access door shall be on the same side of the fan as the coil connection side, unless otherwise indicated. Provide motor on an adjustable base, inside the air handling unit housing. Motors external to the air-handling unit housing are not acceptable.

D. Provide inverter-ready or inverter-duty motors with shaft grounding rings as specified in Division 23 Section "Motors" everywhere variable speed drives are indicated.

E. Noise Rating: Quiet.

F. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

G. Power Cable Raceway: Any and all power cable installed inside the unit proper, such as (but not limited to) power cabling to the fan/motor assembly, shall be installed inside flexible or rigid conduit as further specified in Division 26 Section "Raceways." Cabling installed inside a separate dedicated power or control enclosure need not be installed in raceway.

2.6 HYDRONIC COILS

A. Coil Sections: Individual, insulated casings for each heating coil and cooling coil separately. Design and construct casing to facilitate removal and replacement of coil for maintenance and to assure full airflow through coils.

B. Coil Casing: Same as cabinet construction for heating coil sections; same as cabinet construction but with all stainless steel materials for cooling coil sections.

C. Circuit Arrangement: Self-draining and self-venting coil fabricated according to AHRI 410. Number of rows shall be determined by manufacturer to meet scheduled performance requirements. Unless noted otherwise, do not exceed 2 rows for heating coils or 8 rows for cooling coils.

D. Piping Connections: Threaded or grooved, on same side. Coil connections shall be on the side of the unit indicated on the Drawings.

E. Tubes: Copper, ½-inch O.D. with 0.025-inch minimum wall; or 5/8-inch O.D. with 0.025-inch minimum wall. Select coils for not less than 1 fps water velocity and not more than 6 fps water velocity.

F. Fins: Aluminum of minimum thickness 0.006-inch. Spacing shall not exceed 8 per inch for heating coils nor 10 per inch for cooling coils.

G. Fin and Tube Joint: Mechanical bond created via thermal expansion.

H. Headers: Non-ferrous, such as seamless copper tube with brazed joints, with drain and air vent tappings. Headers and return bends shall be enclosed within the air handling unit casing. Drain and air vent tappings shall extend through the unit exterior casing, with cabinet sealed around the penetration.

I. Frames: Stainless steel, 0.0625-inch (1.58 mm) is required for cooling coils. Galvanized-steel channel frame, 0.052-inch (1.3 mm) is acceptable for heating coils.

J. Stacked Coils: Where two or more coils are stacked vertically within a unit cabinet, provide a design which seals any gap between coils to prevent bypass of air. Any metal hardware used for this purpose shall meet the same construction requirements as for coil frames.

K. Ratings: Designed, tested and rated according to ASHRAE 33 and AHRI 410.

L. Working-Pressure Ratings: 200 psig (1380 kPa), 325ºF (163ºC).

M. Source Quality Control: Test to 300 psig (2070 kPa) and to 200 psig (1380 kPa) underwater.

If you have Energy recovery as part of your AHUs, choose one of three types . . . OPTION #3 is a run-around coil.

A. General: The humidifiers are to be provided under Division 23 Section "Humidifiers." Contractor shall arrange for and properly schedule the direct shipment of the humidifier steam dispersion panels from the humidifier manufacturer's facility to the air handling unit manufacturer's facility. The air handling unit manufacturer shall receive and

factory-install the humidifier steam dispersion panels into the air handling units in accordance with the humidifier manufacturer's written instructions, with no loss of integrity to the air handling unit structure, casing or seals.

B. Option: The Contractor may elect to receive and field-install the humidifier steam dispersion panels into blank sections of the air-handling units specifically designed to receive same. In so doing, the Contractor accepts responsibility for all installation labor and hardware with no loss of integrity to the air handling unit structure, casing or seals. The Contractor will not be entitled to additional compensation for any extra work resulting from selecting this option.

C. Piping Connections: On same side of unit as coil connections unless indicated otherwise.

D. Drain Pans: Provide drain pan under humidifier dispersion grid. Drain pan shall meet all requirements of cooling coil condensate drain pans specified elsewhere in this Section.

2.8 DAMPER SECTION

A. Damper Section: Furnish and factory-install outdoor air dampers, return air dampers, and relief air dampers in an economizer arrangement within air handling units. Dampers shall bear AMCA's Certified Ratings Seal for both air performance and air leakage. Refer to Division 23 Section "Duct Accessories" for specification of automatic control dampers, whose requirements govern as if fully reproduced herein.

B. It is the intent of this specification that damper actuators will be furnished and field-installed as the work of Division 23 Section "HVAC Instrumentation and Controls" as part of an overall building temperature control system.

2.9 FILTER SECTION

A. Air Filters: Refer to Division 23 Section "Air Filters" which is fully applicable to this Section as if repeated herein.

B. Filter Section: Provide filter media holding frames arranged for flat vertical orientation, with access doors on both sides of unit, but capable of complete filter change from one side of the unit.

C. Location: In accordance with State and National Hospital Codes, the initial pre-filter bank shall be located upstream of all coils and supply fan. Final filters shall be located downstream of all coils and supply fan.

2.10 AIR HANDLING UNIT ACCESSORIES

A. Access Sections: Where dedicated access sections are indicated on Drawings or in this specification, the access section shall provide a clear space unobstructed on the interior for the full unit interior height and width. The minimum acceptable length (in direction parallel to airflow) is 19-inches and minimum access door opening shall be as specified elsewhere in this section.

B. Service Platform: 42 inches wide running entire length of unit and located on service access side, with angle side rails, 4-inch kick plates, and metal floor. Provide platform with a fixed ladder that extends from the top of the side rail to the floor.

1. Handrails: 42-inch tall two-pipe, galvanized steel or aluminum complying with 29 CFR 1910.23, sufficient to withstand a 200-pound concentrated live load in any direction.
2. Ladders and Safety Cages: Galvanized steel or aluminum complying with 29 CFR 1910.27.
3. Platforms: Galvanized steel or aluminum, with an open bar grating floor supported by a galvanized steel framework designed for 50 psf live load.

C. Auxiliary Piping Cabinet: Air handling unit manufacturer shall provide a factory-assembled, weather-tight, insulated auxiliary piping cabinet exterior to, but immediately adjacent to, the main body of the air handling unit.

1. Dimensions: 48-inches depth; height matching air handling unit height; width as required to completely encompass all hydronic and/or steam coil sections associated with any given air handling unit.
2. Construction: Casing materials, walls, floor, roof, insulation, curb, base rail, and access doors shall meet the same specifications described above for the main air handling unit casing.
3. Provide floor slightly pitched to one corner, with a small weephole for drainage to the exterior.
4. Auxiliary piping cabinet shall be shipped loose for field installation.

D. View Windows: Each access door shall include a window for viewing, capable of withstanding unit operating pressures specified.

1. Exception: Air handling units less than or equal to 30 square feet (2.8 m^2) in nominal cross sectional area shall not require view windows.
2. Fabricate windows of double-glazed, wire-reinforced safety glass with an air space between panes and sealed with interior and exterior rubber seals.
3. Minimum size 6-inches (150 mm) by 6-inches (150 mm) if rectangular, or 6-inches (150 mm) diameter if round.

E. Antimicrobial UV-C Lamp System: Factory-installed and pre-engineered UV-C lamp system consisting of power supply, power supply housing, wiring, UV lamp(s), lamp plug, lamp plug protector, encapsulated lamp, and lamp holder used for UV germicidal irradiation of cooling coil and condensate drain pan.

1. Standard: UL Category Code ABQK, HVAC accessories, air-duct mounted.
2. Lamps: High output, hot cathode.
3. Lamp-Holder Construction: UV- and moisture-resistant materials and designed to connect the lamp to the plug; with adjustable positioning.
4. Lamp-Clamp Construction: UV- and moisture-resistant materials, water-tight connection, and adjustable positioning.
5. Lamp Protection: Hermetically sealed to provide protection against lamp breakage and to ensure lamp contents from a broken lamp are contained.
6. Lamp Output: UV-C energy, primarily at the 254-nm wavelength with a 360-degree energy distribution.
7. Access Door Interlocks: Automatic disconnect on all access doors into UV-installed casing sections to shield servicing personnel from contact with light.
8. Power Supply: UL-listed, single-point electrical connection with service disconnect.
9. Power Consumption: Maximum of 15 W/sf^2.

F. GFCI Receptacle: Provide duplex GFI receptacle; 20 amp / 120 volt, on the unit exterior. The exterior receptacle shall be weatherproof. Comply with Division 26 Section "Wiring Devices." Field wiring of the receptacle is the work of Division 26.

G. Roof Curb: Refer to Division 23 Section "Mechanical Vibration Controls" for vibration isolation roof curbs and equipment support rails.

H. Roof Curbs: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand 125-mph wind impinging laterally against side of equipment. Galvanized steel; mitered and welded corners; 1½-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1½-inch- wood nailer. Size as required to suit roof opening and unit base.

1. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.
2. Configuration: Built-in cant and mounting flange, with manufactured custom pitch, to take up roof pitch for level mounting surface.
3. Overall Height: Minimum 12 inches

I. Inlet and Outlet: Weatherproof hood and bird screen, with gravity backdraft damper for exhaust and spring-return, two-position, motor-operated damper with blade seals for supply.

J. Motor Overload Panel: Provide a single unit-mounted, listed control panel with all fans in an array pre-wired to it, such that one properly sized variable-frequency drive (VFD) may be field-connected while providing separate overload protection of each individual motor. The control panel enclosure shall be factory-mounted on the exterior of the fan section and shall be NEMA Type 4. A single power distribution block shall be provided for connection of the field-mounted VFD with one conductor per phase. An electronic motor overload protector with lockable manual isolation switch shall be provided individually for each motor in the array. Each motor in the array shall be independently grounded with a dedicated conductor. A minimum of one open ground lug per fan plus one additional shall be provided for field use. Each motor overload protector shall be provided with an auxiliary contact and all auxiliary contacts shall be wired in series to a terminal block for generic trip signaling.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Examine roughing-in of piping systems and electrical services to verify actual locations of connections before installation. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Install factory-packaged air-handling units level and plumb, according to manufacturer's written instructions.

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Adjust damper linkages for proper damper operation.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

1. Coil piping shall not block access doors.
2. Coil piping shall offset beyond the limits of the coil pull access space in as short a distance as practical, to minimize the amount of pipe disassembly required to accomplish coil removal. All coil service valves, control valves, balance valves, strainers, and other appurtenances shall be installed outside the limits of the coil pull access space.

C. Connect condensate drain pans using Type L copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction. Condensate drain sizing:

1. Up to 20 tons (240 MBh) scheduled unit capacity, use ¾-inch (DN 20).
2. Up to 40 tons (480 MBh) scheduled unit capacity, use 1-inch (DN 25).
3. Up to 90 tons (1080 MBh) scheduled unit capacity, use 1¼-inch (DN 32).
4. Up to 125 tons (1500 MBh) scheduled unit capacity, use 1½-inch (DN 40).
5. Up to 250 tons (3000 MBh) scheduled unit capacity, use 2-inch (DN 50).

D. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

1. Hydronic piping shall be connected to hydronic coils in a counterflow arrangement, such that direction of water flow is opposite the direction of air flow.

E. Steam and Condensate Piping: Comply with applicable requirements in Division 23 Section "Steam and Condensate Piping." Connect to supply and return coil tappings with shutoff valve and union or flange at each connection.

F. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.

G. Electrical: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls. Connect wiring and ground equipment according to Division 26 Sections.

H. Temperature control wiring and interlock wiring is specified in Division 23 Section "HVAC Instrumentation and Controls."

3.3 FIELD QUALITY CONTROL

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

1. Leak Test: After installation, fill water and steam coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

3.4 STARTUP SERVICE

A. Final Checks before Startup: Perform the following:

1. Air Handling Units, including their respective equipment rooms and/or service vestibules, are to be inspected for dir/debris prior to any filter installation/start-up and shall be cleaned as necessary. Use 10% Isopropyl Alcohol solution to wipe down the inside surfaces of the air handlers.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
4. Perform cleaning and adjusting specified in this Section.
5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
6. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
7. Set outside- and return-air mixing dampers to minimum outside-air setting.
8. Comb coil fins for parallel orientation.
9. Install clean filters.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for modular packaged air-handling units shall include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

C. Testing, Adjusting and Balancing is the work of Division 23 Section "Testing, Adjusting and Balancing" which shall include adjustment of fan to indicated rpm. After initial testing and balancing, the work of this Section shall include motor and fan pulley/sheave replacement to meet operating conditions indicated. Remove, size, select, and install the proper pulley/sheave sizes, to match specified performance.

1. Exception: Pulley/sheave replacement is not required for fans whose speed is controlled by a variable frequency drive, provided that specified performance can be met with speed controller at or below 100% output.
2. Exception: Pulley/sheave replacement is not required where pulley/sheave is adjustable in pitch.

3.5 CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Clean modular packaged air-handling units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

C. After completing system installation and testing, adjusting, and balancing modular packaged air-handling and air-distribution systems, clean filter housings and install new filters.

3.6 DEMONSTRATION

A. Engage the services of a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

1. Review data in the operation and maintenance manuals. Refer to Division 01 for requirements.
2. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION 23 7313

This page left intentionally blank.

SECTION 23 8239 **– IN-ROOM TERMINAL EQUIPMENT**

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of in-room terminal equipment:

~~1. Flat-pipe steel radiators.~~
~~2. [Hydronic] [steam] [electric-resistance] finned-tube heaters.~~
~~3. Cabinet unit heaters with centrifugal fans and [hot-water] [steam] [electric-resistance heating] coils.~~
4. Propeller unit heaters with [hot-water] [steam] [electric-resistance heating] coils.
~~5. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.~~
6. Heating and cooling fan-coil units.

1.2 RELATED DOCUMENTS

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

B. Section 20 0800 "Seismic Protection," Section 23 0100 "Basic Mechanical Requirements," and Section 23 0500 "Basic Mechanical Materials and Methods" all apply to the work of this Section as if fully repeated herein.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product, include rated capacities, operating characteristics, furnished specialties, and accessories.

B. LEED Submittals: Product Data for LEED-NC v4 prerequisite EQp1: Documentation indicating that units comply with ASHRAE 62.1-2010, Section 5 – "Systems and Equipment."

C. Shop Drawings:

1. Include plans, elevations, sections, and 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. Include location and size of each field connection.

4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Indicate location and arrangement of piping valves and specialties.
7. Indicate location and arrangement of integral controls.

D. Wiring Diagrams: Power, signal, and control wiring.

~~Samples for Initial Selection: Finish colors for units with factory-applied color finishes.~~

~~E. Samples for Verification: Finish colors for each type of in-room terminal unit indicated with factory-applied color finishes.~~

~~F.~~E. Seismic Qualification Certificates: Submit certification that in-room terminal units, accessories, and components will withstand seismic forces defined in Division 20 Section "Seismic Protection." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Include detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

~~H. Demonstrate compliance with the Buy American Act (41 USC 10a-10d) by either certifying that the materials and components furnished under this Section meet the required criteria or that a formal waiver has been granted by an authorized agency. Refer to Division 23 Section "Basic Mechanical Requirements."~~

~~I.~~F. Field quality-control reports.

~~J.~~G. Operation and Maintenance Data: For in-room terminal units to include in emergency, operation, and maintenance manuals.

1.5 EXTRA MATERIALS

A. Furnish extra filters described in Division 23 Section "Air Filters" that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.6 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. Airstream Surfaces: All surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

A. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

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. Seismic Performance: In-room terminal units shall withstand the effects of earthquake motions determined according to Division 20 Section "Seismic Protection."

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified. [**and the unit will be fully operational after the seismic event**]."

PART 2 - PRODUCTS

2.1 IN-ROOM TERMINAL EQUIPMENT, GENERAL (ALL UNITS)

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

1. Flat-Pipe Steel Radiators:

a. Hydro-Air Components Inc.
b. Quincy Hydronic Technology Inc.
c. Runtal North America, Inc.

2. Electric In-Room Terminal Heating Equipment:

a. Chromalox; div. of Spirax-Sarco Engineering plc.
b. Indeeco; div. of ASPEQ Heating Group.
c. Markel Products Company; TPI Corporation.
d. Marley Engineered Products; Qmark and Berko brands.
e. Trane Technologies plc.

3. Hydronic or Steam In-Room Terminal Equipment:

a. Airtherm; a Mestek company.
b. Daikin Applied Americas Inc.
c. Engineered Air.
d. Rosemex Products.
e. Slant/Fin Corporation.
f. Sterling Hydronics; a Mestek company.
g. Trane Technologies plc.

B. Capacities and Characteristics: As Scheduled on the Drawings.

. Buy American: Furnish only domestic materials and components in accordance with the Buy American Act (41 USC 10a-10d) or one of its exceptions as further specified in Division 23 Section "Basic Mechanical Requirements." Comply by either certifying that the materials purchased for the project meet the criteria or apply for a waiver. Document compliance by one of these methods as part of each product's shop drawing submittal.

2.3 FLAT-PIPE STEEL RADIATORS

. Hydronic Heating Elements: Steel, welded and formed into flat, square, steel header with minimum thickness of 0.109 inch (2.76 mm). Include threaded piping and air-vent connections.

. Working Pressure: 125 psig minimum rating.

. Mounting: [Wall brackets] [Floor pedestals] with maximum spacing of 36 inches (914 mm).

. Finish: Baked-enamel finish in manufacturer's [standard] [custom] color as selected by Architect.

. Required Accessories:

0. Steel piping covers finished to match radiator finish.
0. Flexible Expansion Compensation Hoses: Minimum 400-psig (2758-kPa) working pressure, and operating temperatures from 33 to 211°F (0.5 to 99.5°C). Minimum length shall be 24 inches (600 mm) and diameter shall equal connection size.

2.11 FINNED-TUBE RADIATION HEATERS

. Description: Factory packaged units constructed according to UL 499, UL 1030, and UL 2021.

. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

. Hydronic Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. One end of tube shall be belled.

. Electric-Resistance Heating Elements: Nickel-chromium-wire heating element enclosed in metallic sheath mechanically bonded to fins, with high-temperature cutout and sensor running the full length of the element. Element supports shall eliminate thermal expansion noise.

. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.

. Front Panel: Minimum [**0.0428-inch- (1.1-mm-)**] [**0.0528-inch- (1.35-mm-)**] <**Insert dimension**> thick steel.

. Wall-Mounted Back Panel: Minimum 0.0329-inch- (0.85-mm-) thick steel, full height, with full-length channel support for front panel without exposed fasteners.

. Floor Mounted Pedestals: Conceal conduit for power and control wiring at maximum 36-inch (914-mm) spacing. Pedestal-mounted back panel shall be solid panel matching front panel.

. Support Brackets: Locate at maximum 36-inch (914-mm) spacing to support front panel and element.

. Finish: Baked[**-enamel**] [**-epoxy**] finish in manufacturer's [**standard**] [**custom**] color as selected by Architect.

. Damper: Knob-operated internal damper at enclosure outlet.

. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches (150 by 175 mm), integral with enclosure.

. Enclosure Style: [**Sloped**] [**Flat**] top.

0. Top Outlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.

. Mill-finish aluminum.
. Anodized finish, color as selected by Architect from manufacturer's [**standard**] [**custom**] colors.
. Painted to match enclosure.

. Unit Controls: Integral [line-voltage thermostat with minimum range of **60°F to 90°F (15°C to 32°C)**] [low-voltage relay and control transformer for remote thermostat].

. Required Accessories: Integral disconnect switch, filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

2.33 CABINET UNIT HEATERS

. Description: Factory-assembled and -tested unit complying with AHRI 440.

. Comply with UL 2021.

. Coil Section Insulation Materials: ASTM C 1071; surfaces exposed to airstream shall have [**aluminum-foil facing**] [**erosion-resistant coating**] to prevent erosion of glass fibers.

0. Thickness: [**½-inch (13 mm)**] [**1-inch (25 mm)**] [**1½-inches (38 mm)**].
0. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75°F (0.037 W/m x K at 24°C) mean temperature.
0. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
0. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.

. Cabinet: Steel with [**factory prime coating, ready for field painting**] [**baked-enamel finish with manufacturer's standard paint, in color selected by Architect**] [**baked-enamel finish with manufacturer's custom paint, in color selected by Architect**].

0. Vertical Unit, Exposed Front Panels: Minimum [**0.0528-inch- (1.35-mm-)**] [**0.0677-inch- (1.7-mm-)**] thick [**galvanized**] sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
0. Horizontal Unit, Exposed Bottom Panels: Minimum [**0.0528-inch- (1.35-mm-)**] [**0.0677-inch- (1.7-mm-)**] thick [**galvanized**] sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.

0. Recessed Flanges: Steel, finished to match cabinet.
0. Control Access Door: Key operated.

0. Base: Minimum 0.0528-inch- (1.35-mm-) thick steel, finished to match cabinet, [**4 inches (100 mm)**] [**6 inches (150 mm)**] <**Insert dimension**> high with leveling bolts.
0. Extended Piping Compartment: [**8-inch- (200-mm-)**] <**Insert dimension**> wide piping end pocket.

0. False Back: Minimum 0.0428-inch- (1.1-mm-) thick steel, finished to match cabinet.
0. Outdoor-Air Wall Box: Minimum 0.1265-inch- (3.2-mm-) thick, aluminum, rain-resistant louver and box with integral eliminators and bird screen; aluminum louver with [**anodized**] [**baked-enamel**] finish in color selected by Architect from manufacturer's [**standard**] [**custom**] colors.

0. Outdoor-Air Damper: Galvanized-steel blades with edge and end seals and nylon bearings; with [**manual**] [**electronic**] [**pneumatic**], two-position actuators.

. Filters: Pleated, one-inch thickness, MERV-8 according to ASHRAE 52.2, and as further specified in Division 23 Section "Air Filters" whose requirements apply to the work of this section as if fully reproduced herein.

. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220°F (104°C). Include manual air vent and drain.

. Steam Coil: Copper [**distributing**] tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 75 psig (517 kPa).

. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

. Fan and Motor Board: Removable.

0. Fan: Forward curved, [**high static,**] double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.
0. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board; and as further specified in Division 23 Section "Motors" whose requirements apply to the work of this section as if fully reproduced herein.
0. Wiring Terminations: Connect motor to chassis wiring with plug connection.

. Control devices and operational sequences are specified in Division 23 Section "HVAC Instrumentation and Controls."

. Basic Unit Controls:

0. Control voltage transformer.

0. [**Wall**] [**Unit**]-mounted thermostat with the following features:

. Heat-off switch.
. Fan-on-auto switch.

. Manual fan-speed switch.
. Adjustable deadband.
. [**Concealed**] [**Exposed**] set point.
. [**Concealed**] [**Exposed**] indication.
. Deg F (Deg C) indication.

0. [**Wall**] [**Unit**]-mounted temperature sensor.
0. Unoccupied period override push button.
0. Data entry and access port.

. Input data includes room temperature and occupied and unoccupied periods.
. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.

. [**DDC**] Terminal Controller:

0. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
0. Unoccupied Period Override: [**Two**] <**Insert number**> hours.
0. Unit Supply-Air Fan Operations:

. Occupied Periods: Fan runs continuously.
. Unoccupied Periods: Fan cycles to maintain setback room temperature.

0. Heating-Coil Operations:

. Occupied Periods: [**Open control valve**] [**Modulate control valve**] [**Energize electric-resistance coil**] to provide heating if room temperature falls below thermostat set point.
. Unoccupied Periods: Start fan and [**open control valve**] [**modulate control valve**] [**energize electric-resistance coil**] if room temperature falls below setback temperature.

0. Outdoor-Air Damper Operation:

. Occupied Periods: Open dampers. Delay damper opening if room temperature is more than three degrees below set point.
. Unoccupied Periods: Close damper.

0. Controller shall have volatile-memory backup.

. BAS Interface Requirements:

0. Interface relay for scheduled operation.
0. Interface relay to provide indication of fault at central workstation.
0. Interface shall be [**BAC-net**] [**or**] [**LonWorks**] compatible for central BAS workstation and include the following functions:

. Adjust set points.

~~. Cabinet unit-heater start, stop, and operating status.~~
~~. Data inquiry, including [**outdoor-air damper position and**] supply air and room-air temperature.~~
~~. Occupied and unoccupied schedules.~~

~~. Electrical Connection: Factory-wired motors and controls for a single field connection.~~

~~2.11~~2.2 PROPELLER UNIT HEATERS

A. Description: Assembly including casing, coil, fan, and motor in ~~[**vertical**] [**and**] [~~**horizontal**~~]~~ discharge configuration with adjustable discharge louvers.

B. Comply with UL 2021.

C. Comply with UL 823.

D. Housing Finish: Manufacturer's ~~[~~**standard**~~] [custom]~~ baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.

E. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

F. Coil Requirements: Test and rate ~~[~~**hot-water**~~] [steam]~~ propeller unit-heater coils according to ASHRAE 33.

G. Hot-Water Coil: Copper tube, minimum 0.025-inch (0.635-mm) wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 325°F (163°C), with manual air vent. Test for leaks to 350 psig (2413 kPa) underwater.

~~H. Steam Coil: Copper tube, minimum 0.025-inch (0.635-mm) wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 75 psig (520 kPa).~~

~~I. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch (4 mm). Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550°F (288°C) at any point during normal operation.~~

~~0. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.~~
~~0. Wiring Terminations: Stainless-steel or corrosion-resistant material.~~

~~I.~~H. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

~~M.~~I. Motor: Permanently lubricated, ~~[**explosion proof**] [~~**multispeed**~~] [variable speed]~~; and as further specified in Division 23 Section "Motors" whose requirements apply to the work of this section as if fully reproduced herein.

~~N.~~J. Control Devices:

1. [**Unit**] [~~**Wall**~~]-mounted, [**variable**] fan-speed switch.
2. [~~**Unit**~~] [**Wall**]-mounted thermostat.

~~2.115 WALL AND CEILING HEATERS~~

~~. Description: Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.~~

~~. Cabinet Front Panel: [Stamped-steel louver] [Extruded-aluminum bar grille], with removable panels fastened with tamperproof fasteners.~~

~~. Cabinet Finish: Baked enamel over baked-on primer with manufacturer's [standard] [custom] color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.~~

~~. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.~~

~~. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.~~

~~. Fan: Aluminum propeller directly connected to motor.~~

~~. Motor: Permanently lubricated[, multispeed]; and as further specified in Division 23 Section "Motors" whose requirements apply to the work of this section as if fully reproduced herein.~~

~~. Controls: Unit-mounted thermostat. [Low-voltage relay with transformer kit.]~~

~~. Electrical Connection: Factory wire motors and controls for a single-point field connection.~~

~~2.126~~2.3 HEATING AND COOLING FAN-COIL UNITS

A. Description: Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

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. Fan Coil Unit Configurations: Ducted concealed type. If schedule indicates both hydronic heating and cooling, provide four-pipe configuration with two physically separate and independent hydronic coils.

D. Coil Section Insulation: 1-inch-thick glass fiber complying with ASTM C1071 and attached with adhesive complying with ASTM C916. Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE Standard 62.1.

F. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panel. Floor-mounting units shall have leveling screws.

G. Cabinets: Galvanized steel with baked-enamel finish in manufacturer's standard paint color.

H. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220°F. Include manual air vent and drain.

1. Hydronic Coil Tubing: Minimum ½-inch diameter with minimum 0.016-inch wall thickness.

2. Hydronic Coil Fins: Minimum 0.006-inch fin thickness. Spacing shall not exceed 10 per inch for heating coils nor 12 per inch for cooling coils.

~~I. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.~~

~~J.~~I. ~~Belt-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the cabinet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.~~Direct Drive or ECM fans: Three speed motor installed on an adjustable fan base and mounted in the cabinet.

~~K.~~J. DDC Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied Period Override: Two hours.
3. Unit Supply-Air Fan Operations: Fan cycles on/off with call for heating or cooling.
4. Cooling-Coil Operation: Modulate control valve to maintain room temperature setpoint.
5. Heating-Coil Operation: ~~Energize electric-resistance coil or~~ modulate hydronic coil control valve (whichever is applicable) to provide heating if room temperature falls below setpoint.

~~L.~~K. BAS Interface Requirements: Provide interface relay for scheduled operation, and interface relay to provide indication of fault at central workstation. Interface shall be BACnet compatible for central BAS workstation and shall be BTL-Certified under MS/TP Protocol. Include the following functions: Adjust set points; start-stop and status monitoring; room-air temperature monitoring; and occupied-unoccupied schedules.

~~M.~~L. Electrical Connection: Factory-wired motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive in-room terminal equipment for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.

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

3.2 INSTALLATION

~~A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07 Sections.~~

~~B.~~A. Install in-room terminal equipment to comply with NFPA 90A.

~~Suspend in-room terminal units from structure with elastomeric hangers and seismic restraints. Vibration isolators and seismic restraints are specified in Division 23 Section "Mechanical Vibration Isolation" and Division 20 Section "Seismic Protection."~~

~~D.~~B. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

~~E.~~C. Install new filters in each cabinet unit heater within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

~~B. Piping installation requirements are specified in Division 23 Section "Steam and Condensate Piping." Drawings indicate general arrangement of piping, fittings, and specialties.~~

~~C.~~B. Install valves, unions, fittings, and other specialty items as indicated by detail on the Drawings.

~~D.~~C. Factory, Hot-Water Piping Package: Pre-packaged hydronic coil connection kits, composed of multiple pre-assembled components such as valves, fittings, balancing devices, strainers, flexible connectors, and so forth, are acceptable at Contractor's Option provided that each individual component in the kit is in complete and strict accordance with the respective individual component specification found in Division 23 Section "Hydronic Piping"; and provided that the arrangement of the kit equals the arrangement of coil trim components as detailed on the Drawings.

~~E.~~D. Install piping adjacent to machine to allow service and maintenance.

~~F.~~E. Comply with safety requirements in UL 1995.

~~. Connect wiring and ground equipment according to Division 26 Sections.~~

~~3.5~~3.4 FIELD QUALITY CONTROL

A. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

B. Operate electric heating elements through each stage to verify proper operation and electrical connections.

C. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment. Units will be considered defective if they do not pass tests and inspections. Prepare test and inspection reports.

END OF SECTION 23 8239

SECTION 23 8413 – **HUMIDIFIERS**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of humidifiers:

1. Direct steam injection.
~~0. Self-contained, electrode steam-generating.~~
~~0. Electric resistance heated pan.~~
~~0. Steam-to-steam heat exchanger.~~
~~0. Gas-fired steam-generating.~~

~~1.6~~1.2 RELATED DOCUMENTS

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

B. Section 20 0800 "Seismic Protection," Section 23 0100 "Basic Mechanical Requirements," and Section 23 0500 "Basic Mechanical Materials and Methods" all apply to the work of this Section as if fully repeated herein.

C. The following Sections contain requirements that relate to this Section:

~~1. Division 23 Section "Factory-Packaged Air-Handling Units" for air handlers which will house humidifier steam dispersion grids.~~

~~2.~~1. Division 23 Section "Metal Ducts" for HVAC ducts which will house humidifier steam dispersion grids.
~~3.~~2. Division 23 Section "Hydronic Piping" for makeup and drain lines associated with the humidifiers.
~~4.~~3. Division 23 Section "Steam and Condensate Piping" for steam and condensate lines, steam traps, strainers, and other specialties associated with the humidifiers.
~~5. Division 23 Section "Computer-Room Air-Conditioners" for humidifiers associated with those units, not specified herein.~~
~~6.~~4. Division 23 Section "HVAC Instrumentation and Controls" for humidistats and humidification controls.

~~DEFINITION~~

~~. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.~~

~~1.9~~1.3 SUBMITTALS

A. Product data including rated capacities of selected models, weights (shipping, installed, and operating), supports, weight on each support, required clearances, furnished specialties, and accessories.

B. Shop Drawings: Detail fabrication and installation of humidifiers. Include piping details, plans, elevations, sections, details of components, manifolds, injection and dispersion

elements, and attachments to other work. Show support locations, type of support, weight on each support, required clearances, and other details.

C. Wiring Diagrams: Power, signal, and control wiring. Clearly differentiate between factory- and field-installed wiring.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For humidifiers to include in operation and maintenance manuals specified in Division 01. Include detailed manufacturer's instructions on startup, shutdown, troubleshooting, preventive maintenance, and servicing. Include parts list and list of accessories.

~~. Demonstrate compliance with the Buy American Act (41 USC 10a-10d) by either certifying that the materials and components furnished under this Section meet the required criteria or that a formal waiver has been granted by an authorized agency. Refer to Division 23 Section "Basic Mechanical Requirements."~~

~~1.11~~1.4 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.~~A. Comply with AHRI Standard 640-2017 *Performance Rating of Commercial and Industrial Humidifiers*.

~~Comply with the American Gas Association (AGA) for natural gas burner certification.~~

~~1.11 EXTRA MATERIALS~~

~~. Furnish one replacement electrode cylinder with each self-contained humidifier, that matches products installed and that are packaged with protective covering for storage and identified with labels describing contents.~~

~~1.13~~1.5 COORDINATION

A. Coordinate location and installation of humidifiers with manifolds in ducts and air-handling units or occupied space. Revise locations and elevations to suit field conditions and to ensure proper humidifier operation.

B. Coordinate physical size of humidifier steam dispersion manifold with interior dimensions of the air handling unit for uniform steam distribution. At contractor's discretion, ship steam dispersion grids with complete written mounting instructions to air handling unit manufacturer's facility for incorporation into air handling units.

~~1.14~~1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle humidifiers according to manufacturer's recommendations.

B. Store humidifiers on elevated platforms in a dry location.

~~1.15~~1.7 WARRANTY

A. General Warranty: Extended 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. Manufacturer's Extended Warranty: Submit written warranty, signed by manufacturer, agreeing to repair or replace any component up to and including the entire unit, due to defects in materials or workmanship. Warranty must include parts, labor, shipping and handling charges, and applicable taxes; for no out-of-pocket cost to the Owner. Extended warranty period shall be manufacturer's standard, but not less than two years (2) after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 HUMIDIFIERS, GENERAL

A. Manufacturers: Subject to compliance with requirements, provide humidifiers and humidifier accessory products by one of the following manufacturers:

1. Armstrong International, Inc.
2. Herrmidifier Co., Inc.
3. National Environmental Products Ltd. "Neptronic"
4. Nortec Humidity Inc.
5. Pure Humidifier Company.
6. Research Products Corporation "DriSteem"

~~Buy American: Furnish only domestic materials and components in accordance with the Buy American Act (41 USC 10a-10d) or one of its exceptions as further specified in Division 23 Section "Basic Mechanical Requirements." Comply by either certifying that the materials purchased for the project meet the criteria or apply for a waiver. Document compliance by one of these methods as part of each product's shop drawing submittal.~~

~~C.~~B. Water Source: Cold domestic tap water.

~~C. Water Source: Hot domestic tap water.~~

~~C. Water Source: Cold domestic softened water.~~

~~C. Water Source: Hot domestic softened water.~~

~~C. Water Source: Deionized (DI) water.~~

~~C. Water Source: Deionized and reverse-osmosis (DI/RO) water.~~

2.2 DIRECT STEAM-INJECTION HUMIDIFIERS

A. Steam Separator: ASTM A666, Type 304 stainless steel, with internal baffles and a separate humidifier control valve.

B. Humidifier Control Valve: Comply with ANSI B16.15 Class 250; equal percentage flow characteristics; brass or bronze body globe valve with stainless steel seat, stem and plug.

1. Actuator: As specified in Division 23 Section "HVAC Instrumentation and Controls."

~~2.2 SELF-CONTAINED, ELECTRODE STEAM-GENERATING HUMIDIFIERS~~

~~B. Electrode Cylinder: Replaceable plastic assembly complying with UL 499, with internal electrodes to create heat caused by electrical resistance in the conductive water itself. The humidifier shall be capable of operating on water with a conductivity of 100-1500 micromho.~~

~~B. Cabinet: Sheet metal enclosure for housing heater cylinder, electrical wiring, components, controls, and control panel. Enclosure shall include baked-enamel finish, hinged or removable access door, and threaded outlet in bottom of cabinet for drain piping.~~

~~B. Water connection shall include integral air gap to prevent back-siphoning.~~

~~B. Controls: Automatic flush, drain, and fill cycles; automatically control output of steam to within ±5% of setpoint.~~

~~2.2 ELECTRIC-RESISTANCE HEATED-PAN HUMIDIFIERS~~

~~B. Heat Source: Humidifier shall create humidification steam through use of electric-resistance immersion heating elements. Provide multiple stages of heat where scheduled. Electrode-type humidifiers are NOT acceptable. Boiler steam shall not be used directly for humidification.~~

~~B. Comply with UL 499.~~

~~B. Electric-Resistance Heater Container: Cleanable, ASTM A666, 14-gage Type 304 or 316 stainless steel, with gasketed stainless steel lid, welded seams, overflow fitting, and drain fitting; pan shall be readily removable for cleaning.~~

~~B. Electric-Resistance Heating Element: Incoloy-clad immersion heater(s); removable and replaceable; anchored at one end and free to expand and contract longitudinally.~~

~~B. Cabinet Enclosure shall be minimum 20-gauge steel, all welded cabinet with an enamel finish. Cabinet floor shall be 14-gauge steel and constitute a drain pan, having a threaded connection for drain piping. Electrical compartment shall house electrical devices and shall be secured by a keyed panel.~~

~~B. Surface Skimmer: Surface skimmer shall be provided which is field adjustable for optimum mineral removal with minimum water waste. Humidifiers using disposable ionic bed inserts, in lieu of surface skimmers, to remove minerals are also acceptable.~~

~~2.2 STEAM-TO-STEAM HEAT-EXCHANGER HUMIDIFIERS~~

~~B. Heat Source: Humidifier shall create humidification steam through use of a steam-to-steam heat exchanger. Boiler steam shall not be used directly for humidification.~~

B. Heating Chamber: Cleanable, ASTM A666, 14-gage Type 304 or 316 stainless steel, with gasketed stainless steel lid, welded seams, overflow fitting, and drain fitting; pan shall be readily removable for cleaning.

B. Heat Exchanger: ASTM A666, Type 304 or 316 stainless steel; anchored at one end and free to expand and contract longitudinally.

B. Cabinet Enclosure shall be minimum 20-gauge steel, all welded cabinet with an enamel finish. Cabinet floor shall be 14-gauge steel and constitute a drain pan, having a threaded connection for drain piping. Electrical compartment shall house electrical devices and shall be secured by a keyed panel.

B. Surface Skimmer: Surface skimmer shall be provided which is field adjustable for optimum mineral removal with minimum water waste. Humidifiers using disposable ionic bed inserts, in lieu of surface skimmers, to remove minerals are also acceptable.

B. Steam Inlet Control Valve: Factory-installed, pre-piped, and pre-wired. Comply with ANSI B16.15 Class 250; equal percentage flow characteristics; brass or bronze body globe valve with stainless steel seat, stem and plug. The actuator shall be electric modulating with spring return; normally closed.

2.2 GAS-FIRED STEAM-GENERATING HUMIDIFIERS

B. Heat Source: Humidifier shall create humidification steam through use of a natural gas-fired heat exchanger. Boiler steam shall not be used directly for humidification.

B. Heating Chamber: Cleanable, ASTM A666, 14-gage Type 304 or 316 stainless steel, with gasketed stainless steel lid, welded seams, overflow fitting, and drain fitting; pan shall be readily removable for cleaning.

B. Burner: Stainless steel burners with adjustable combustion-air supply, gas-pressure regulator, diaphragm gas valves, manual shutoff, thermistor flame-sensing device, and automatic 100 percent safety gas shutoff. Fabricate and label steam generator to comply with AGA. Include the following features:

1. Burner Type: Natural-gas fired with modulating, low NOx infrared burner, minimum 82 percent efficient; minimum 4-to-1 turndown ratio.
1. Burner Ignition: Intermittent spark or glow coil.
1. Flue-Gas Collector and Draft Hood: Integral with boiler casing.
1. Maximum Steam Pressure: 10 inches wg (2488 Pa).
1. Ignition: Hot surface ignition with flame safety system.
1. Combustion Chamber: Sealed with outdoor-air and flue-vent connections.
1. Safety Controls: Energize ignition, limit time for establishing flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, and allow gas valve to open.

B. Heat Exchanger: ASTM A666, Type 304 or 316 stainless steel; anchored at one end and free to expand and contract longitudinally.

B. Cabinet Enclosure shall be minimum 20-gauge steel, all welded cabinet with an enamel finish. Cabinet floor shall be 14-gauge steel and constitute a drain pan, having a threaded connection for drain piping. Electrical compartment shall house electrical devices and shall be secured by a keyed panel.

~~Surface Skimmer: Surface skimmer shall be provided which is field adjustable for optimum mineral removal with minimum water waste.~~

~~0. Alternate: Humidifiers using disposable ionic bed inserts, in lieu of surface skimmers, to remove minerals are acceptable.~~

~~C. Gas-Piping Train: Integrally mounted, with lubricated plug cock located upstream from primary valve for manual shutoff, plugged leakage test cock, second lubricated plug cock, and the following:~~

~~0. Primary gas shutoff valve, motor operated with spring return, starts and stops gas burner, and closes automatically in the event of power failure, flame failure, or low-water condition.~~
~~0. Proof-of-closure switch on primary valve, and high- and low-gas-pressure switches.~~
~~0. Second motorized, safety shutoff valve and additional plugged leakage test cock, with proof-of-closure switch and manual reset.~~
~~0. Vent valve located between safety shutoff valves.~~

2.3 STEAM-INJECTION DISPERSION MANIFOLD

~~. Steam Dispersion Blower Pack: Stainless-steel tube with integral fan to discharge vapor directly into occupied space.~~

~~0. Steam-jacketed discharge nozzle, aluminum blade propeller fan with finger guard, and motor interlocked to operate with humidifier.~~
~~0. Fan Mounting: Above and behind humidifier discharge outlet on bracket integral to discharge outlet.~~

~~. Steam Dispersion Manifold: ASTM A666, Type 304 or 316 stainless-steel tube extending across entire width of duct or plenum and equipped with mounting brackets on ends. Tube shall be 1½-inch nominal diameter and minimum 0.049-inch wall thickness.~~

A. Steam Dispersion Grid: Tube bank consisting of a header and required quantity of multiple dispersion tubes, factory assembled in a rack sized to fit across entire cross-section of duct or plenum and equipped with mounting hardware.

1. Header shall be constructed of ASTM A666, Type 304 or 316 stainless steel and shall be fitted with 1-inch, 1½-inch or 2-inch tee outlets for dispersion tube connections. The header shall be baffled or otherwise internally balanced to ensure uniform steam flow to each dispersion tube.
2. The dispersion tubes shall be constructed of ASTM A666, Type 304 or 316 stainless steel and shall be engineered to limit airstream sensible heat gain to a maximum of 3ºF when no humidification is required.
3. Vapor emission ports shall be sized and located along the dispersion tube for uniform steam distribution across the grid. Dispersion tubes shall either be fully jacketed with punched emission ports, or unjacketed with emission port sleeves extending to the center of the dispersion tube; to minimize condensate carryover.
4. Steam shall be absorbed into the airstream such that no moisture accumulates on interior air handling unit surfaces more than 18 inches beyond the centerline of the steam dispersion grid at 500 fpm face velocity. The dispersion tube quantity and spacing, and vapor outlet ports quantity and spacing, shall be factory-engineered to meet this absorption requirement.

5. Provide 1/8-inch thick, PVDF insulation on thermal dispersion tubes and humidifier grid header. Insulation shall have a maximum rating under UL 723 (ASTM E84) flame spread/smoke developed of 25/50; high temperature rated for 300°F continuous operation; closed-cell construction that will not absorb moisture and therefore not support microbial growth; zero particle erosion per ASTM C1071, and resistant to UV light.

2.4 MICROPROCESSOR-BASED CONTROLS

~~Microprocessor control panel shall be factory-installed and pre-wired on the front, side, or top face of the humidifier; compatible for interface to a central HVAC instrumentation and controls system. Provide the following features and functions:~~

~~0. Proportional-Integral-Derivative (PID) Modulating Control System, including a modulating circuit board mounted and wired in the control cabinet. The system shall modulate the humidifier output from 0% to 100% of total capacity.~~
~~0. Factory-wired disconnect switch.~~
~~0. Low-voltage control circuit.~~
~~0. Minimum 2-line, 20-character text display.~~
~~0. User-programmable keyboard interface with setpoint adjustment, and with lockout to prevent unauthorized adjustments.~~
~~0. Relative humidity (RH) setpoint and actual conditions in the space (from humidistat or humidity transmitter).~~
~~0. Relative humidity (RH) setpoint and actual conditions in the air-handler.~~
~~0. Relative humidity (RH) high limit setpoint and actual conditions.~~
~~0. Total system output in lbs/hour.~~
~~0. High/low humidity deviation alarms.~~
~~0. "Maintenance Recommended" indicators.~~
~~0. Visual indication of normal operation, fill/drain operation, and system fault.~~
~~0. Water make-up valve control and low water safety shutdown.~~

~~0. Field adjustable to accept 4-20 mA, 0-135 ohms or 1-15 vdc input signals. Coordinate with Division 23 Section "HVAC Instrumentation and Controls" for control signal.~~

~~0. Auto drain/flush sequence whereby microprocessor accumulates actual humidifying "on" time and activates auto drain/flush sequence.~~
~~0. End-of-season drain activates when there has been no demand for humidification over a preset period.~~

~~0. Blocked flue safety shutoff and alarm.~~

~~A. Humidifier controls hardware shall include the following features and functions:~~

~~0. A brass- or bronze-body solenoid-operated fill valve, factory-mounted and factory-wired.~~
~~0. A motor-driven brass- or bronze-body drain valve factory-mounted and factory-wired.~~

~~B.~~A. The following humidifier controls hardware is intended to be furnished and installed as the work of Division 23 Section "HVAC Instrumentation and Controls":

1. Wall-mounted and/or return duct-mounted humidistats.
2. Duct-mounted, high-limit humidistats.

3. Airflow switch for preventing humidifier operation without airflow.
4. Aquastat mounted on steam condensate return piping to prevent cold operation of humidifier.

~~The following humidifier controls hardware shall be furnished and installed as the work of this Section.~~

~~0. Space Humidity Sensors: Bulk polymer sensor element; 2% accuracy over full range with linear output; range of 20% to 80% relative humidity; with wall-mounting hardware and locking covers.~~
~~0. Duct Humidity Sensors: Bulk polymer sensor element; 2% accuracy over full range with linear output; range of 20% to 80% relative humidity; with element guard and mounting plate.~~
~~0. Duct-Mounting High-limit Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, adjustable to trip at 60% to 95% relative humidity, and single- or double-pole contacts.~~
~~0. Duct-Mounting differential-pressure switch for preventing humidifier operation without airflow; pilot-duty rating, with adjustable range of 0- to 5-inch wg.~~

~~0. Aquastat: Mount on steam condensate return piping to prevent cold operation of humidifier; remote-bulb or bimetal rod-and-tube type with precision snap switch. Include brass socket with minimum insertion length of 2½ inches (64 mm).~~

~~2.6~~2.5 ACCESSORY HARDWARE

A. Condensate Tempering Tank: Type 304 stainless steel cylindrical mixing chamber and internal baffles; self-contained thermostatically-controlled metering valve set at 140°F for blending tap water with hot condensate drainage prior to discharge to sewer.

1. Fabricate with tappings for condensate outlet, condensate inlet, makeup water inlet, and legs.
2. Subject to compliance with requirements, example of acceptable device is "Drane Kooler" by Dri-Steem Corporation, or equal.
3. Alternate methods of ensuring a discharge drain and/or blowdown temperature no higher than 140°F may be submitted to the Engineer for consideration.

B. Multiple outlet hardware: Provide hardware and controls to support up to four (4) separate steam dispersion manifolds from one steam generator. Include microprocessor controls suitable for multiple outlet applications.

C. Factory Insulation: Humidifier shall be covered with 3/4-inch thick, rigid fiberglass insulation. Insulation shall be covered with reinforced aluminum foil. All surfaces except face panel shall be covered.

D. Support Legs: Four galvanized steel or finish-painted steel support legs, for supporting humidifier from floor surface, shall be provided; minimum dimensions 1¼ x 1¼-inch angle iron or u-channel. Cross-brace for structural rigidity.

E. Wall Brackets: Two galvanized steel or finish-painted steel wall brackets, for supporting humidifier from a vertical surface, shall be provided; minimum dimensions 1¼ x 1¼-inch angle iron or u-channel.

F. Outdoor Enclosure: Provide heavy-gage galvanized steel, fully-insulated outdoor enclosure suitable for installation on grade or on the roof. The outdoor enclosure shall

ship complete with the humidifier preinstalled and tested, pre-piped within the enclosure with an integral water seal, and ready for field connection to gas, water, steam, and/or electricity as applicable.

1. Steel enclosure doors shall provide full access to all internal components. The doors shall be gasketed and shall feature stainless steel hinges and latches operable from both the exterior and interior of the unit.
2. The outdoor enclosure shall include supplemental heating and ventilating systems that automatically maintain required operation conditions when outdoor temperature ranges from -40°F to 122°F (-40°C to 50°C).

~~2.7~~2.6 FIELD PIPING

~~As specified in Division 23 Section "Steam and Condensate Piping."~~

~~B.~~A. Steam Piping: Stainless-steel tubing in compliance with ASTM A269, Type 316.

1. Steam Pipe Fittings: Stainless-steel in compliance with ASTM A815, Type 316, Grade WP-S.
2. Two-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A351, Type 316 stainless-steel body; ASTM A276, Type 316 stainless-steel stem and vented ball, carbon-filled TFE seats, threaded body design with adjustable stem packing, threaded ends, and 250-psig (1725-kPa) steam working-pressure rating and 600-psig (4140-kPa) cold working-pressure rating.

~~C.~~B. Condensate Piping: ASTM A53, Type S, Grade B, Schedule 80 steel pipe with threaded joints and ASTM B16.3 Class 125 malleable-iron threaded fittings; and ASME B16.39; Class 150 malleable-iron unions.

~~D.~~C. Y-Pattern Strainers:

1. Body: ASTM A126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 (DN 50) and smaller; flanged ends for strainers NPS 2½ (DN 65) and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. Tapped blowoff plug.
5. CWP Rating: 250-psig (1725-kPa) working steam pressure.

~~E.~~D. Float and Thermostatic Traps: ASTM A126, Class 30, cast-iron body and bolted cap; renewable, stainless steel float mechanism with renewable, hardened stainless steel head and seat; balanced-pressure, thermostatic air vent made with stainless steel or monel bellows, and stainless steel head and seat.

1. End Connections: Threaded.
2. Thermostatic air vent shall be capable of withstanding 45°F (25 C) of superheat and resisting water hammer without sustaining damage.
3. Maximum Operating Pressure: 125 psig (860 kPa).
4. Subject to compliance with requirements, provide float and thermostatic traps by Armstrong International, Inc.; Hoffman Specialty division of ITT Industries; or Spirax Sarco, Inc.

~~F.~~E. Inverted Bucket Traps: ASTM A126, Class 30, cast-iron body and cap; with stainless steel head and seat; and with brass or stainless steel bucket.

1. End Connections: Threaded.
2. Valve Retainer, Lever, and Guide Pin Assembly: Stainless steel.
3. Maximum Operating Pressure: 250 psig (1725 kPa).
4. Subject to compliance with requirements, provide float and thermostatic traps by Armstrong International, Inc.; Hoffman Specialty division of ITT Industries; or Spirax Sarco, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine ducts, air-handling units, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier installation. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Install humidifiers as indicated, in accordance with manufacturer's written instructions and AHRI 640. Install humidifiers with required clearance for service and maintenance.

C. Seal humidifier manifold duct or plenum penetrations with flange.

~~Install humidifier manifolds in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."~~

~~D. Install stainless-steel drain pan under each manifold mounted in a duct.~~

~~0. Construct drain pans to comply with ASHRAE 62.1-2016.~~
~~0. Connect to condensate trap and drainage piping.~~
~~0. Extend drain pan upstream and downstream from manifold a minimum of 24-inches (600 mm) or as recommended by manufacturer.~~

~~D. Install manifold supply piping pitched to drain condensate back to humidifier.~~

~~E.~~D. Install drip leg upstream from steam trap a minimum of 12 inches (300 mm) tall for proper operation of trap.

~~F.~~E. Install humidifier on manufacturer-provided wall brackets as indicated.

~~G. Install humidifier on manufacturer-provided floor stand support legs as indicated.~~

~~H. Install humidifier on concrete base. Concrete base is specified in Division 23 Section "Basic Mechanical Materials and Methods."~~

~~I.~~F. Concrete Bases: Anchor humidifier to concrete base.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of 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 supported equipment.
5. Cast-in-place concrete materials and placement requirements are specified in Division 03.

~~J.~~G. Install seismic restraints on humidifiers. Seismic restraints are specified in Division 20 Section "Seismic Protection."

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Install piping adjacent to humidifiers to allow service and maintenance.

~~0. Install shutoff valve, strainer, backflow preventer, and union in humidifier makeup line.~~

~~C.~~B. Install electrical devices and piping specialties furnished by manufacturer but not factory mounted.

~~D. Install piping from safety relief valves to nearest floor drain.~~

~~E. Connect gas piping full size to steam-generator, gas-train inlet with union. Gas piping materials and specialties are specified in Division 22 Section "Fuel Gas Piping."~~

~~F. Connect breeching full size to steam-generator outlet. Venting materials are specified in Division 23 Section "Breechings, Chimneys, and Stacks."~~

~~G. Connect combustion-air inlet to intake terminal using PVC piping with solvent-cemented joints. Run from boiler connection to outside and terminate adjacent to flue termination.~~

~~H.~~C. Connect wiring and ground equipment according to Division 26 Sections.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain humidifiers.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
2. Review data in maintenance manuals. Refer to Division 01.
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 23 8413

GENERAL SYMBOLS

- TEMPERATURE SENSOR
- TEMPERATURE SENSOR WITH INSULATED SUB-BASE
- TEMPERATURE SENSOR WITH GUARD
- HUMIDITY SENSOR
- OCCUPANCY SENSOR
- REFRIGERANT SENSOR
- PRESSURE SENSOR
- SENSOR: CO = CARBON MONOXIDE; CO2 = CARBON DIOXIDE; NG = NATURAL GAS
- AIRFLOW MEASURING STATION
- TYPE OF SERVICE: S = SUPPLY, R = RETURN, E = EXHAUST, T = TRANSFER; SCHEDULED DEVICE NO; AIR QUANTITY IN CFM
- LIMIT OF DEMOLITION
- INTERFACE, EXISTING TO NEW
- PLAN NUMBER; SHEET WHERE LOCATED
- SECTION NUMBER; SHEET WHERE LOCATED
- EQUIPMENT DESIGNATION; UNIT NUMBER
- **AHU-1** EQUIPMENT DESIGNATION
- DAMPER TYPE DESIGNATION; UNIT NUMBER

DUCT SYSTEM SYMBOLS

- NEW WORK
- EXISTING TO REMAIN
- DUCT SIZE, FIRST FIGURE IS SIDE SHOWN (CLEAR INSIDE, ADJUST FOR LINER)
- ROUND DUCT SIZE, (ACTUAL SIZE INDICATED)
- SPIRAL FLAT-OVAL DUCT SIZE, FIRST FIGURE IS SIDE SHOWN (ACTUAL SIZE INDICATED)
- ACCESS PANEL, TOP OR SIDE
- FLEXIBLE DUCT CONNECTION
- CHANGE OF ELEVATION - RISE (R) OR DROP (D)
- TURNING VANES
- DEMO TO BE REMOVED
- MOTORIZED DAMPER
- GRAVITY BACKDRAFT DAMPER
- MANUAL VOLUME DAMPER
- FIRE DAMPER
- SMOKE DAMPER
- FIRE/SMOKE DAMPER
- FLEXIBLE DUCT
- SUPPLY AND OUTSIDE AIR SECTION UP
- SUPPLY AND OUTSIDE AIR SECTION DOWN
- RETURN AIR SECTION UP
- RETURN AIR SECTION DOWN
- EXHAUST AIR SECTION UP
- EXHAUST AIR SECTION DOWN
- FLOW ARROW DOWNSTREAM OF FAN
- FLOW ARROW UPSTREAM OF FAN
- SUPPLY DIFFUSER AS SCHEDULED. ARROWS INDICATE DIRECTION OF AIR DISCHARGE. IF NO ARROWS ARE SHOWN ON PLAN, DEFAULT IS A 4-WAY THROW.
- RETURN GRILLE OR REGISTER AS SCHEDULED
- EXHAUST GRILLE OR REGISTER AS SCHEDULED
- SLOT DIFFUSER AS SCHEDULED. ARROWS INDICATE DIRECTION OF AIR DISCHARGE. IF NO ARROWS ARE SHOWN ON PLAN, DEFAULT IS 2-WAY THROW.
- SIDEWALL DIFFUSER AS SCHEDULED
- SIDEWALL RETURN OR EXHAUST AS SCHEDULED

PIPE LINE SYMBOLS

- SHUT OFF VALVE (SEE SPECIFICATION FOR TYPE)
- GATE VALVE
- BALL VALVE
- BUTTERFLY VALVE
- VALVE IN RISE (SEE SPECIFICATIONS FOR TYPE)
- MULTI-PURPOSE PUMP DISCHARGE VALVE
- CHECK VALVE
- GLOBE VALVE
- SOLENOID VALVE
- PRESSURE REDUCING VALVE (HYDRONIC)
- PRESSURE REGULATING VALVE (STEAM)
- CALIBRATED - ORIFACE BALANCING VALVE
- ACTIVE FLOW - LIMITING VALVE
- PLUG VALVE
- IN-LINE PUMP
- Y - PATTERN STRAINER
- Y - PATTERN STRAINER W/ BLOWDOWN VALVE
- UNION
- AIR VENT (M - MANUAL, A - AUTOMATIC)
- RELIEF VALVE
- VACUUM BREAKER
- PRESSURE AND TEMPERATURE TEST PORT
- THERMOMETER
- PRESSURE GAGE WITH COCK
- FLEX PIPE COUPLING
- EXPANSION JOINT
- PIPE ANCHOR
- PIPE GUIDE
- PITCH DOWN IN DIRECTION OF ARROW
- FLOW ARROW
- WATER METER
- STEAM TRAP
- TWO-WAY CONTROL VALVE
- THREE-WAY CONTROL VALVE
- MOTORIZED BUTTERFLY VALVE

MEDIUM DETAIL	FINE DETAIL	
		ELBOW DOWN
		ELBOW UP
		TEE DOWN
		TEE UP
		CAP
		CONCENTRIC REDUCER/INCREASER
		ECCENTRIC REDUCER/INCREASER
		FLANGE
		DEMO TO BE REMOVED

PIPE SYSTEM ABBREVIATIONS

BD	BLOW DOWN
CA	COMPRESSED AIR
CD	CONDENSATE (STEAM) DRAIN
CF	CHEMICAL FEED
CHR	CHILLED/HOT WATER RETURN
CHS	CHILLED/HOT WATER SUPPLY
CR	CONDENSER WATER RETURN
CS	CONDENSER WATER SUPPLY
CW	COLD WATER, DOMESTIC
CWR	CHILLED WATER RETURN
CWS	CHILLED WATER SUPPLY
D	DRAIN
E	EQUALIZING LINE
FOF	FUEL OIL FILL
FOR	FUEL OIL RETURN
FOS	FUEL OIL SUPPLY
FOV	FUEL OIL VENT
G	NATURAL GAS
GLR	GLYCOL RETURN
GLS	GLYCOL SUPPLY
HG	REFRIGERANT HOT GAS
HPR	HIGH PRESSURE CONDENSATE RETURN (100 PSIG)
HPS	HIGH PRESSURE STEAM SUPPLY (100 PSIG)
HW	DOMESTIC HOT WATER
HWR	HEATING WATER RETURN
HWS	HEATING WATER SUPPLY
LPG	LIQUEFIED PETROLEUM GAS
LPR	LOW PRESSURE CONDENSATE RETURN (15 PSIG)
LPS	LOW PRESSURE STEAM SUPPLY (15 PSIG)
MPR	MEDIUM PRESSURE CONDENSATE RETURN (60 PSIG)
MPS	MEDIUM PRESSURE STEAM SUPPLY (60PSIG)
MU	MAKE-UP WATER (NON-POTABLE)
PC	PUMPED CONDENSATE
PD	PUMP DISCHARGE
PCWR	PRIMARY CHILLED WATER RETURN
PCWS	PRIMARY CHILLED WATER SUPPLY
PHWR	PRIMARY HEATING WATER RETURN
PHWS	PRIMARY HEATING WATER SUPPLY
RL	REFRIGERANT LIQUID
RS	REFRIGERANT SUCTION
RV	REFRIGERANT VENT
SCWR	SECONDARY CHILLED WATER RETURN
SCWS	SECONDARY CHILLED WATER SUPPLY
SHWR	SECONDARY HEATING WATER RETURN
SHWS	SECONDARY HEATING WATER SUPPLY
SRV	STEAM RELIEF VENT
V	VENT

EQUIPMENT DESIGNATION

AC	AIR CURTAIN
ACC	AIR COOLED CONDENSER
ACU	AIR CONDITIONING UNIT
AF	AIR FILTER
AHU	AIR HANDLING UNIT
AS	AIR SEPARATOR
B	BOILER
BCU	BLOWER COIL UNIT
CAV	CONSTANT AIR VOLUME
CB	CHILLED BEAM
CC	COOLING COIL
CFP	CHEMICAL FEED PUMP
CH	CHILLER
CP	CONDENSER WATER PUMP
CRAC	COMPUTER ROOM AIR CONDITIONING UNIT
CRP	CONDENSATE RETURN PUMP
CSG	CLEAN STEAM GENERATOR
CT	COOLING TOWER
CTF	COOLING TOWER FILTER
CU	CONDENSING UNIT
CUH	CABINET UNIT HEATER
CVR	CONVECTOR
CWP	CHILLED WATER PUMP
DFH	DEAERATING FEEDWATER HEATER
EAV	EXHAUST AIR VALVE
EF	EXHAUST FAN
EJ	EXPANSION JOINT
ERU	ENERGY RECOVERY UNIT
ET	EXPANSION TANK
EVC	EVAPORATIVE COOLER
F	FAN
FAV	FUME AIR VALVE
FC	FLUID COOLER
FCU	FAN COIL UNIT
FD	FIRE DAMPER
FM	FLOW METER
FSD	COMBINATION FIRE/SMOKE DAMPER
FT	FLASH TANK
FTR	FIN-TUBE RADIATION
FTU	FAN TERMINAL UNIT
GP	GLYCOL PUMP
GV	GRAVITY VENTILATOR
H	HUMIDIFIER
HC	HEATING COIL
HEV	HOOD EXHAUST VALVE
HPU	HEAT PUMP UNIT
HRU	HEAT RECOVERY UNIT
HWP	HEATING WATER PUMP
HX	HEAT EXCHANGER
L	LOUVER
MAU	MAKE-UP AIR UNIT
MD	MOTORIZED DAMPER
P	PUMP
PAC	PACKAGED AIR CONDITIONING UNIT
PCWP	PRIMARY CHILLED WATER PUMP
PG	PIPE GUIDE
PHWP	PRIMARY HEATING WATER PUMP
PHX	PLATE HEAT EXCHANGER
PRV	PRESSURE REGULATING VALVE
RF	RETURN FAN
RHC	TERMINAL REHEAT COIL
RP	RADIANT PANEL
RTU	ROOFTOP UNIT
SAV	SUPPLY AIR VALVE
SCWP	SECONDARY CHILLED WATER PUMP
SD	SMOKE DAMPER
SF	SUPPLY FAN
SHWP	SECONDARY HEATING WATER PUMP
ST	STEAM TRAP
T	TANK
UH	UNIT HEATER
VAV	VARIABLE AIR VOLUME BOX
WCC	WATER COOLED CONDENSER

GENERAL ABBREVIATIONS

A	AIR OR AMP (PER CONTEXT)
ACC	ACCESSORIES
AD	ACCESS DOOR
AFF	ABOVE FINISHED FLOOR
AFS	AIR FLOW SWITCH
AHRI	AIR CONDITIONING, HEATING, AND REFRIGERATION INSTITUTE
AI	ANALOG SIGNAL INPUT
AMB	AMBIENT
AO	ANALOG SIGNAL OUTPUT
AP	ACCESS PANEL
APD	AIR PRESSURE DROP
APLV	APPLICATION PART LOAD VALUE
APPROX	APPROXIMATE
ARCH	ARCHITECTURE/ARCHITECT
AUX	AUXILIARY
AV	AUTOMATIC VENT
AVG	AVERAGE
BDD	BACK DRAFT DAMPER
BFC	BELOW FINISHED CEILING
BFP	BACKFLOW PREVENTER
BHP	BRAKE HORSEPOWER
BI	BINARY SIGNAL INPUT
BMS	BUILDING MANAGEMENT SYSTEM
BO	BINARY SIGNAL OUTPUT
BOB	BOTTOM OF BEAM
BOD	BOTTOM OF DUCT
BOP	BOTTOM OF PIPE
BS	BEAM SPACE
BTU	BRITISH THERMAL UNIT
BTUH	BRITISH THERMAL UNITS PER HOUR
BWE	BAKED WHITE ENAMEL
CAP	CAPACITY
CAV	CONSTANT AIR VOLUME
CFH	CUBIC FEET PER HOUR
CFM	CUBIC FEET PER MINUTE
CI	CAST IRON
CLG	COOLING DUCT (COLD DUCT)
CO	CLEAN OUT
COMP	COMPRESSOR
CONC	CONCRETE
COND	CONDENSATE
CONN	CONNECTION
CORR	CORRIDOR
CV	CONTROL VALVE
D	DEPTH
DB	DRY BULB
DBA	A-WEIGHTED DECIBELS
DEFL	DEFLECTION
DEG	DEGREES
DEG F	DEGREES FAHRENHEIT
DES	DESIGN
DIA	DIAMETER
DIM	DIMENSION
DISCH	DISCHARGE
DIV	DIVISION
DN	DOWN
DP	DIFFERENTIAL PRESSURE SENSOR
DPS	DIFFERENTIAL PRESSURE SWITCH
DPT	DIFFERENTIAL PRESSURE TRANSMITTER
DTL	DETAIL
DWG(S)	DRAWING(S)
EA	EXHAUST AIR OR EACH (PER CONTEXT)
EAT	ENTERING AIR TEMPERATURE
EER	ENERGY EFFICIENT RATIO
EFF	EFFICIENCY
ELEC	ELECTRIC
ELEV	ELEVATION
EQ	EQUAL
ESP	EXTERNAL STATIC PRESSURE
EWB	ENTERING AIR WET BULB TEMPERATURE
EWT	ENTERING WATER TEMPERATURE
EXH	EXHAUST
EXIST, EX	EXISTING
EXT	EXTERNAL
F	FAHRENHEIT
F&T	FLOAT AND THERMOSTATIC
FC	FLEXIBLE CONNECTION
FD	FLOOR DRAIN
FDC	FIRE DEPARTMENT CONNECTION
FIN	FINISHED
FLR	FLOOR
FM	FLOW METER
FPF	FINS PER FOOT
FPM	FEET PER MINUTE
FS	FLOW SWITCH
FT	FEET
FT-HD	HEAD IN FEET
GA	GAUGE
GAL	GALLONS
GALV	GALVANIZED
GC	GENERAL CONTRACTOR
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
H	HEIGHT
HD	HEAD
HEV	HOSE END VALVE
HORIZ	HORIZONTAL
HP	HORSEPOWER
HR	HOUR
HTG	HEATING DUCT (HOT DECK)
HVAC	HEATING, VENTILATING & AIR CONDITIONING
HW	HOT WATER
HZ	HERTZ
IB	INVERTED BUCKET
IE	INVERT ELEVATION
IN	INCH/INCHES

GENERAL ABBREVIATIONS, CONTINUED

INDIC	INDICATOR
IPLV	INTEGRATED PART-LOAD VALUE
ISP	INTERNAL STATIC PRESSURE
JS	JOIST SPACE
KW	KILOWATTS
L	LENGTH
LAT	LEAVING AIR TEMPERATURE
LB(S)	POUNDS
LF	LINEAR FEET
LRA	LOCKED ROTOR AMPS
LS	LIGHT SPACE
LVL	LEVEL
LWT	LEAVING WATER TEMPERATURE
MAN	MANUAL
MANU	MANUFACTURER
MAX	MAXIMUM
MBH	THOUSAND BRITISH THERMAL UNITS PER HOUR
MCA	MINIMUM CIRCUIT AMPS
MCC	MOTOR CONTROL CENTER
MECH	MECHANICAL
MERV	MINIMUM EFFICIENCY REPORTING VALUE (ASHRAE 52.2)
MFR	MANUFACTURER
MIN	MINIMUM OR MINUTE (PER CONTEXT)
MTD	MOUNTED
MTL	METAL
MV	MANUAL VENT
NC	NORMALLY CLOSED OR NOISE CRITERIA (PER CONTEXT)
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN OR NUMBER (PER CONTEXT)
NOM	NOMINAL
NPLV	NON-STANDARD PART LOAD VALUE
NPSH	NET POSITIVE SUCTION HEAD
NTS	NOT TO SCALE
OA	OUTSIDE AIR
OBD	OPPOSED BLADE DAMPER
OC	ON CENTER
OD	OUTSIDE DIAMETER
OT	OIL TRAP
PA	PIPE ANCHOR
PBD	PARALLEL BLADE DAMPER
PD	PRESSURE DROP
PENT	PENTHOUSE
PH	PHASE
PHC	PREHEAT COIL
PLBG	PLUMBING
PNEU	PNEUMATIC
PPH	POUNDS PER HOUR
PRESS	PRESSURE
PRV	PRESSURE REGULATING VALVE
PSI	POUNDS PER SQUARE INCH
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSIG	POUNDS PER SQUARE INCH GAUGE
QTY	QUANTITY
RA	RETURN AIR
RAD	RADIATED
RD	ROOF DRAIN
REFR	REFRIGERANT
REQ	REQUIRED
RH	RELATIVE HUMIDITY
RLA	RUNNING LOAD AMPS
RM	ROOM
RND	ROUND
RPM	REVOLUTIONS PER MINUTE
SA	SUPPLY AIR
SAN	SANITARY
SEC'N	SECTION
SEER	SEASONAL ENERGY EFFICIENCY RATIO
SENS	SENSIBLE
SF	SQUARE FOOT
SH	SENSIBLE HEAT
SHT	SHEET
SND	SOUND
SOL	SOLENOID
SP	STATIC PRESSURE
SPD	STATIC PRESSURE DIFFERENTIAL
SPT	STATIC PRESSURE TRANSMITTER
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
STM	STEAM
T&P	TEMPERATURE AND PRESSURE
TC	TEMPERATURE CONTROL
TD	THERMODYNAMIC OR TEMPERATURE DIFFERENTIAL (PER CONTEXT)
TDH	TOTAL DYNAMIC HEAD
TEMP	TEMPERATURE
TOT	TOTAL
TPD	TOTAL PRESSURE DROP
TSP	TOTAL STATIC PRESSURE
TYP	TYPICAL
UC	UNDERCUT DOOR
UG	UNDERGROUND
UNO	UNLESS NOTED OTHERWISE
V	VOLTS
VAC	VACUUM
VD	VOLUME DAMPER (MANUAL)
VEL	VELOCITY
VERT	VERTICAL
VFD	VARIABLE FREQUENCY DRIVE
VOL	VOLUME
VTR	VENT THRU ROOF
W	WATT OR WIDTH (PER CONTEXT)
W/	WITH
W/O	WITHOUT
WB	WET BULB
WC	WATER COLUMN
WG	WATER GAUGE
WPD	WATER PRESSURE DIFFERENTIAL
WT	WEIGHT

GENERAL NOTES:

1. THESE PLANS ARE DIAGRAMMATIC IN NATURE. THE CONTRACTOR SHALL BE PREPARED TO MAKE SOME ALTERATIONS TO THE EXACT LOCATION OF DUCTWORK, PIPING AND EQUIPMENT FROM THE LOCATION INDICATED ON THESE DRAWINGS TO FIT ACTUAL JOB CONDITIONS.
2. ALL ELBOWS, FITTINGS, ETC., IN PIPING AND DUCTWORK REQUIRED TO CLEAR ALL JOB OBSTRUCTIONS ARE NOT NECESSARILY INDICATED. ALL NECESSARY TRANSITIONS, FITTINGS AND OFFSETS ARE REQUIRED WHETHER SHOWN OR NOT.
3. BECAUSE OF THE LIMITED SPACE AVAILABLE TO INSTALL ALL OF THE MECHANICAL WORK, COORDINATION BETWEEN THE VARIOUS TRADES IS OF THE UTMOST IMPORTANCE. SEE SPECIFICATION 230100 FOR REQUIRED COORDINATION DRAWINGS.
4. THE CONTRACTOR SHALL COORDINATE STAGING AND SCHEDULING WITH THE OWNER'S REPRESENTATIVE.
5. EXISTING CONDITIONS ARE BASED ON INFORMATION OBTAINED FROM PREVIOUS CONSTRUCTION DOCUMENTS AND INFORMAL FIELD OBSERVATION AND SHALL NOT BE CONSTITUTED AS "AS BUILT." THE CONTRACTOR SHALL FIELD-VERIFY EXISTING CONDITIONS BEFORE THE ONSET OF CONSTRUCTION.
6. DEMOLISH ALL PIPING, DUCTWORK EQUIPMENT, ETC., SHOWN TO BE DEMOLISHED BACK TO THE LIMITS OF DEMOLITION SHOWN ON THE DRAWINGS, INCLUDING ALL ACCESSORIES, HANGERS, AND SUPPORTS.
7. WHERE CONTRACTOR IS REQUIRED TO CONCEAL NEW WORK, REMOVE OR MODIFY EXISTING CONSTRUCTION OR EQUIPMENT, OR ATTACH TO EXISTING CONSTRUCTION, THE CONTRACTOR SHALL REPAIR OR REPLACE EXISTING CONSTRUCTION AND MATERIALS TO MATCH CONDITIONS AT THE ONSET OF CONSTRUCTION. IT IS THE CONTRACTOR'S RESPONSIBILITY TO REMOVE AND REPLACE EXISTING CEILINGS AND WALLS REQUIRED FOR INSTALLATION OF MECHANICAL SYSTEMS.
8. THE OWNER SHALL MAINTAIN ALL SALVAGE RIGHTS OF EQUIPMENT AND MATERIALS REMOVED. ALL EQUIPMENT AND MATERIALS NOT CLAIMED BY THE OWNER SHALL BE REMOVED FROM THE PREMISES BY THIS CONTRACTOR.
9. CONTRACTOR SHALL PROVIDE SEISMIC BRACING AND MOUNTING OF EQUIPMENT AND MATERIALS IN COMPLIANCE WITH ALL LOCAL CODE REQUIREMENTS AND THE REQUIREMENTS OF SPECIFICATION SECTION SEISMIC PROTECTION.
10. ALL WORK SHALL BE INSTALLED PER THE REFERENCE DETAILS, REGARDLESS OF WHETHER OR NOT THE DETAILS ARE CALLED OUT ON THE PLANS. WHERE DEVICES ON PLAN ALTER FROM DEVICES SHOWN ON THE DETAILS, THE DETAILS SHALL GOVERN UNLESS EXPLICITLY NOTED OTHERWISE ON PLANS OR IN THE SPECIFICATIONS. SEE SHEET(S) M501.
11. PROVIDE VENTS AT ALL HYDRONIC PIPING HIGH POINTS, AND DRAINS AT ALL PIPING LOW POINTS, REGARDLESS OF WHETHER SHOWN OR NOT.
12. THE CONTRACTOR SHALL VERIFY ALL REFRIGERANT PIPE SIZING AND ROUTINGS WITH THE EQUIPMENT MANUFACTURER. THE CONTRACTOR SHALL ALSO PROVIDE ALL REQUIRED REFRIGERANT ACCESSORIES AS RECOMMENDED BY THE EQUIPMENT MANUFACTURER FOR COMPLETE AND FULLY FUNCTIONAL SYSTEMS.
13. DO NOT SCALE THE LOCATION OF HVAC CEILING ELEMENTS, SUCH AS AIR INLETS AND OUTLETS, FROM THE ARCHITECTURAL DRAWINGS. THE MECHANICAL DRAWINGS GOVERN LOCATION, TYPE, AND SIZE OF DIFFUSER. WHERE THERE IS A CONFLICT BETWEEN DISCIPLINES, SLIGHT MODIFICATIONS TO THE DRG LOCATION ARE PERMITTED IN AREAS WITH NON-CRITICAL AIRFLOW AND PRESSURIZATION REQUIREMENTS.
14. ALL DUCT CONSTRUCTION SHALL COMPLY WITH "SMACNA HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," MOST CURRENT EDITIO, EXCEPT WHERE MORE RESTRICTIVE REQUIREMENTS ARE SPECIFIED. ANY PLAN REFERENCES TO "SMACNA FIGURE —" REFERS TO THIS STANDARD. SEE SPECIFICATIONS FOR SCHEDULE OF DUCT PRESSURE CLASS AND SEAL CLASS.
15. INTERNAL DUCT LINER IS NOT PERMITTED.
16. ALL EXISTING TEMPERATURE CONTROLS THAT ARE BEING DEMOLISHED OR DISABLED AS WORK OF THIS CONTRACT SHALL BE COMPLETELY REMOVED FROM BUILDING. WHERE PARTIAL DEMOLITION OF PNEUMATIC CONTROL SYSTEMS TAKES PLACE, THE CONTRACTOR SHALL SODER AND CAP THE REMAINING PNEUMATIC TUBE LINE AND ENSURE A LEAK FREE SEAL.
17. THE CONTRACTOR SHALL CONNECT THE NEW HVAC SYSTEM TO THE OWNER'S EXISTING UMHC MPC JCI METASYS BUILDING AUTOMATION SYSTEM. REFER TO THE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
18. COORDINATION DRAWINGS SHALL BE PROVIDED PER THE SPECIFICATIONS.
19. IT SHOULD BE NOTED THAT SOME SYSTEMS (I.E. GENERAL AND ISOLATION EXHAUST) ARE REQUIRED TO BE BALANCED MORE THAN ONCE TO ASSURE DESIGN AIRFLOWS ARE PROVIDED.
20. NEW AND EXISTING EQUIPMENT AND THE ASSOCIATED SERVICIBLE COMPONENTS SHALL HAVE A CLEAR MAINTENANCE AREA THAT SHALL BE MINIMUM 24" ON ALL SERVICIBLE SIDES OR THE MANUFACTURERS RECOMMENDED SERVICE CLEARANCE, WHICHEVER IS GREATER. NO NEW SYSTEMS, MECHANICAL OR OTHERWISE, SHALL INFRINGE UPON THE SERVICE AREAS OF NEW OR EXISTING MECHANICAL EQUIPMENT, AND SHALL BE INSTALLED SUCH THAT THIS CLEAR AREA IS MAINTAINED VERTICALLY FROM THE CEILING PLENUM ACCESS LOCATION TO THE EQUIPMENT. NO SYSTEMS OR DEVICES SHALL BE INSTALLED WITHIN THIS CLEARANCE AREA WITHOUT EXPLICIT APPROVAL FROM THE OWNERS REPRESENTATIVE. COORDINATE WORK WITH ALL OTHER TRADES THROUGHOUT THE DURATION OF CONSTRUCTION.

bcDESIGN GROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number A-2011033299

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383
Missouri Certificate of Authority #000148

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111
Missouri Certificate of Authority #000442

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD, BLDG. 1,
COLUMBIA, MO 65203
573.447.0292
Missouri Certificate of Authority #2005151001

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

STATE OF MISSOURI
JOHN ERNEST SOMMERS
NUMBER PE-2015028399
PROFESSIONAL ENGINEER
03/12/2021

John E Sommers, P.E.
PE-2015028399

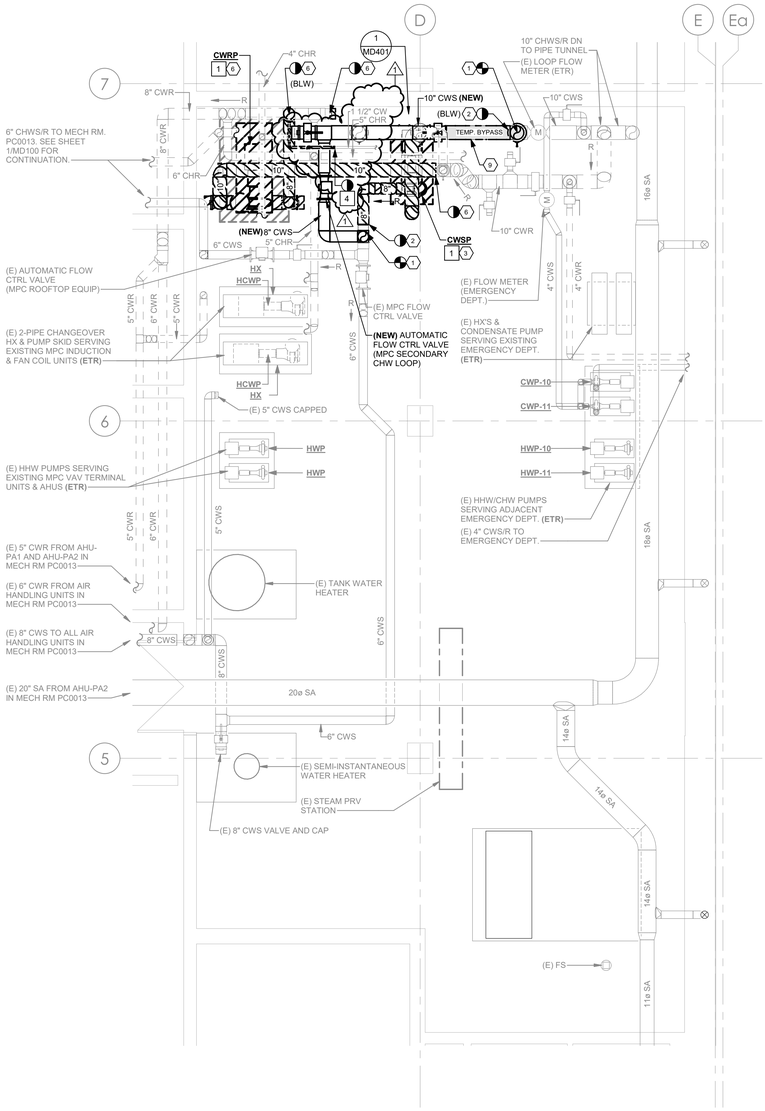
Issue Date: 02.25.2021

	Issue:	Date:
1	ADDENDUM 1	03.12.2021

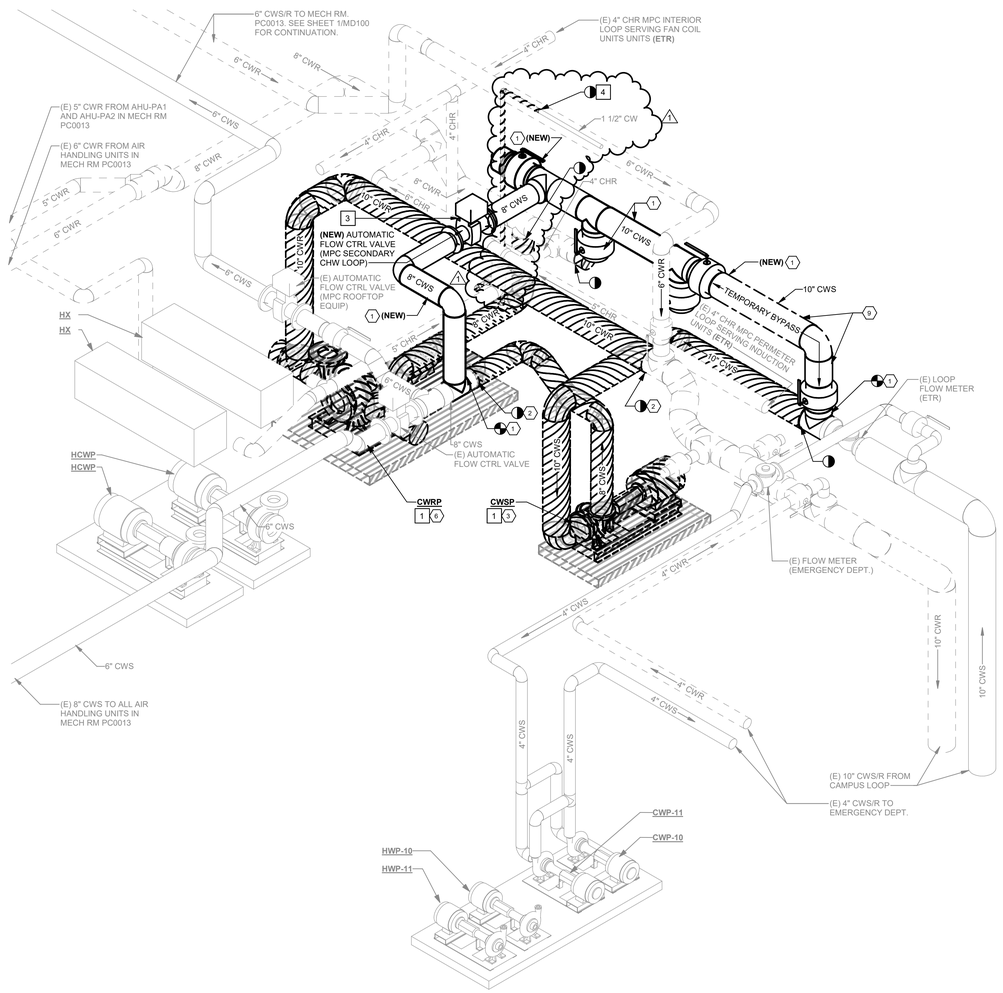
Drawn by: JAD

bcdg Project #: 12275.42
MU Project #: CP210251

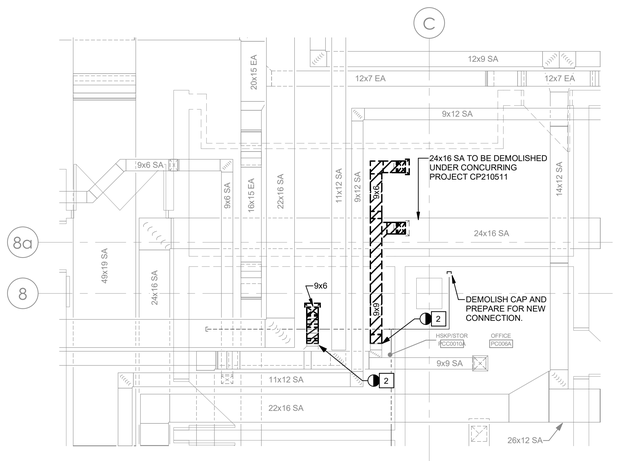
M000
MECHANICAL SYMBOLS & ABBREVIATIONS



2 ENLARGED MECHANICAL DEMOLITION PLAN - MECHANICAL ROOM PC0016
1/4" = 1'-0"



1 CHILLED WATER DEMOLITION ISOMETRIC DIAGRAM - MECHANICAL ROOM PC0016



3 ENLARGED MECHANICAL DEMOLITION PLAN - BASEMENT ELECTRICAL ROOM
1/4" = 1'-0"

GENERAL SHEET NOTES

A. THE AREA OF WORK SHOWN IS ASSOCIATED WITH AN OPERATING FACILITY THAT MUST REMAIN IN SERVICE 24/7. ALL PRIMARY BUILDING SYSTEM EQUIPMENT SHUTDOWNS SHALL OCCUR AFTER HOURS OR ON WEEKENDS UNLESS APPROVED OTHERWISE BY THE OWNER. COORDINATE ALL SHUTDOWNS WITH THE OWNER'S REPRESENTATIVE.

B. THIS PROJECT IS ONE OF SEVERAL IN SEQUENCE WITH SCOPE OVERLAP WHERE CONSTRUCTION AND PHASING PROCEDURES AS OUTLINED IN THIS PROJECT MAY REQUIRE COORDINATION WITH OTHER PROJECTS. COORDINATE WORK SCHEDULE WITH THE OWNER'S REPRESENTATIVE.

C. NO MECHANICAL PIPING OR HVAC DUCT (EXCEPT WHERE USED FOR STAIRWELL PRESSURIZATION PURPOSES) SHALL PENETRATE THROUGH FIRE RESISTANCE RATED EXIT ENCLOSURES (STAIRWELLS AND EXIT PASSAGEWAYS).

D. VERIFY EXISTING CONDITIONS BEFORE THE START OF WORK. COORDINATE ALL WORK WITH OTHER TRADES.

E. CONTRACTOR SHALL BE AWARE THAT TAR-CONTAINING ASBESTOS MATERIAL WAS DETERMINED TO EXIST AT THE INDUCTION UNIT CHILLED/HOT WATER (CHR / CHS) PIPING. REFER TO THE FEB. 13, 2012 PRE-RENOVATION HAZARDOUS BUILDING MATERIALS SURVEY CONDUCTED BY TERRACON (PROVIDED BY OWNER'S REPRESENTATIVE).

KEYED NOTES

1. DEMOLISH CHILLED WATER SUPPLY AND RETURN PUMPS AND ASSOCIATED PIPING, CONTROLS, AND ACCESSORIES IN ACCORDANCE WITH PHASING NOTES ON THIS SHEET. SCHEDULE WORK TO MINIMIZE LENGTH OF SHUTDOWN(S).
2. DEMOLISH AHU-S6 SUPPLY AIR BRANCH DUCTWORK AS SHOWN AND PROVIDE INSULATED CAP & SEAL. VERIFY DUCTWORK IS TERMINATED OUTSIDE OF THE NEW ELECTRICAL ROOM BOUNDARY AS SHOWN ON SHEET 3/M401.
3. LOCATE NEW CHILLED WATER FLOW CONTROL VALVE SUCH THAT IT IS EASILY ACCESSIBLE FOR SERVICE AND MAINTENANCE NO OBSTRUCTIONS SHALL BE PRESENT THAT WOULD OTHERWISE AFFECT SERVICEABILITY.
4. DEMOLISH DOMESTIC COLD WATER MAKEUP PIPING AS REQUIRED TO INSTALL NEW PIPING SYSTEMS AS SHOWN AND PROVIDED INSULATED CAP AND SEAL.

ⓟ PHASING NOTES

DEMOLITION AND NEW CONSTRUCTION OF THE CHILLED WATER SYSTEM AND ASSOCIATED COMPONENTS AND ACCESSORIES SHALL BE COMPLETED IN THE ORDER INDICATED BELOW. SEE CONTINUATION OF PHASING ON SHEET M401.

1. INSTALL NEW 10" CHILLED WATER SUPPLY HEADER, TEMPORARY BYPASS, AUTOMATIC FLOW CONTROL VALVE, AND ALL ASSOCIATED TAPS AND ACCESSORIES AS SHOWN PRIOR TO THE START OF DEMOLITION. INSTALLATION SHALL TAKE PLACE DURING OFF-PEAK MONTHS WHEN TOTAL CHILLED WATER DEMAND IS MINIMAL.
2. DEMOLISH CHILLED WATER SUPPLY PIPING AS REQUIRED FOR ISOLATION OF THE NEW BYPASS AT THE DEMARCATION POINT SHOWN AND PROVIDE VALVE AND CAP FOR FUTURE CONNECTION.
3. DEMOLISH CHILLED WATER SUPPLY PUMP AND REMAINING PIPING AND ACCESSORIES AS SHOWN. COORDINATE DEMOLITION OF THE ASSOCIATED CONCRETE PAD AND FLOOR REPAIR/SEAL WITH THE ARCHITECTURAL DRAWINGS. CHILLED WATER RETURN PUMP SHALL REMAIN TO SERVE THE MPC CHILLED WATER DEMAND UNTIL THE NEW CHILLED WATER SUPPLY PUMPS ARE INSTALLED.
4. SEE SHEET M401.
5. SEE SHEET M401.
6. DEMOLISH CHILLED WATER RETURN PUMP AND ASSOCIATED PIPING, ACCESSORIES, AND CONTROLS TO THE DEMARCATION POINT(S) SHOWN. COORDINATE DEMOLITION OF THE ASSOCIATED CONCRETE PAD AND FLOOR REPAIR/SEAL WITH THE ARCHITECTURAL DRAWINGS.
7. SEE SHEET M401.
8. DEMOLISH CHILLED WATER BYPASS IN MECHANICAL ROOM PC0013. SEE SHEET MD100 FOR RELATED INFORMATION..
9. DEMOLISH TEMPORARY 10" BYPASS PROVIDED FOR THE COMPLETION OF THIS WORK AND PROVIDE INSULATED CAP AND SEAL AT VALVES.
10. SEE SHEET M401.

bcDESIGN GROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number A-2011033299

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383
Missouri Certificate of Authority #000148

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111
Missouri Certificate of Authority #000442

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD. BLDG. 1, COLUMBIA, MO 65203
573.447.0292
Missouri Certificate of Authority #2005151001

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

STATE OF MISSOURI
JOHN ERNEST SOMMERS
NUMBER PE-2015028399
PROFESSIONAL ENGINEER
03/12/2021

John E Sommers, P.E.
PE-2015028399

Issue Date: 02.25.2021

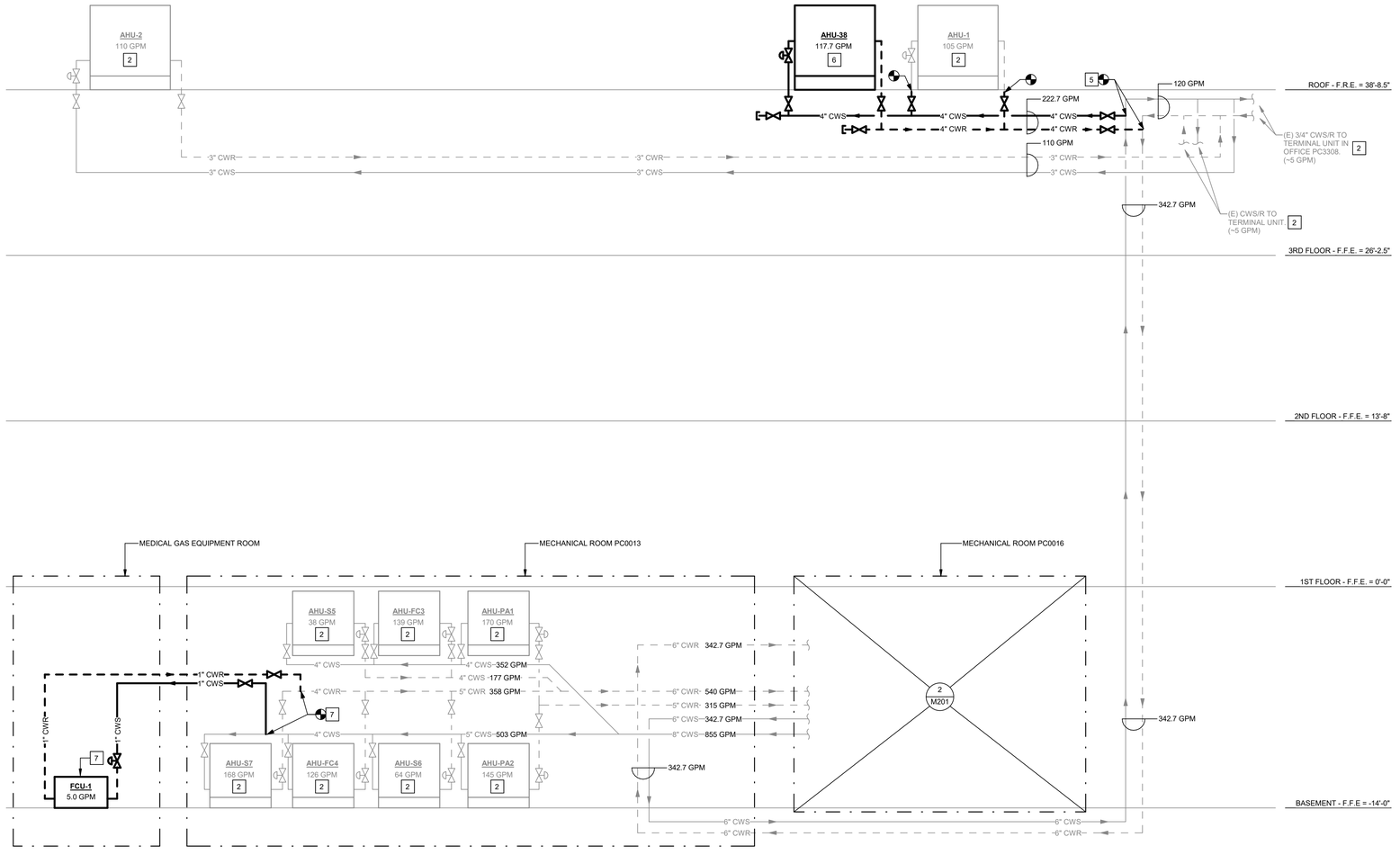
⚠	Issue:	Date:
1	ADDENDUM 1	03.12.2021

Drawn by: JAD

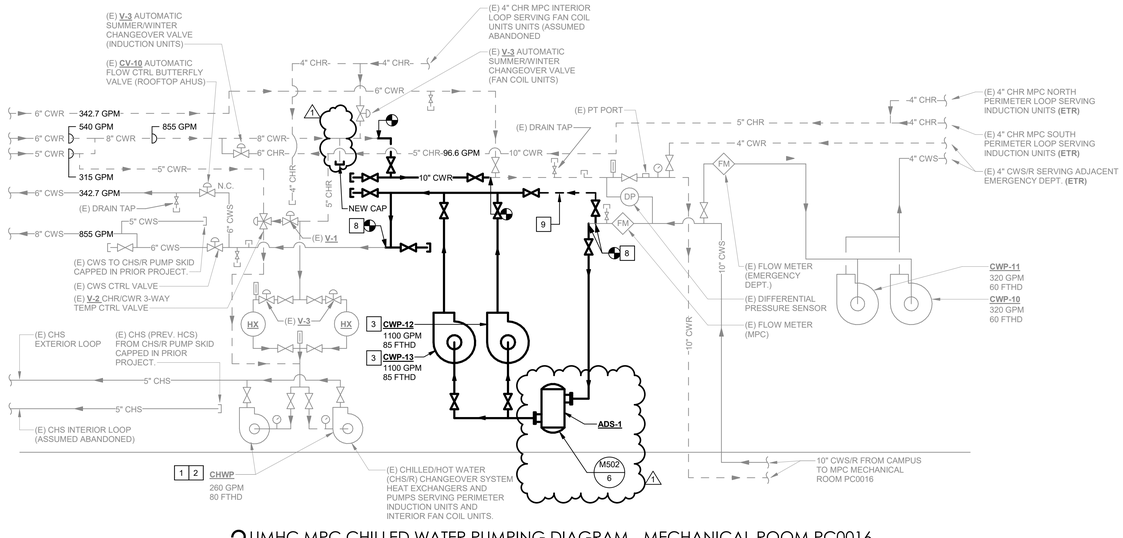
bcdg Project #: 12275.42
MU Project #: CP210251

MD401

MECHANICAL ENLARGED DEMO PLANS - BASEMENT



1 UMHC MPC CHILLED WATER FLOW DIAGRAM
NTS



2 UMHC MPC CHILLED WATER PUMPING DIAGRAM - MECHANICAL ROOM PC0016
NTS

GENERAL SHEET NOTES

A. THE AREA OF WORK SHOWN IS ASSOCIATED WITH AN OPERATING FACILITY THAT MUST REMAIN IN SERVICE 24/7. ALL PRIMARY BUILDING SYSTEM EQUIPMENT SHUTDOWNS SHALL OCCUR AFTER HOURS OR ON WEEKENDS UNLESS APPROVED OTHERWISE BY THE OWNER. COORDINATE ALL SHUTDOWNS WITH THE OWNER'S REPRESENTATIVE.

B. THIS PROJECT IS ONE OF SEVERAL IN SEQUENCE WITH SCOPE OVERLAP WHERE CONSTRUCTION AND PHASING PROCEDURES AS OUTLINED IN THIS PROJECT MAY REQUIRE COORDINATION WITH OTHER PROJECTS. COORDINATE WORK SCHEDULE WITH THE OWNER'S REPRESENTATIVE.

C. NO MECHANICAL PIPING OR HVAC DUCT (EXCEPT WHERE USED FOR STAIRWELL PRESSURIZATION PURPOSES) SHALL PENETRATE THROUGH FIRE RESISTANCE RATED EXIT ENCLOSURES (STAIRWELLS AND EXIT PASSAGEWAYS).

D. VERIFY EXISTING CONDITIONS BEFORE THE START OF WORK. COORDINATE ALL WORK WITH OTHER TRADES.

E. CONTRACTOR SHALL BE AWARE THAT TAR-CONTAINING ASBESTOS MATERIAL WAS DETERMINED TO EXIST AT THE INDUCTION UNIT CHILLED/HOT WATER (CHS / CHR) PIPING. REFER TO THE FEB. 13, 2012 PRE-RENOVATION HAZARDOUS BUILDING MATERIALS SURVEY CONDUCTED BY TERRACON (PROVIDED BY OWNER'S REPRESENTATIVE).

KEYED NOTES

1. EXISTING CHILLED/HOT WATER (CHS/CHR) PIPING, ACCESSORIES, EQUIPMENT, AND THE ASSOCIATED CONFIGURATION SHOWN SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO THE START OF WORK.
2. EXISTING EQUIPMENT PERFORMANCE DATA SHOWN REPRESENTS EXISTING NAMEPLATE AND SCHEDULED DATA AND DOES NOT REFLECT CURRENT OPERATING CONDITIONS UNLESS OTHERWISE NOTED. THE EXISTING EQUIPMENT SHALL BE REBALANCED TO THE EXISTING CONDITIONS AS DETERMINED DURING PRE-TEST.
3. PROVIDE NEW CHILLED WATER SUPPLY PUMPS, CWP-12 AND CWP-13 AS SHOWN AND BALANCE IN COMPLIANCE WITH THE SPECIFICATIONS TO MEET THE CHILLED WATER DEMAND AS NOTED. PROVIDE IN ACCORDANCE WITH PHASING INFORMATION ON SHEETS MD401 AND M401
4. KEYNOTE 4 NOT USED.
5. PROVIDE NEW 4" CWS/R BRANCH PIPING OFF 6" RISER AND ROUTE TO AHU-38. RECONNECT AHU-1 CWS/R BRANCH PIPING AND PROVIDE NEW SHUTOFF VALVES. SEE SHEET M103 FOR RELATED INFORMATION. COORDINATE RISER SHUTDOWN WITH CHILLED WATER PHASING INFORMATION ON SHEET M401.
6. PROVIDE NEW AIR HANDLING UNIT ON ROOF AND ROUTE CWS/R PIPING AS SHOWN. SEE SHEETS M103 AND M104 FOR RELATED INFORMATION.
7. PROVIDE NEW FAN COIL UNIT, FCU-1, AND ASSOCIATED CWS/R BRANCH PIPING FROM MECHANICAL ROOM PC0013 AS SHOWN. SEE SHEET M100 FOR RELATED INFORMATION.
8. PROVIDE NEW CHILLED WATER SUPPLY AND RETURN PIPING HEADERS IN ACCORDANCE WITH PHASING INFORMATION ON SHEETS MD401 AND M401.
9. PROVIDE TEMPORARY CHILLED WATER BYPASS IN ACCORDANCE WITH PHASING INFORMATION SHOWN ON SHEETS MD401 AND M401. THE TEMPORARY BYPASS WILL ALLOW THE EXISTING MPC CHILLED WATER RETURN PUMP TO PROVIDE CHILLED WATER TO MPC EQUIPMENT WHILE THE NEW SUPPLY PUMPS ARE INSTALLED.

bcDESIGNGROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number A-2011033299

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383
Missouri Certificate of Authority #000148

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111
Missouri Certificate of Authority #000442

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD, BLDG. 1,
COLUMBIA, MO 65203
573.447.0292
Missouri Certificate of Authority #2000151301

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

STATE OF MISSOURI
JOHN ERNEST SOMMERS
NUMBER PE-2015028399
03/12/2021
PROFESSIONAL ENGINEER

John E Sommers, P.E.
PE-2015028399

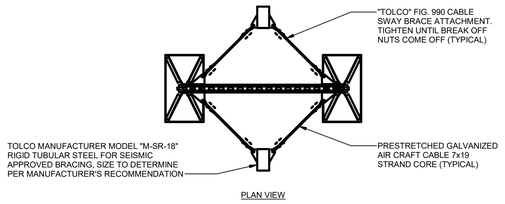
Issue Date: 02.25.2021

⚠	Issue:	Date:
1	ADDENDUM 1	03.12.2021

Drawn by: JAD

bcdg Project #: 12275.42
MU Project #: CP210251

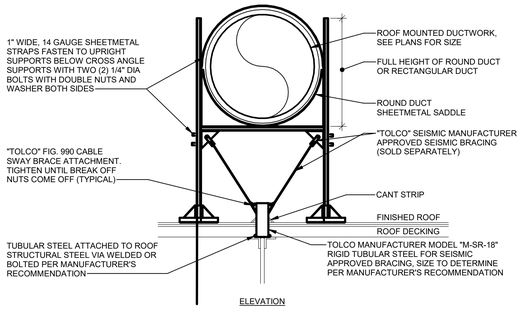
M201
MECHANICAL FLOW DIAGRAMS - MPC CHILLED WATER SYSTEM
BID SET - ADDENDUM #1



PLAN VIEW

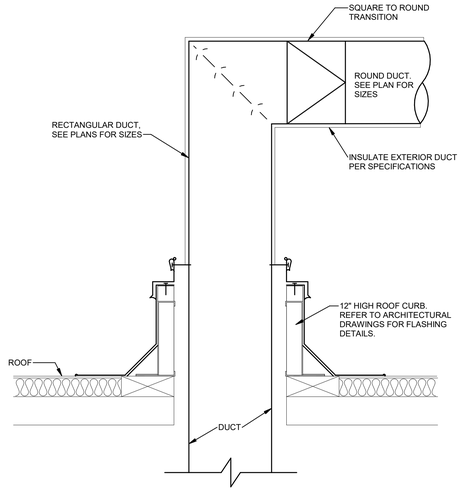
NOTES:

1. ROOF DUCT SUPPORT BASIS OF DESIGN IS MIRO INDUCTRIES WITH TOLCO MANUFACTURER FOR APPROVED SEISMIC BRACING.
2. MANUFACTURER'S RECOMMENDED SPACING IS NOT TO EXCEED 8'-0" FEET.
3. BASE IS 9x15, HAS A BAR WIDTH WHICH ALLOWS AT LEAST 12" BETWEEN THE STRUT ASSEMBLY, AND CAN ADJUST IN HEIGHT TO SUPPORT DUCT FROM A LOW OF 4" TO A HIGH OF 36" IN ELEVATION ABOVE THE ROOF MEMBRANE. THE STRUT IS 1 5/8" x 13/16" OR 1 5/8" SQUARE AND IS CONSTRUCTED AT VARIOUS HEIGHTS TO GIVE DUCT CLEARANCE ADJUSTMENT ABOVE THE ROOF PLUS OR MINUS.
4. SEE PLANS FOR BOTTOM OF DUCT ELEVATION.

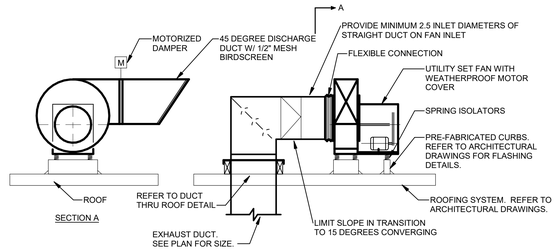


ELEVATION

3 ROOF DUCT SEISMIC SUPPORT
NTS

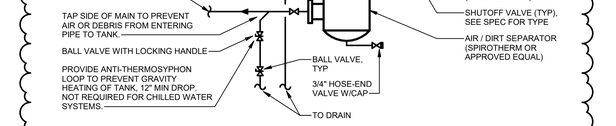


2 DUCT THROUGH ROOF DETAIL
NTS

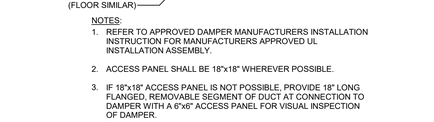


SECTION A

1 ROOF MOUNTED UTILITY SET EXHAUST FAN DETAIL
NTS



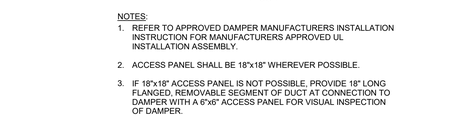
6 AIR-DIRT SEPARATOR PIPING DETAIL
NTS



NOTES:

1. REFER TO APPROVED DAMPER MANUFACTURERS INSTALLATION INSTRUCTION FOR MANUFACTURERS APPROVED UL INSTALLATION ASSEMBLY.
2. ACCESS PANEL SHALL BE 18"x18" WHEREVER POSSIBLE.
3. IF 18"x18" ACCESS PANEL IS NOT POSSIBLE, PROVIDE 18" LONG FLANGED, REMOVABLE SEGMENT OF DUCT AT CONNECTION TO DAMPER WITH A 6"x6" ACCESS PANEL FOR VISUAL INSPECTION OF DAMPER.

5 SMOKE DAMPER INSTALLATION DETAIL
NTS

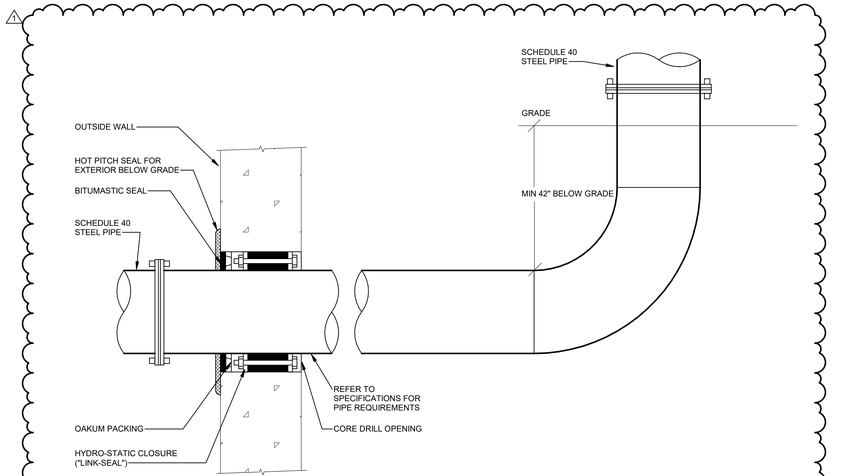


NOTE:
AIR FLOW CAN BE EITHER DIRECTION

NOTES:

1. REFER TO APPROVED DAMPER MANUFACTURERS INSTALLATION INSTRUCTION FOR MANUFACTURERS APPROVED UL INSTALLATION ASSEMBLY.
2. ACCESS PANEL SHALL BE 18"x18" WHEREVER POSSIBLE.
3. IF 18"x18" ACCESS PANEL IS NOT POSSIBLE, PROVIDE 18" LONG FLANGED, REMOVABLE SEGMENT OF DUCT AT CONNECTION TO DAMPER WITH A 6"x6" ACCESS PANEL FOR VISUAL INSPECTION OF DAMPER.

4 FIRE DAMPER INSTALLATION DETAIL
NTS



7 PIPE THROUGH EXTERIOR WALL
12" = 1'-0"

bcDESIGNGROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number A-2011033799

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383
Missouri Certificate of Authority #000148

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111
Missouri Certificate of Authority #000442

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD. BLDG. 1,
COLUMBIA, MO 65203
573.447.0292
Missouri Certificate of Authority #2005151001

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

STATE OF MISSOURI
JOHN ERNEST SOMMERS
NUMBER PE-2015028399
PROFESSIONAL ENGINEER
03/12/2021

John E Sommers, P.E.
PE-2015028399

Issue Date: 02.25.2021

	Issue:	Date:
1	ADDENDUM 1	03.12.2021

Drawn by: JAD

bcdg Project #: 12275.42
MU Project #: CP210251

M502
MECHANICAL DETAILS

AIR HANDLING UNIT SCHEDULE (HOT WATER/ CHILLED WATER)

AHU MARK	LOCATION	SERVES	MANUFACTURER	MODEL	LOCATION	SUPPLY FAN											RETURN / EXHAUST FAN									
						DESIGN AIRFLOW		ESP	TSP	MULTI-FAN ARRAY		MOTOR DATA					DESIGN			MULTI-FAN ARRAY		MOTOR DATA				
						SUPPLY CFM	MIN OSA CFM	IN	IN	FANS	VFDS	HP/ FAN	TOTAL HP	FAN BHP	FAN RPM	DRIVE TYPE	AIRFLOW CFM	ESP IN	TSP IN	FANS	VFDS	HP/ FAN	TOTAL HP	TOTAL BHP	RPM	DRIVE TYPE
AHU-38	ROOF	LEVEL 1 ADULT AU/ED EXPANSION/OBSV. UNIT	TRANE	TCFS	ROOF	18,000	4,060	2.10	6.23	6	6	7.50	45.00	26.67	1800	DIRECT	16,000	1.75	2.36	4	4	5.00	20.00	9.54	2631	DIRECT

AIR HANDLING UNIT SCHEDULE (HOT WATER/ CHILLED WATER) CONT…

COOLING COIL														PREHEAT COIL												FILTERS						PHYSICAL DATA				ELECTRICAL			NOTES
CC ENTERING AIR TEMP.		CC LEAVING AIR TEMP.		CC CAPACITY		CC FLUID				COIL	MAX. VEL	MAX FINS	MAX ROWS	HC AIR CONDITIONS		DESIGN AIRFLOW	HEATING CAPACITY	HC FLUID				COIL	MAX APD	MAX VEL	MAX FINS	MAX ROWS	PRE-FILTER		AFTER FILTER				MAX. H	MAX. W	MAX. L	MAX. WEIGHT	DISC. TYPE	STARTER TYPE	V/PH	
EDB F	EWB F	LDB F	LWB F	TOTAL MBH	SENS. MBH	ENT. EWT F	LVG. LWT F	FLOW GPM	WPD FT	APD IN	FPM	FPI	ROWS	EDB F	LDB F	CFM	MBH	ENT. EWT F	LVG. LWT F	FLOW GPM	WPD FT	APD IN	FPM	FPI	ROWS	MERV	IN	MERV	IN	MERV	IN	IN	IN	IN	LBS	TYPE	TYPE		
79.6	69.3	55.0	54.6	823.7	472.6	46	60	117.7	10.8	0.57	450	10	6	40.0	60.0	11880	256.6	180.0	150.0	17.1	0.8	0.2	500	10	6	7.00	2.00	11.00	2.00	14.00	6.00	7'-6"	14'-0"	37'-0"	25400	VFD	VFD	208/3	1-11

NOTES:
1 SELECT SUPPLY AND RETURN FANS FOR 100% AIRFLOW WITH ONE MOTOR OR VFD IN FAILURE MODE. PROVIDE AUTOMATIC DISCHARGE DAMPER ON EACH FAN DISCHARGE. MANUAL BLANK OFF PLATES ARE NOT ACCEPTABLE.
2 THE DIVISION 26 CONTRACTOR SHALL PROVIDE ONE VFD PER FAN FOR BOTH SUPPLY AND RETURN FAN ARRAYS.
3 PROVIDE UNIT WITH COMPONENTS AS SHOWN IN DETAIL 1/M601 AND IN ACCORDANCE WITH THE SPECIFICATIONS. AIR HANDLING UNIT ROOF CURB HEIGHT SHALL ACCOMODATE THE REQUIREMENTS INDICATED FOR THE CONDENSATE TRAP IN DETAIL 11/M501 BUT SHALL NOT BE LESS THAN 10 INCHES.
4 MANUFACTURER TO PROVIDE THERMOSTATICALLY CONTROLLED HYDRONIC UNIT HEATER IN WALK-IN SERVICE VESTIBULE.
5 MANUFACTURER TO PROVIDE LED LIGHTING AND INTERIOR RECEPTACLES FOR EACH ACCESSIBLE UNIT SECTION SEPARATELY POWERED FROM UNIT POWER. COORDINATE WITH DIVISION 26.
6 MANUFACTURER TO PROVIDE EXTERIOR RECEPTACLES FOR UNIT MAINTENANCE
7 COIL AND HUMIDIFIER SECTION ACCESS DOORS SHALL BE PROVIDED WITH VIEWING PANEL. MINIMUM ACCESS PANEL WIDTH IS 24 INCHES.
8 MANUFACTURER TO PROVIDE ENCAPSULATED UV LIGHTED WITH THE COOLING COIL SECTION. TITANIUM DIOXIDE DISINFECTANT IS NOT PERMITTED.
9 FILTERS: PROVIDE DIRTY FILTER ALLOWANCE IN FAN SELECTION OF 2X INITIAL AIR PRESSURE DROP.
10 PROVIDE INVERTER BALANCE WITH SHAFT GROUND RING.
11 SCHEDULED UNIT HEIGHT IS THE MAXIMUM HEIGHT PERMITTED OF THE UNIT NOT INCLUDING THE ROOF CURB HEIGHT.

HUMIDIFIER SCHEDULE (STEAM)

AHU MARK	LOCATION	SERVICE	MANUFACTURERS	MODEL	TYPE	AIRFLOW (CFM)	SUPPLY AIR COND. (DB/RH)	CAPACITY (LBS/HR)	STEAM PRESS. (PSIG)	HUMID. SIZING COND. (DB/RH)	ROOM COND. (DB/RH)	AMBIENT COND. (DB/RH)	MAX. ABSORPTION DISTANCE (IN.)	MAX. AIR PRESS. DROP (IN. W.C.)	NOTES
AHU-38	ROOF	LEVEL 1 ADULT AU / ED EXPANSION / OBSV. UNIT	DRISTEEM	ULTRA-SORB	DIRECT INJECTION	14,000	55°F / 50.9%	100.00	15.00	55 / 18.2	75°F / 30%	5.5°F / 58%	18.0	0.20	1-4

NOTES:
1 AIR HANDLING UNIT DISPERSION GRID TO BE PROVIDED WITH THE AHU BY THE MANUFACTURER.
2 PROVIDE ELECTRONIC OPERATOR
3 PROVIDE WITH Y-TYPE STRAINER AND INVERTED BUCKET STEAM TRAP SIZED AT A SAFETY FACTOR OF 3:1..
4 PROVIDE ELECTRIC TEMPERATURE SWITCH FOR MANIFOLD WARMUP.
5 THE MANUFACTURER MUST PROVIDE PUBLISHED DATA GUARANTEEING THE REQUIRED NON-WETTING DISTANCE OF THE HUMIDIFIER.

PUMP SCHEDULE

MARK	LOCATION	SERVICE	MANUFACTURERS	MODEL	CONN. DIA IN	TYPE	MOUNTING	MAX. FLOW/HEAD		MOTOR			DIMENSIONS				ELECTRICAL			NOTES
								GPM	FTHD	MIN. HP	BHP	SPEED RPM	L IN	W IN	H IN	WEIGHT LBS	DISC. TYPE	STARTER TYPE	V/PH	
(E) CHP-1	MECHANICAL ROOM PC0016	UMHC CHILLED/HOT WATER CHANGEOVER SYSTEM	STERLING	F1-1025A	-	END SUCTION	BASE	260	80	-	-	1773	-	-	-	-	-	-	208/3	1, ETR
(E) CHP-2	MECHANICAL ROOM PC0016	UMHC CHILLED/HOT WATER CHANGEOVER SYSTEM	STERLING	F1-1025A	-	END SUCTION	BASE	260	80	-	-	1773	-	-	-	-	-	-	208/3	1, ETR
(E) CWP-10	MECHANICAL ROOM PC0016	UMHC EMERGENCY DEPT. TERTIARY CHW LOOP	TACO	FI3009E4FAJ1L0C000000	-	END SUCTION	BASE	320	60	7.5	-	1750	-	-	-	-	VFD	VFD	208/3	1, ETR
(E) CWP-11	MECHANICAL ROOM PC0016	UMHC EMERGENCY DEPT. TERTIARY CHW LOOP	TACO	FI3009E4FAJ1L0C000001	-	END SUCTION	BASE	320	60	7.5	-	1750	-	-	-	-	VFD	VFD	208/3	1, ETR
(E) HWP-1	MECHANICAL ROOM PC0016	UMHC MPC PRIMARY HW SYSTEM	BELL & GOSSETT	-	-	END SUCTION	BASE	-	-	-	-	-	-	-	-	-	-	-	208/3	1, ETR
(E) HWP-2	MECHANICAL ROOM PC0016	UMHC MPC PRIMARY HW SYSTEM	BELL & GOSSETT	-	-	END SUCTION	BASE	-	-	-	-	-	-	-	-	-	-	-	208/3	1, ETR
(E) HWP-10	MECHANICAL ROOM PC0016	UMHC EMERGENCY DEPT. PRIMARY HW SYSTEM	TACO	FI2509E2FAH1L0CB1971D	-	END SUCTION	BASE	225	60	-	-	-	-	-	-	-	VFD	VFD	208/3	1, ETR
(E) HWP-11	MECHANICAL ROOM PC0016	UMHC EMERGENCY DEPT. PRIMARY HW SYSTEM	TACO	FI2509E2FAH1L0CB1971D	-	END SUCTION	BASE	225	60	-	-	-	-	-	-	-	VFD	VFD	208/3	1, ETR
CWP-12	MECHANICAL ROOM PC0016	UMHC MPC TERTIARY CHW LOOP	ARMSTRONG	4300 DE	6.0	INLINE	HORIZONTAL	1000	85	30	26.71	1750	35.0	28.5	42.6	1044.0	VFD	VFD	208/3	2-6
CWP-13	MECHANICAL ROOM PC0016	UMHC MPC TERTIARY CHW LOOP	ARMSTRONG	4300 DE	6.0	INLINE	HORIZONTAL	1000	85	30	26.71	1750	35.0	28.5	42.6	1044.0	VFD	VFD	208/3	2-6
HCP-38	AHU-38 SERVICE VESTIBULE	AHU-38 PREHEAT COIL FREEZE PROTECTION	ARMSTRONG	4380 DE	1.25	INLINE	HORIZONTAL	26	30	1.00	0.35	1800	11.0	8.0	18.5	70.6	VFD	VFD	208/3	4-6

NOTES:
1 EXISTING PUMP DATA SHOWN IS DERIVED FROM SITE INVESTIGATION INFORMATION AND IS FOR REFERENCE ONLY.
2 PROVIDE WITH AIR/DIRT SEPARATOR (SPIROTHERM OR APPROVED EQUAL).
3 PROVIDE CONCRETE INERTIA BASE PER SPECIFICATIONS AND MOUNT PUMP FROM BASE WITH PRE-ENGINEERED, INLINE PUMP STANDS. USE VIBRO-ACOUSTICS OR SIMILAR.
4 DISCONNECT SWITCH FURNISHED AND INSTALLED BY DIVISION 26 CONTRACTOR.
5 VFD FURNISHED AND INSTALLED BY DIVISION 26 CONTRACTOR.
6 PUMP MOTOR SHALL BE NON-OVERLOADING THROUGHOUT THE FULL RANGE OF THE PUMP CURVE.

FAN SCHEDULE

MARK	LOCATION	SERVICE (EA, RA, SA)	MANUFACTURER	TYPE	MODEL	SYSTEM EA CFM	BYPASS CFM	EFF. PLUME HEIGHT (FT)	ESP (IN)	DRIVE (BELT/DIRECT)	MIN. HP	MOTOR BHP	FAN RPM	VFD (Y/N)	ELECTRICAL			NOTES
															V/PH	DISC. TYPE	STARTER TYPE	
(E) E-1	MPC ROOF (NORTH)	MPC KITCHEN EA	GREENHECK	UTILITY SET		8825	-	-	1.00	BELT	3	-	1800 / 1200	-	208/3	-	-	1, ETR
E-2	MPC ROOF (NORTH)	MPC NORTH GEN EA	GREENHECK	UTILITY SET	USF-24-A1	9000	-	-	1.5	DIRECT	3	2.9	1215	Y	208/3	VFD	VFD	2,3,4
E-3	MPC ROOF (SOUTH)	MPC SOUTH GEN EA	GREENHECK	UTILITY SET	USF-27-A1	10000	-	-	1.3	DIRECT	5	2.9	1050	Y	208/3	VFD	VFD	2,3,4
E-4	MPC ROOF	LVL 1 AII ISOLATION ROOMS	COOK	HIGH PLUME DISCHARGE	TORNADO	1000	200	16.7	1.10	DIRECT	2	1.19	2694	Y	208/3	VFD	VFD	2,3,4,6,7,8,9

NOTES:
1 EXISTING EXHAUST FAN DATA SHOWN IS DERIVED FROM EXISTING EQUIPMENT SCHEDULES AND IS FOR REFERENCE ONLY.
2 PROVIDE WITH MINIMUM 16" HIGH ROOF CURB, BIRDSCREEN AND BACKDRAFT DAMPER.
3 VARIABLE FREQUENCY DRIVE TO BE FURNISHED AND INSTALLED BY DIVISION 26 CONTRACTOR.
4 PROVIDE SHAFT GROUNDING SYSTEM ON MOTOR. REFER TO MOTOR SPECIFICATION FOR ADDITIONAL INFORMATION.
5 DIVISION 26 CONTRACTOR TO FURNISH AND INSTALL DISCONNECT SWITCH AND MOTOR STARTER.
6 PROVIDE HIGH PLUME DISCHARGE FAN STACK ASSEMBLY FOR ISOLATION ROOM EXHAUST. FAN SYSTEM SHALL BE DUAL FAN AND DUAL STACK FOR REDUNDANCY.
7 FAN STACK NOZZLE EXIT VELOCITY AND EFFECTIVE PLUME DISCHARGE HEIGHT BASIS OF DESIGN VALUES ARE 3000 FPM AND 25 FT, RESPECTIVELY.
8 CONTRACTOR SHALL PROVIDE A WEATHER & UV RESISTANT HAZARDOUS EXHAUST LABEL ON THE EXHAUST FAN. THE LABEL SHALL BE CLEARLY VISIBLE AND UNOBSTRUCTED FROM VIEW.
9 EFFECTIVE PLUME HEIGHT SCHEDULED IS THE MINIMUM ACCEPTABLE PLUME HEIGHT WITH A 12 MPH CROSSWIND.

FAN COIL UNIT SCHEDULE (HYDRONIC COILS)

MARK	LOCATION / SERVICE	MANUFACTURERS	MODEL	SUPPLY FAN				COOLING COIL										HEATING COIL							WEIGHT	ELECTRICAL			NOTES
				FLOW CFM	MIN. HP	ESP IN	TSP IN	TH MBH	SH MBH	EAT °F DB	EAT °F WB	LAT °F DB	LAT °F WB	FLOW GPM	EWT °F	LWT °F	MAX ROWS/FPI	MAX. WPD (FT)	CAP (MBH)	EAT °F	LAT °F	FLOW GPM	EWT °F	LWT °F	MAX ROWS/FPI	MAX. WPD (FT)	LBS	DISC. TYPE	STARTER TYPE	V/PH	
FCU-1	MED GAS/VAC EQUIP RM	JOHNSON CONTROLS	FWX-08	630	(2) 1/10	0.50	0.50	18.6	12.9	85.0	71.0	55.0	54.5	5.0	46.0	60.0	3 / 10	10.0	40.1	65.0	95.0	2.1	180.0	150.0	2 / 10	3.0	102	NOTE 3	NOTE 4	208/3	1-5

NOTES
1 EQUIPMENT COMPONENTS SHALL BE BY THE SAME MANUFACTURER.
2 PROVIDE 1" PANEL THROWAWAY AIR FILTERS.
3 PROVIDE FACTORY MOUNTED DISCONNECT INSTALLED ON SERVICE SIDE OF UNIT.
4 STARTER SHALL BE FURNISHED WITH THE MOTOR FROM THE MANUFACTURER.
5 SELECT EQUIPMENT FOR ELEVATION OF 800 FEET ABOVE SEA LEVEL.

UNIT HEATER SCHEDULE (HYDRONIC)

MARK	SERVICE	MANUFACTURERS	SIZE	PERFORMANCE				HEATING COIL				MOTOR	ELECTRICAL			NOTES
				CAP. MBH	FLOW CFM	EAT °F	LAT °F	EWT °F	LWT °F	FLOW GPM	MAX WPD FT	HP	DISC. TYPE	STARTER TYPE	V/PH	
UH-38	AHU-38 SERVICE VESTIBULE	TRANE	S-36	24.00	550	50.0	90.4	160.0	180.0	1.8	0.1	1/20	NOTE 5	NOTE 6	115/1	1-6

NOTES:
1 MOUNT IN AHU SERVICE VESTIBULE AS HIGH AS POSSIBLE. ENSURE PROPER CLEARANCE OF SERVICEABLE COMPONENTS
2 PROVIDE WITH UNIT MOUNTED THERMOSTAT.
3 PROVIDE NECESSARY MOUNTING BRACKET AND ACCESSORIES FOR VERTICAL MOUNTING.
4 PROVIDE FACTORY MOUNTED DISCONNECT INSTALLED ON SERVICE SIDE OF UNIT.
5 DISCONNECT SWITCH PROVIDED WITH THE UNIT BY THE MANUFACTURER.
6 STARTER PROVIDED WITH THE UNIT BY THE MANUFACTURER.

bcDESIGNGROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number A-2011037299

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383
Missouri Certificate of Authority #000148

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111
Missouri Certificate of Authority #000442

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD, BLDG. 1,
COLUMBIA, MO 65203
573.447.0292
Missouri Certificate of Authority #2005151301

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

STATE OF MISSOURI
JOHN ERNEST SOMMERS
NUMBER PE-2015028399
PROFESSIONAL ENGINEER
03/12/2021

John E Sommers, P.E.
PE-2015028399

Issue Date: 02.25.2021

Issue:	Date:
1 ADDENDUM 1	03.12.2021

Drawn by: JAD

bcdg Project #: 12275.42
MU Project #: CP210251

M601
MECHANICAL SCHEDULES

VRF SPLIT SYSTEM FAN COIL UNIT SCHEDULE

MARK	LOCATION	SERVICE	MANUFACTURER	MODEL	MOUNTING	COOLING												NOTES
						REFR. TYPE	CFM	NOMINAL TONS	TH MBH	SH MBH	EAT DB	EAT WB	LAT DB	LAT WB	WEIGHT LBS	MCA	V/PH	
ACU-1	BASEMENT ELECTRICAL ROOM	BASEMENT ELECTRICAL ROOM	MITSUBISHI	PKA-A24KA7	WALL	R410A	750	2	22.5	20.3	80.0	67.0	55.0	54.2	37	1	208/3	1-8

NOTES:
1 PROVIDE COOLING CAPACITY SCHEDULED AT 100F AMBIENT AIR TEMPERATURE
2 DISCONNECT PROVIDED WITH THE EQUIPMENT BY MANUFACTURER.
3 INDOOR FAN COIL POWERED FROM OUTDOOR CONDENSING UNIT.
4 TEMPERATURE CONTROL - PROVIDE COMMUNICATING WALL THERMOSTAT INTERFACE FOR COMMUNICATION WITH BAS.
5 PROVIDE NECESSARY MOUNTING BRACKET AND ACCESSORIES FOR SPECIFIED MOUNTING.
6 PROVIDE ALL MOUNTING HARDWARE REQUIRED FOR UNIT TYPE SUBJECT TO MANUFACTURERS INSTALLATION INSTRUCTIONS.
7 PROVIDE CONDENSATE PUMP AND OVERFLOW SHUTOFF SWITCH WITH UNIT.
8 PROVIDE STANDARD FACTORY FURNISHED WASHABLE FILTERS.

CONDENSING UNIT SCHEDULE

MARK	LOCATION	SERVICE	MANUFACTURERS	MODEL	REFR. TYPE	CAP. MBH	SEER	COP @ 47°F	WEIGHT LBS	ELECTRICAL					NOTES
										MCA	MOCP	DISC. TYPE	STARTER TYPE	V/PH	
CU-1	MPC EXTERIOR	ACU-1	MITSUBISHI	PUZ-A24NHA7	410A	24.0	21.40	4.35	180	19	26	NOTE 6	NOTE 7	208/3	1-10

NOTES:
1 EQUIPMENT SIZED FOR 95°F AMBIENT TEMPERATURE.
2 COORDINATE WITH THE MANUFACTURER THE HORIZONTAL AND VERTICAL REFRIGERANT PIPE ROUTING TO DETERMINE PIPE SIZES FOR THE REFRIGERANT PIPING. MANUFACTURER SHALL PROVIDE DETAILED REFRIGERANT PIPING DIAGRAMS INCLUDING DIMENSIONAL DATA FOR ALL REFRIGERANT PIPING DEVICES. THE MANUFACTURER SHALL SIZE AND LOCATE THE ASSOCIATED REFRIGERANT TRAPS BASED ON THE ACTUAL ROUTING AND PROVIDE OTHER APPURTENANCES TO PROVIDE A FULLY FUNCTIONAL AND OPERATIONAL SYSTEM.
3 COORDINATE WITH THE MANUFACTURER LOCATIONS FOR ALL REFRIGERANT PIPING DEVICES TO MAINTAIN SERVICEABILITY AND ACCESSIBILITY.
4 PROVIDE LIQUID LINE FILTER DRYER AND SIGHT GLASS.
5 UNIT TO MOUNT ON ROOF MOUNTED BASE RAILS. SEE ARCHITECTURAL DRAWINGS FOR MORE INFORMATION.
6 PROVIDE FACTORY MOUNTED DISCONNECT INSTALLED ON SERVICE SIDE OF UNIT.
7 STARTERS FOR ALL MOTORS SHALL BE FURNISHED INTEGRAL WITH UNIT.
8 PROVIDE CONDENSER COIL HAIL GUARDS.
9 PROVIDE HARD START KIT.
10 INDOOR FAN COIL POWERED FROM OUTDOOR CONDENSING UNIT

AIR-DIRT SEPARATOR SCHEDULE

MARK	LOCATION	SERVICE	MANUFACTURERS	MODEL	TYPE	CONN. SIZE IN	MAX FLOW GPM	MAX P.D. FT	DRAIN SIZE IN	PHYSICAL DATA				NOTES
										L IN	W IN	H IN	WEIGHT LBS	
ADS-1	MECHANICAL ROOM PC0016	UMHC MPC CHILLED WATER LOOP	SPIROTHERM	VDT1000	COALESCING	10.00	1000	5.00	1.00	38	20	67	718	1-7

NOTES:
1 PROVIDE COALESCING TYPE SEPARATOR. CENTRIFUGAL TYPE NOT ACCEPTED.
2 VESSEL SHALL BE CERTIFIED FOR 150 LB WORKING PRESSURE AND SHALL BE FURNISHED WITH ANSI / ASME B16.5 OR B16.47 CLASS 150 STEEL WELD NECK RAISED-FACE FLANGES.
3 UNIT SHALL INCLUDE STRUCTURED COALESCING MEDIA FILLING THE ENTIRE VESSEL.
4 VESSELS WITH LOOSE OR PARTIALLY FILLED INTERNAL MEDIA NOT ACCEPTED.
5 UNIT SHALL REMOVE 100% OF FREE AND ENTRAINED AIR AND 99.6% OF DISSOLVED AIR AS TESTED BY INDEPENDENT LAB.
6 UNIT SHALL REMOVE 80% OF THE 30 MICRON PARTICLES IN 100 CIRCULATIONS. UNIT SHALL BE CAPABLE OF 5 MICRON PARTICLE SIZE REMOVAL.
7 UNIT SHALL MAINTAIN ACCESSIBILITY FOR CLEARANCE ON ALL SERVICIBLE SIDES. MINIMUM CLEAR AREA SHALL BE 24" X 24" OR MANUFACTURERS RECOMMENDED CLEARANCE -- WHICHEVER IS GREATER.

bcdesign GROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number A-2011033799

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383
Missouri Certificate of Authority #000148

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111
Missouri Certificate of Authority #000442

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD. BLDG. 1,
COLUMBIA, MO 65203
573.447.0292
Missouri Certificate of Authority #2000151301

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

STATE OF MISSOURI
JOHN ERNEST SOMMERS
NUMBER PE-2015028399
PROFESSIONAL ENGINEER
03/12/2021

John E Sommers, P.E.
PE-2015028399

Issue Date: 02.25.2021

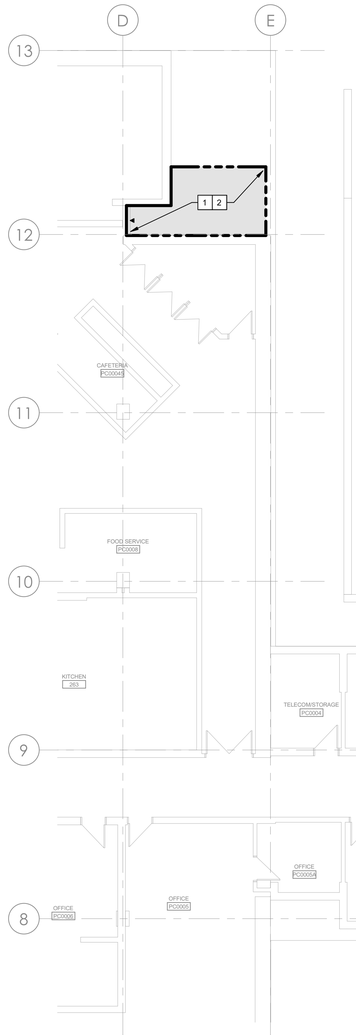
⚠	Issue:	Date:
1	ADDENDUM 1	03.12.2021

Drawn by: JAD

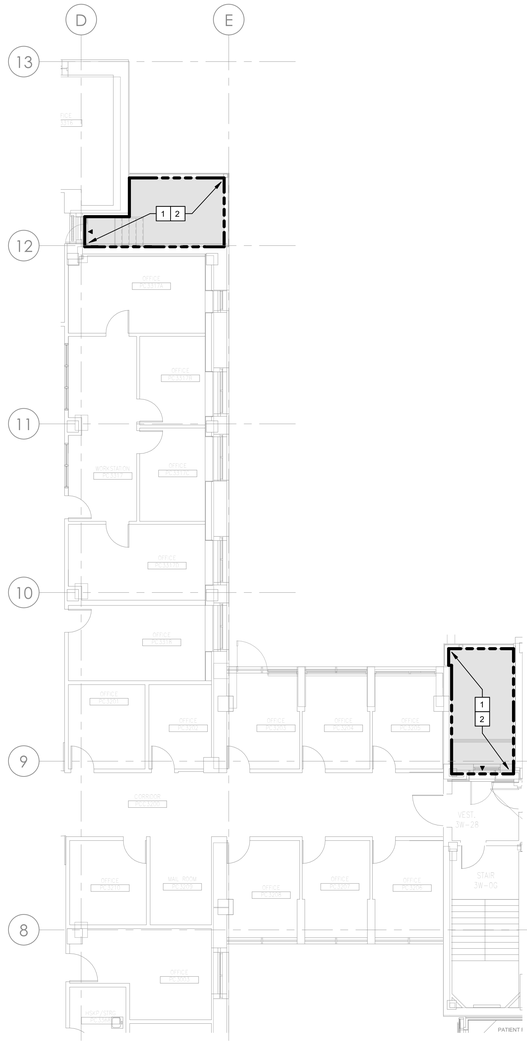
bcdg Project #: 12275.42
MU Project #: CP210251

M602

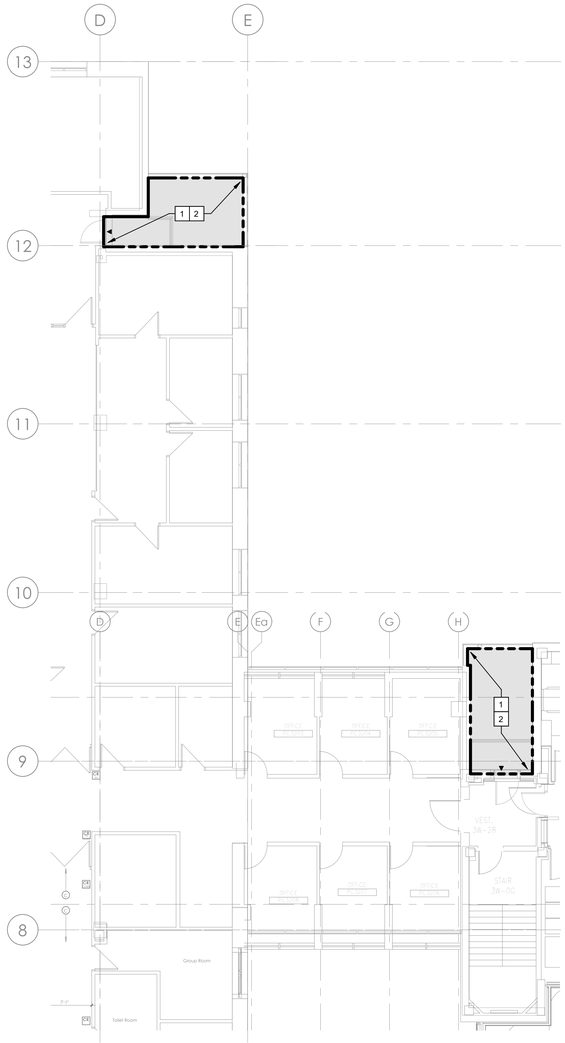
MECHANICAL SCHEDULES



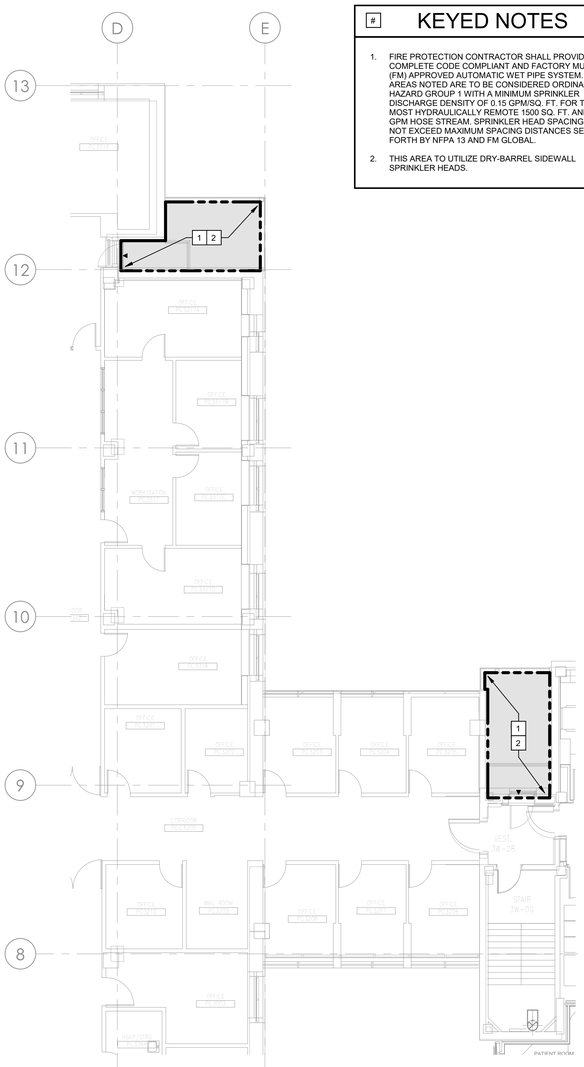
4 FIRE PROTECTION - GROUND FLOOR - NEW WORK Copy 1
1/8" = 1'-0"



3 FIRE PROTECTION - FIRST FLOOR NORTH & UMTH MECHANICAL SHAFT- NEW WORK
1/8" = 1'-0"



2 FIRE PROTECTION - 2ND FLOOR NORTH & UMTH MECHANICAL SHAFT - NEW WORK
1/8" = 1'-0"



1 FIRE PROTECTION - 3RD FLOOR NORTH & UMTH MECHANICAL SHAFT - NEW WORK
1/8" = 1'-0"

KEYED NOTES

1. FIRE PROTECTION CONTRACTOR SHALL PROVIDE A COMPLETE CODE COMPLIANT AND FACTORY MUTUAL (FM) APPROVED AUTOMATIC WET PIPE SYSTEM. ALL AREAS NOTED ARE TO BE CONSIDERED ORDINARY HAZARD GROUP 1 WITH A MINIMUM SPRINKLER DISCHARGE DENSITY OF 0.15 GPM/SQ. FT. FOR THE MOST HYDRAULICALLY REMOTE 1500 SQ. FT. AND A 250 GPM HOSE STREAM. SPRINKLER HEAD SPACING SHALL NOT EXCEED MAXIMUM SPACING DISTANCES SET FORTH BY NFPA 13 AND FM GLOBAL.
2. THIS AREA TO UTILIZE DRY-BARREL SIDEWALL SPRINKLER HEADS.

bcDESIGNGROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number
A-2011033799

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383
Missouri Certificate of Authority #000148

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111
Missouri Certificate of Authority #000442

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD. BLDG. 1,
COLUMBIA, MO 65203
573.447.0292
Missouri Certificate of Authority #2000151001

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

STATE OF MISSOURI
JOHN ERNEST SOMMERS
NUMBER PE-2015028399
PROFESSIONAL ENGINEER
03/12/2021

John E Sommers, P.E.
PE-2015028399

Issue Date: 02.25.2021

	Issue:	Date:
1	ADDENDUM 1	03.12.2021

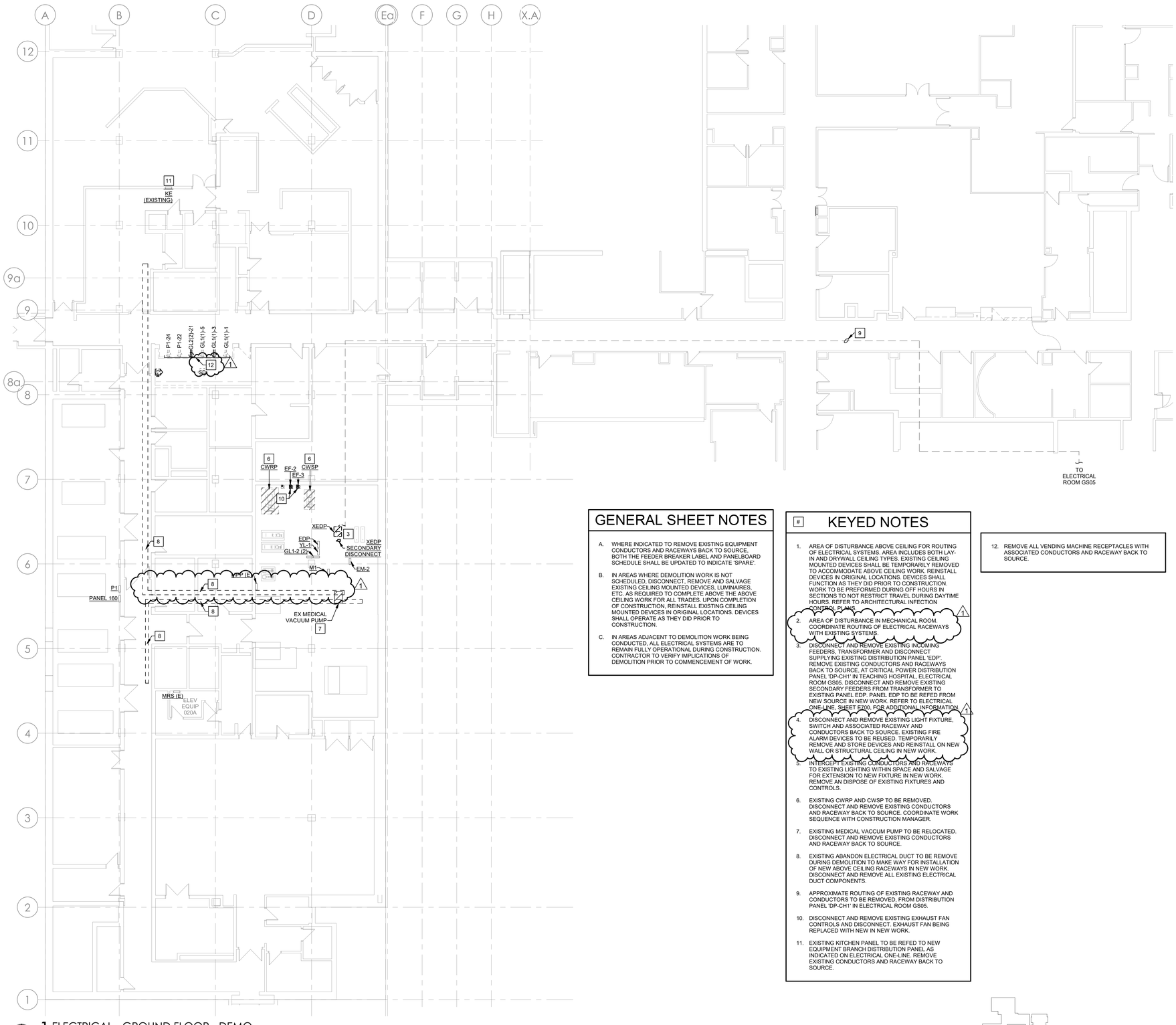
Drawn by: MAS

bcdg Project #: 12275.42
MU Project #: CP210251

1

FP101
FIRE PROTECTION - GROUND FLOOR, 1ST FLOOR, 2ND FLOOR & 3RD FLOOR

BID SET- ADDENDUM #1



1 ELECTRICAL - GROUND FLOOR - DEMO
3/32" = 1'-0"

0'1' 4' 8' 16' 32'

GENERAL SHEET NOTES

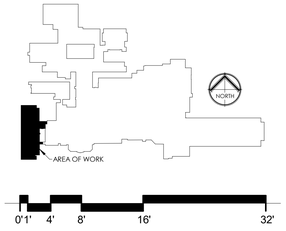
A. WHERE INDICATED TO REMOVE EXISTING EQUIPMENT CONDUCTORS AND RACEWAYS BACK TO SOURCE, BOTH THE FEEDER BREAKER LABEL AND PANELBOARD SCHEDULE SHALL BE UPDATED TO INDICATE 'SPARE'.

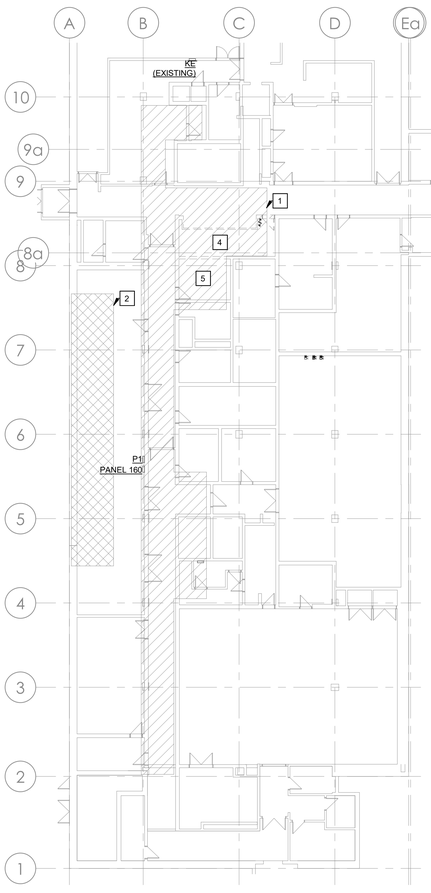
B. IN AREAS WHERE DEMOLITION WORK IS NOT SCHEDULED, DISCONNECT, REMOVE AND SALVAGE EXISTING CEILING MOUNTED DEVICES, LUMINAIRES, ETC. AS REQUIRED TO COMPLETE ABOVE THE ABOVE CEILING WORK FOR ALL TRADES. UPON COMPLETION OF CONSTRUCTION, REINSTALL EXISTING CEILING MOUNTED DEVICES IN ORIGINAL LOCATIONS. DEVICES SHALL OPERATE AS THEY DID PRIOR TO CONSTRUCTION.

C. IN AREAS ADJACENT TO DEMOLITION WORK BEING CONDUCTED, ALL ELECTRICAL SYSTEMS ARE TO REMAIN FULLY OPERATIONAL DURING CONSTRUCTION. CONTRACTOR TO VERIFY IMPLICATIONS OF DEMOLITION PRIOR TO COMMENCEMENT OF WORK.

KEYED NOTES

1. AREA OF DISTURBANCE ABOVE CEILING FOR ROUTING OF ELECTRICAL SYSTEMS. AREA INCLUDES BOTH LAY-IN AND DRYWALL CEILING TYPES. EXISTING CEILING MOUNTED DEVICES SHALL BE TEMPORARILY REMOVED TO ACCOMMODATE ABOVE CEILING WORK. REINSTALL DEVICES IN ORIGINAL LOCATIONS. DEVICES SHALL FUNCTION AS THEY DID PRIOR TO CONSTRUCTION. WORK TO BE PREFORMED DURING OFF HOURS IN SECTIONS TO NOT RESTRICT TRAVEL DURING DAYTIME HOURS. REFER TO ARCHITECTURAL INFECTION CONTROL PLANS.
2. AREA OF DISTURBANCE IN MECHANICAL ROOM. COORDINATE ROUTING OF ELECTRICAL RACEWAYS WITH EXISTING SYSTEMS.
3. DISCONNECT AND REMOVE EXISTING INCOMING FEEDERS, TRANSFORMER AND DISCONNECT SUPPLYING EXISTING DISTRIBUTION PANEL 'EDP'. REMOVE EXISTING CONDUCTORS AND RACEWAYS BACK TO SOURCE, AT CRITICAL POWER DISTRIBUTION PANEL 'DP-CH1' IN TEACHING HOSPITAL, ELECTRICAL ROOM GS05. DISCONNECT AND REMOVE EXISTING SECONDARY FEEDERS FROM TRANSFORMER TO EXISTING PANEL EDP. PANEL EDP TO BE REFED FROM NEW SOURCE IN NEW WORK. REFER TO ELECTRICAL ONE-LINE, SHEET E700, FOR ADDITIONAL INFORMATION.
4. DISCONNECT AND REMOVE EXISTING LIGHT FIXTURE, SWITCH AND ASSOCIATED RACEWAY AND CONDUCTORS BACK TO SOURCE. EXISTING FIRE ALARM DEVICES TO BE REUSED. TEMPORARILY REMOVE AND STORE DEVICES AND REINSTALL ON NEW WALL OR STRUCTURAL CEILING IN NEW WORK.
5. INTERCEPT EXISTING CONDUCTORS AND RACEWAYS TO EXISTING LIGHTING WITHIN SPACE AND SALVAGE FOR EXTENSION TO NEW FIXTURE IN NEW WORK. REMOVE AN DISPOSE OF EXISTING FIXTURES AND CONTROLS.
6. EXISTING CWRP AND CWSP TO BE REMOVED. DISCONNECT AND REMOVE EXISTING CONDUCTORS AND RACEWAY BACK TO SOURCE. COORDINATE WORK SEQUENCE WITH CONSTRUCTION MANAGER.
7. EXISTING MEDICAL VACCUM PUMP TO BE RELOCATED. DISCONNECT AND REMOVE EXISTING CONDUCTORS AND RACEWAY BACK TO SOURCE.
8. EXISTING ABANDON ELECTRICAL DUCT TO BE REMOVE DURING DEMOLITION TO MAKE WAY FOR INSTALLATION OF NEW ABOVE CEILING RACEWAYS IN NEW WORK. DISCONNECT AND REMOVE ALL EXISTING ELECTRICAL DUCT COMPONENTS.
9. APPROXIMATE ROUTING OF EXISTING RACEWAY AND CONDUCTORS TO BE REMOVED, FROM DISTRIBUTION PANEL 'DP-CH1' IN ELECTRICAL ROOM GS05.
10. DISCONNECT AND REMOVE EXISTING EXHAUST FAN CONTROLS AND DISCONNECT. EXHAUST FAN BEING REPLACED WITH NEW IN NEW WORK.
11. EXISTING KITCHEN PANEL TO BE REFED TO NEW EQUIPMENT BRANCH DISTRIBUTION PANEL AS INDICATED ON ELECTRICAL ONE-LINE. REMOVE EXISTING CONDUCTORS AND RACEWAY BACK TO SOURCE.
12. REMOVE ALL VENDING MACHINE RECEPTACLES WITH ASSOCIATED CONDUCTORS AND RACEWAY BACK TO SOURCE.





2 ELECTRICAL - GROUND FLOOR - DEMO - CEILING PLAN
1/16" = 1'-0"

bcdesignGROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number
A-2011037299

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383
Missouri Certificate of Authority #000148

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111
Missouri Certificate of Authority #000442

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD. BLDG. 1,
COLUMBIA, MO 65203
573.447.0292
Missouri Certificate of Authority #2000151001

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

STATE OF MISSOURI
ALLAN ROBERT HENDRIKSE
NUMBER PE-2004017185
REGISTERED PROFESSIONAL ENGINEER

Allan Robert Hendrikse, Engineer
PE-2004017185

Issue Date: 02.25.2021

#	Issue:	Date:
1	ADDENDUM 1	03.12.2021

Drawn by: MJS

bcdg Project #: 12275.42
MU Project #: CP210251

ED100
ELECTRICAL - GROUND FLOOR - DEMOLITION

GENERAL SEQUENCING OF WORK

THIS CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING ELECTRICAL POWER OUTAGES AND PROCEDURES WITH THE OWNER'S REPRESENTATIVE PRIOR TO COMMENCING WORK. THE FOLLOWING PROPOSED SEQUENCE IS A SUGGESTION OF PROCEDURES. THIS CONTRACTOR MAY CHOOSE TO UTILIZE THIS METHODOLOGY OR A MORE EFFICIENT METHODOLOGY TO COMPLETE THIS WORK PROVIDED THE POWER OUTAGE DURATION AND PROCEDURE IS APPROVED BY THE OWNER'S REPRESENTATIVE. WORK SHALL BE PERFORMED IN A MANNER THAT WILL MINIMIZE POWER OUTAGES AS MUCH AS POSSIBLE.

1. SITE PREP WORK INCLUDING CONCRETE ENCASED UNDERGROUND ELECTRICAL DUCTBANK, PULLBOXES AND OUTDOOR EQUIPMENT PADS.
2. DEMOLITION AND CONSTRUCTION OF NEW ESSENTIAL ELECTRICAL SYSTEM ELECTRICAL ROOM INCLUDING REMOVAL OF CEILING, MODIFICATIONS OF WALLS/DOORS, AND NEW EQUIPMENT HOUSEKEEPING PADS.
3. ABOVE CORRIDOR CEILING DEMOLITION AND INSTALLATION INCLUDING DUCTBANK REMOVAL, GENERATOR FEEDER CONDUIT INSTALLATION, NORMAL FEEDER CONDUIT INSTALLATION AND ESSENTIAL ELECTRICAL SYSTEM DISTRIBUTION FEEDER CONDUIT INSTALLATIONS.
4. INSTALLATION OF NEW ESSENTIAL ELECTRICAL SYSTEM (GENERATOR, GENERATOR TAP BOX SWITCHBOARD, GENERATOR DISTRIBUTION SWITCHBOARD, TRANSFER SWITCHES, DISTRIBUTION PANELBOARDS, BRANCH PANELBOARDS WITH ASSOCIATED CONDUITS AND FEEDERS FOR TIE IN TO EXISTING ELECTRICAL DISTRIBUTION SYSTEM.
5. PROVIDE LOAD BANK AND TEST GENERATOR WITH NEW LOAD BANK TAP CONNECTION BOX.
6. **COORDINATE ELECTRICAL DISTRIBUTION SWITCHBOARD SHUTDOWN WITH OWNER FOR MODIFICATIONS/INSTALLATION OF NEW SHUNT TRIP BREAKER WITH NEW FEEDERS TO SERVE NEW ATS'S. PROVIDE TEMPORARY POWER AS REQUIRED MINIMIZE OUTAGE AND MAINTAIN CRITICAL BUILDING OPERATION.**
7. TEST AUTOMATIC TRANSFER SWITCH OPERATION WITH GENERATOR AND NORMAL FEEDERS PRIOR TO TRANSFER OF EXISTING BUILDING LOADS TO NEW ESSENTIAL ELECTRICAL SYSTEM.
8. **COORDINATE EXISTING EMERGENCY DISTRIBUTION SYSTEM SHUTDOWN WITH OWNER FOR DISCONNECTION/REMOVAL OF EXISTING CRITICAL BRANCH FEEDER FROM TEACHING HOSPITAL AND RECONNECTION OF NEW LIFE SAFETY BRANCH FEEDER.**
9. DISCONNECT AND REMOVE ELECTRICAL RACEWAYS, CONDUCTORS AND JUNCTION BOXES BACK TO SOURCE FOR EXISTING MECHANICAL AND ELECTRICAL LOADS TO BE REMOVED.
10. DISCONNECTION OF EXISTING MECHANICAL LOADS AND RECONNECTION TO NEW EQUIPMENT POWER DISTRIBUTION PANELBOARDS AS INDICATED ON ELECTRICAL ONE-LINE.
11. REMOVE EXISTING EMERGENCY POWER TRANSFORMER, DISCONNECT WITH ASSOCIATED CONDUIT AND FEEDER BACK TO TEACHING HOSPITAL ESSENTIAL ELECTRICAL SYSTEM.
12. IMPLEMENT AND COMPLETE TESTING OF GENERATOR.

ONE-LINE DIAGRAM GENERAL NOTES

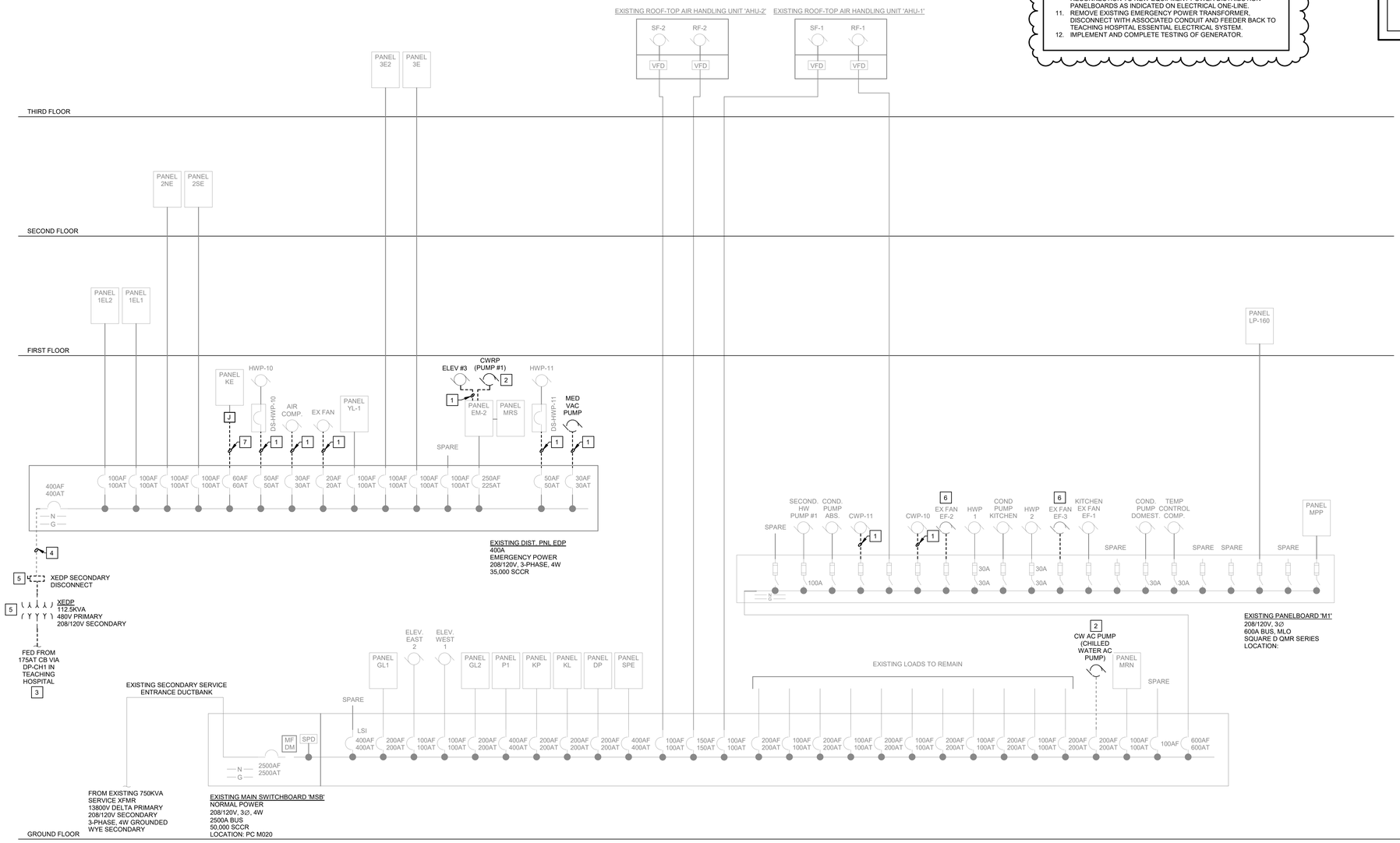
1. SHORT CIRCUIT CURRENT AND AIC RATINGS LISTED FOR ELECTRICAL EQUIPMENT ARE THE MINIMUM REQUIREMENTS FOR THE BUS BRACING AND DEVICE RATINGS. ALL EQUIPMENT SHALL BE FULLY RATED UNLESS SPECIFICALLY NOTED AS SERIES RATED. ELECTRICAL CONTRACTOR IS REQUIRED TO PROVIDE ARC FLASH HAZARD AND PERSONNEL PROTECTIVE EQUIPMENT LABELS FOR EACH INDICATED PIECE OF ELECTRICAL EQUIPMENT.
2. ALL FUSED SWITCHES AND CIRCUIT BREAKERS SHOWN ON ONE-LINE DIAGRAM ARE 3-POLE. UNLESS NOTED OTHERWISE.
3. "AF" INDICATES CIRCUIT BREAKER/FUSIBLE SWITCH FRAME SIZE.
4. "AT" INDICATES CIRCUIT BREAKER TRIP SETTING (FOR ADJUSTABLE TRIP TYPE CIRCUIT BREAKERS)/FUSE SIZE.
5. THE VARIABLE FREQUENCY DRIVE AND DISCONNECT SCHEME SHOWN ON ONE-LINE DIAGRAM REQUIRES SPECIFIC INTERLOCKING OF EQUIPMENT. IT IS THE ELECTRICAL CONTRACTOR'S RESPONSIBILITY TO COORDINATE ALL REQUIRED AUXILIARY CONTACTS OF EQUIPMENT AND FURNISH AND INSTALL ALL CABLES, CONDUIT, TERMINATIONS, ETC. FOR A COMPLETE INTERLOCKING SYSTEM.

ONE-LINE DIAGRAM SYMBOLS

- XX/XX — FUSIBLE SWITCH (SIZE/FUSE)
- DRAWOUT CIRCUIT BREAKER
- XX/XX — CIRCUIT BREAKER (FRAME/TRIP)
- MP DM — MICROPROCESSOR BASED DIGITAL MONITOR
- MOTOR STARTER
- CONTACTOR
- GEN — GENERATOR
- POWER TRANSFORMER
- G — GROUND BUS
- N — NEUTRAL BUS
- GROUND
- SPD — SURGE PROTECTION DEVICE
- M — ELECTRICAL SERVICE METER
- LSIGA — ADJUSTABLE ELECTRONIC TRIP CIRCUIT BREAKER FUNCTIONS
  L: LONG TIME (WITH DELAY)
  S: SHORT TIME (WITH DELAY)
  I: INSTANTANEOUS (WITH DELAY)
  G: GROUND FAULT
  A: GROUND FAULT ANNUNCIATE ONLY

KEYED NOTES

1. EXISTING LOADS TO BE REFED FROM NEW EQUIPMENT POWER PANEL IN NEW WORK. DISCONNECT AND REMOVE EXISTING RACEWAYS AND FEEDERS FROM BREAKERS IN PANEL 'EDP' FOR EXTENSION TO NEW EQUIPMENT POWER PANEL IN NEW WORK.
2. DISCONNECT AND REMOVE EXISTING DISCONNECT, CONTROLLER, RACEWAY AND CONDUCTORS BACK TO SOURCE PANELBOARD ASSOCIATED WITH CHILLED WATER PUMPS BEING REMOVED.
3. DISCONNECT AND REMOVE EXISTING EXPOSED RACEWAY AND FEEDERS SERVING EXISTING TRANSFORMER FROM BREAKER IN CRITICAL BRANCH DISTRIBUTION PANEL DP-CH1 IN TEACHING HOSPITAL DISTRIBUTION ROOM GS-06.
4. DISCONNECT EXISTING FEEDER. DISTRIBUTION BOARD TO BE REFED FROM NEW LIFE SAFETY BRANCH ATS IN NEW WORK. REFER TO NEW WORK ONE-LINE FOR ADDITIONAL INFORMATION.
5. DISCONNECT AND REMOVE EXISTING TRANSFORMER, SECONDARY DISCONNECT, AND ASSOCIATED RACEWAYS AND FEEDERS.
6. EXISTING ROOF TOP EXHAUST FAN WITH LOCAL DISCONNECT AND BRANCH CIRCUIT WIRING DOWN TO CONTROLLER IN GROUND FLOOR MECHANICAL ROOM TO BE REMOVED. EXISTING CONDUIT FROM GROUND FLOOR TO ROOF TO REMAIN FOR NEW EXHAUST FAN BRANCH CIRCUIT WIRING AS SHOWN ON ELECTRICAL NEW WORK PLANS.
7. EXISTING PANELBOARD 'KE' TO BE REFED FROM NEW EQUIPMENT BRANCH POWER DISTRIBUTION BOARD IN NEW WORK. DISCONNECT AND REMOVE EXISTING CONDUCTORS AND RACEWAYS BACK TO SOURCE.



1 PARTIAL ELECTRICAL DEMOLITION ONE-LINE DIAGRAM
NO SCALE

bcdesign GROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number
A-2011033299

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383
Missouri Certificate of Authority #000148

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111
Missouri Certificate of Authority #000442

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD, BLDG. 1,
COLUMBIA, MO 65203
573.447.0292
Missouri Certificate of Authority #2000151301

Level 1

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

STATE OF MISSOURI — ALLAN ROBERT HENDRIKSE — NUMBER PE-2004017185 — PROFESSIONAL ENGINEER

Allan Robert Hendrikse, Engineer
PE-2004017185

Issue Date: 02.25.2021

⚠	Issue:	Date:
1	ADDENDUM 1	03.12.2021

Drawn by: MJS

bcdg Project #: 12275.42
MU Project #: CP210251

ED700
ELECTRICAL DEMOLITION ONE-LINE

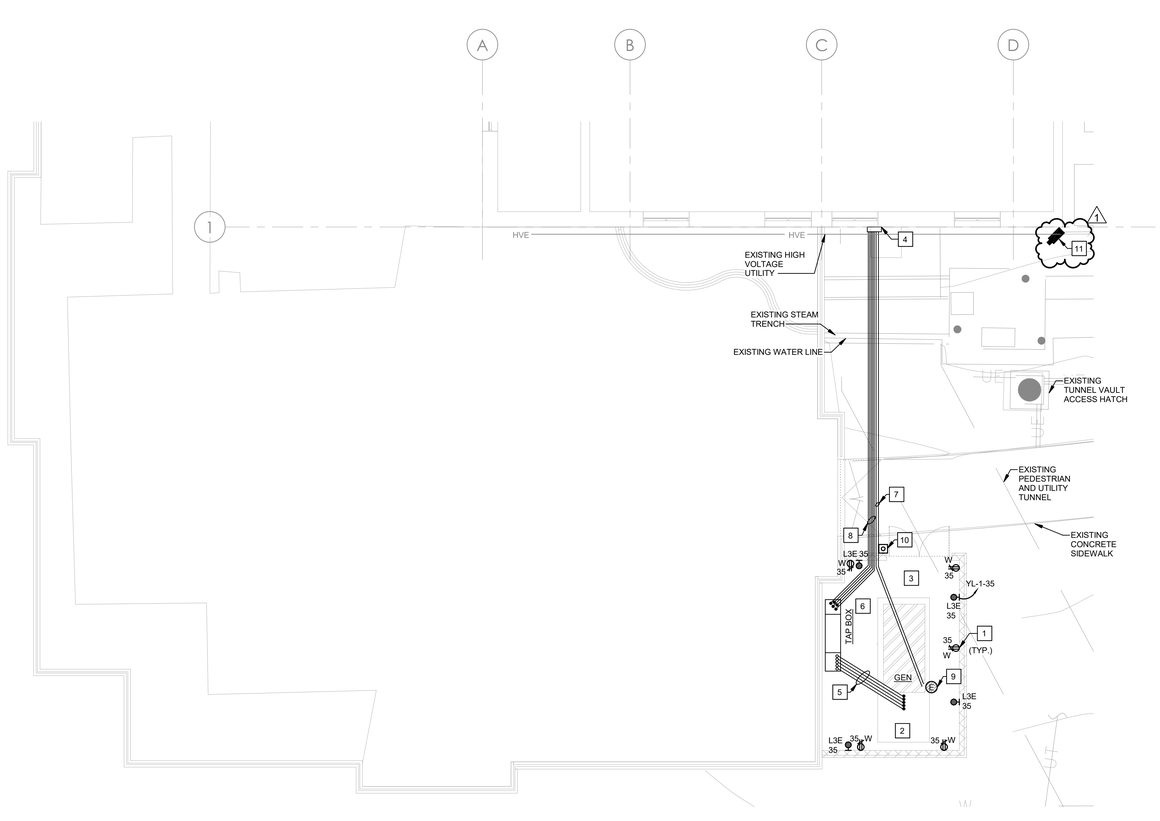
BID SET - ADDENDUM #1

GENERAL SHEET NOTES

A. REFER TO CIVIL SITE PLAN FOR UNDERGROUND UTILITY COORDINATION FOR INSTALLATION OF UNDERGROUND DUCT BANK. EXISTING UNDERGROUND UTILITIES SHOWN THIS SHEET FOR REFERENCE ONLY.

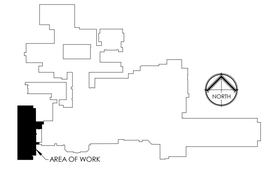
KEYED NOTES

1. MOUNT RECEPTACLES FLUSH WITHIN MASONRY WALL.
2. NEW GENERATOR WITH SOUND ATTENUATED WEATHER ENCLOSURE ON SKID MOUNTED 48-HOUR FUEL TANK. PROVIDE CONCRETE HOUSEKEEPING PAD FOR GENERATOR. MAINTAIN MINIMUM 4'-6" CLEAR FROM TAP BOX AND MASONRY WALL. PROVIDE MINIMUM 4'-6" CLEAR AT INTAKE SIDE OF UNIT.
3. ALL CONDUITS WITHIN THE GENERATOR YARD SHALL BE CONCEALED UNDER GRADE AND WITHIN MASONRY WALL.
4. NEW GENERATOR FEEDERS AND CONDUITS TO BE ROUTED UP FROM DUCTBANK AND ENTER BUILDING AT MEZZANINE LEVEL CEILING BELOW FIRST FLOOR WINDOW. PROVIDE EXTERIOR PULLBOX WITH REMOVABLE COVER. FOR INCOMING GENERATOR FEEDERS. PROVIDE SEPERATE PULLBOX ADJACENT TO INCOMING GENERATOR POWER FEEDER PULLBOX FOR BOTH COMMUNICATION WIRING AND LIFE SAFEY BRANCH CIRCUIT WIRING TO GENERATOR ACCESSORY PANEL, GENERATOR YARD LIGHTING AND RECEPTACLES.
5. PROVIDE DUCTBANK WITH FOUR (4) 4" CONDUITS FOR POWER AND ONE (1) 1-1/2" CONDUIT FOR COMMUNICATIONS CABLING BETWEEN GENERATOR AND TAP BOX.
6. NEW OUTDOOR TEMPORARY GENERATOR AND LOAD BANK CONNECTION TO TRANSFER SWITCHBOARD.
7. 1-1/2" CONDUIT FOR POWER AND 1-1/2" CONDUIT FOR COMMUNICATION CABLING FROM GENERATOR TO BUILDING. REFER TO DUCT BANK DETAIL FOR ADDITIONAL INFORMATION.
8. FOUR (4) 4" CONDUITS FOR POWER, ONE (1) 1-1/2" CONDUIT FOR COMMUNICATIONS CABLING FROM GENERATOR TO BUILDING. REFER TO DUCT BANK DETAIL FOR ADDITIONAL INFORMATION.
9. PROVIDE ELECTRICAL CONNECTION TO GENERATOR MDP PANELBOARD WITHIN GENERATOR ENCLOSURE. REFER TO ELECTRICAL ONE-LINE FOR CONDUCTOR, RACEWAY AND DISTRIBUTION INFORMATION.
10. PROVIDE REMOTE EMERGENCY SHUTDOWN PUSHBUTTON FOR GENERATOR IN LOCATION SHOWN. INSTALL WITHIN BREAK-GLASS ENCLOSURE. PROVIDE LABEL TO READ AS FOLLOWS: "GENERATOR EMERGENCY SHUTDOWN"
11. PROVIDE CAMERA ROUGH-IN FOR MONITORING OF GENERATOR YARD. COORDINATE LOCATION WITH OWNER PRIOR TO ROUGH-IN.



1 ENLARGED PLAN - GENERATOR YARD AND BUILDING SERVICE ENTRANCE
1/8" = 1'-0"

0' 4' 8' 16' 32'



bcdesign GROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number
A-2011033799

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383
Missouri Certificate of Authority #000148

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111
Missouri Certificate of Authority #000442

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD, BLDG. 1,
COLUMBIA, MO 65203
573.447.0292
Missouri Certificate of Authority #2000151301

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

STATE OF MISSOURI
ALLAN ROBERT HENDRIKSE
NUMBER
PE-2004017185
PROFESSIONAL ENGINEER

Allan Robert Hendrikse, Engineer
PE-2004017185

Issue Date: 02.25.2021

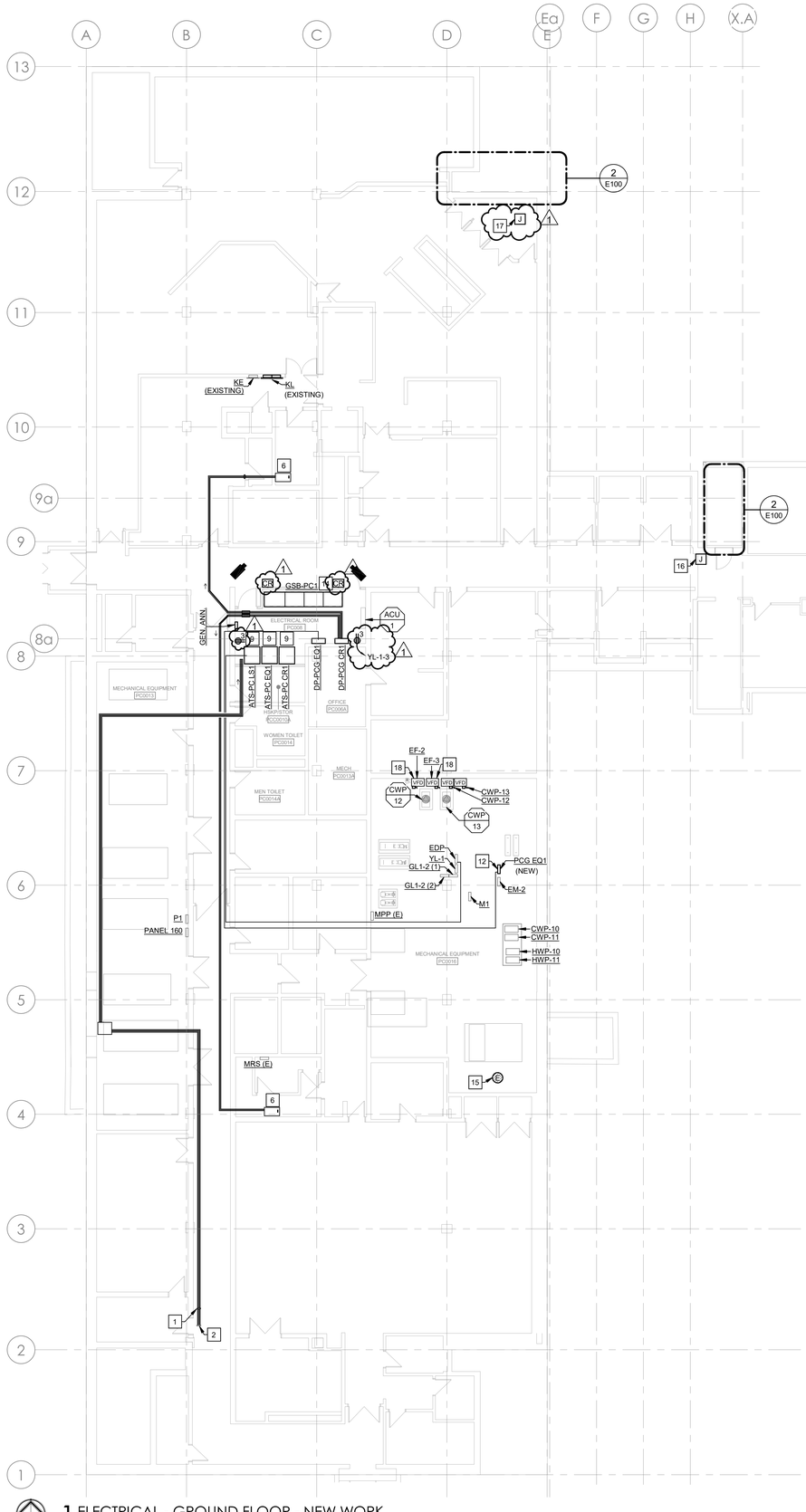
⚠	Issue:	Date:
1	ADDENDUM 1	03.12.2021

Drawn by: MJS

bcdg Project #: 12275.42
MU Project #: CP210251

E001

ELECTRICAL - SITE PLAN - NEW WORK



1 ELECTRICAL - GROUND FLOOR - NEW WORK
3/32" = 1'-0"

0' 1' 4' 8' 16' 32'

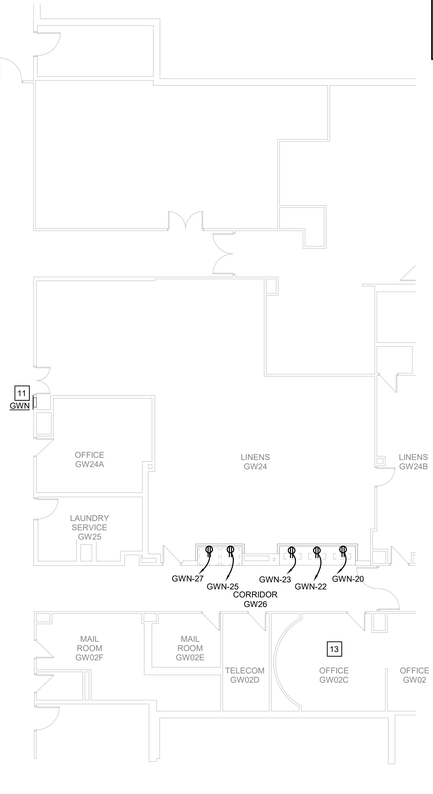
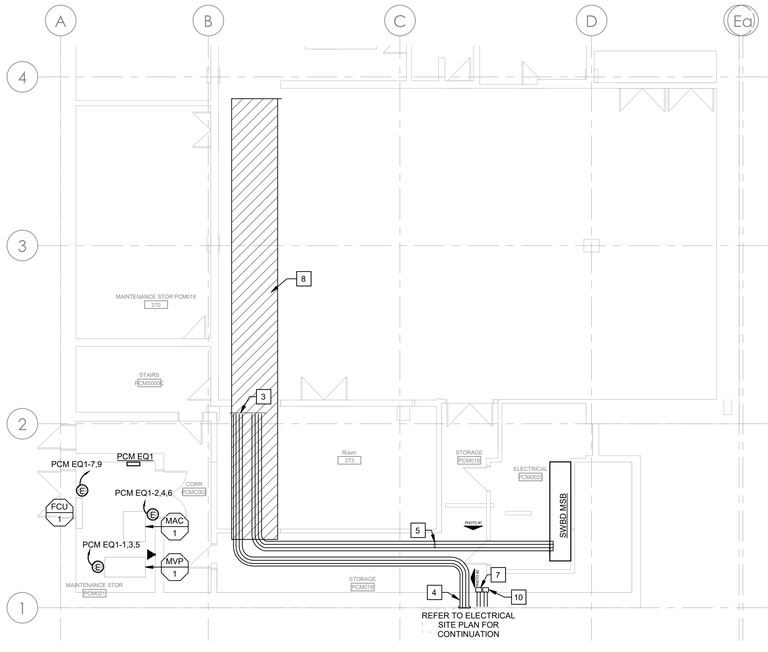


PHOTO #1

PHOTO #2



2 ELECTRICAL - MEZZ - NEW WORK
1/8" = 1'-0"

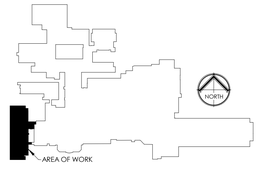
0' 4' 8' 16' 32'

GENERAL SHEET NOTES

A. EXISTING ELECTRICAL INFRASTRUCTURE (PANELBOARDS, ETC.) ARE SHOWN FOR REFERENCE ONLY AND ARE EXISTING TO REMAIN UNLESS OTHERWISE NOTED. SEE ELECTRICAL ONE-LINE DIAGRAM FOR ADDITIONAL INFORMATION.

KEYED NOTES

1. PROVIDE (4) 3-1/2" CONDUITS TO NEW GENERATOR SWITCHBOARD. IN ADDITION, PROVIDE (2) 2" CONDUITS FOR CONTROL WIRING AND MISC. GENERATOR POWER. ROUTED UP HIGH ABOVE MECHANICAL DUCTS. APPROXIMATE ROUTING OF CONDUITS SHOWN IS ONLY A SUGGESTION. ALTERNATE ROUTING METHODS MAY BE AVAILABLE. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO INVESTIGATE AND VERIFY ALTERNATE ROUTING METHODS IN THE FIELD.
2. REFER TO MEZZANINE FLOOR PLAN. THIS SHEET FOR ROUTING CONTINUATION. CHANGE IN ELEVATION OF GROUND FLOOR OCCURS HERE AT RAMP DOWN TO THE VA ACCESS TUNNEL.
3. REFER TO GROUND-FLOOR FLOOR PLAN, THIS SHEET FOR ROUTING CONTINUATION. CHANGE IN ELEVATION OCCURS ON FLOOR BELOW.
4. INCOMING CONDUITS AND FEEDERS, BELOW GRADE FROM GENERATOR.
5. ROUTE NEW RACEWAY AND CONDUCTORS FROM BREAKERS IN EXISTING MAIN SWITCHBOARD 'MSB' TO NEW LIFE SAFETY, CRITICAL AND EQUIPMENT POWER AUTOMATIC TRANSFER SWITCHES. REFER TO ELECTRICAL ONE-LINE FOR RACEWAY/CONDUCTOR REQUIREMENTS AND ADDITIONAL INFORMATION.
6. PROVIDE NEW PULLBOX IN ACCESSIBLE LOCATION NEAR BUILDING SHAFT FOR FUTURE CONDUITS UP TO NEW CRITICAL BRANCH PANELBOARDS IN ELECTRICAL ROOMS ON THREE FLOORS ABOVE. PROVIDE AND ROUTE (3) 2-1/2" CONDUITS FROM PULLBOX BACK TO CRITICAL BRANCH DISTRIBUTION PANEL 'DP-PCG CR1'.
7. PROVIDE 2" CONDUIT FROM NEW PULLBOX IN NEW ESSENTIAL ELECTRICAL SYSTEM DISTRIBUTION ROOM WITH MONITOR CONTROL WIRING AS REQUIRED FROM NEW REMOTE GENERATOR ANNUNCIATOR AND AUTOMATIC TRANSFER SWITCHES TO NEW OUTDOOR GENERATOR AND TEMP GENERATOR/LOAD BANK CONNECTION SWITCHBOARD.
8. HATCHED REGION INDICATES CEILING SPACE BELOW FOR ROUTING CLARITY.
9. PROVIDE 4" HIGH HOUSEKEEPING PAD AROUND NEW AUTOMATIC TRANSFER SWITCH LINE-UP. HOUSEKEEPING PAD SHALL EXTEND 4" BEYOND EQUIPMENT ENCLOSURE.
10. PROVIDE NEW PULLBOX FOR BRANCH CIRCUITS TO GENERATOR AREA LIGHTS, RECEPTACLES AND GENERATOR ACCESSORIES FROM EXISTING LIFE SAFETY PANELBOARD 'YL-1'.
11. PROVIDE NEW GROUND FAULT TYPE CIRCUIT BREAKERS WITHIN EXISTING SPACES IN PANEL 'GWN' FOR RELOCATED LIGHTING CIRCUITS. REFER TO PANEL SCHEDULE FOR ADDITIONAL INFORMATION. REFER TO ARCHITECTURAL OVERALL PLANS FOR ADDITIONAL INFORMATION.
12. PROVIDE AND INSTALL SLOTTED STEEL CHANNEL AND SUPPORTS, ADJACENT TO EXISTING PANEL 'EM-2' FOR MOUNTING OF NEW PANELBOARD.
13. PROVIDE GENERATOR AND ATS ANNUCIATOR AND CABLING FROM NEW AUTOMATIC TRANSFER SWITCHES AND GENERATOR TO THIS ROOM. COORDINATE ANNUCIATOR PANEL LOCATIONS WITH OWNER.
14. PROVIDE 4" HIGH HOUSEKEEPING PAD AROUND NEW DISTRIBUTION BOARD LINE-UP. HOUSEKEEPING PAD SHALL EXTEND 4" BEYOND EQUIPMENT ENCLOSURE.
15. PROVIDE 120V ELECTRICAL CONNECTION TO NEW PRESSURE SWITCH ACTUATOR. COORDINATE POWER CONNECTION WITH DIVISION 22, CONTROLS CONTRACTOR, AND ACTUAL EQUIPMENT PROVIDED.
16. INTERCEPT EXISTING NORMAL POWER CORRIDOR LIGHTING CIRCUIT AND EXTEND TO FOUR NEW LED FIXTURES AT EACH LANDING OF NEW MECHANICAL CHASE.
17. INTERCEPT EXISTING NORMAL POWER LIGHTING CIRCUIT 'KL-43' AND EXTEND TO THREE NEW LED FIXTURES AT EACH LANDING OF NEW MECHANICAL CHASE.
18. MOUNT NEW VFD'S FOR EXISTING EXHAUST FANS BEING REPLACED. UTILIZE EXISTING RACEWAY ROUTING UP TO EXHAUST FAN LOCATION ON ROOF.



bcdesign GROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number
A-2011033299

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383
Missouri Certificate of Authority #000148

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111
Missouri Certificate of Authority #000442

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD. BLDG. 1,
COLUMBIA, MO 65203
573.447.0292
Missouri Certificate of Authority #2005151001

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

STATE OF MISSOURI
ALLAN ROBERT HENDRIKSE
NUMBER
PE-2004017185
PROFESSIONAL ENGINEER

Allan Robert Hendrikse, Engineer
PE-2004017185

Issue Date: 02.25.2021

Issue:	Date:
1 ADDENDUM 1	03.12.2021

Drawn by: MJS

bcdg Project #: 12275.42
MU Project #: CP210251

E101
ELECTRICAL - GROUND FLOOR - POWER AND SYSTEMS - NEW WORK

BID SET - ADDENDUM #1

AUTOMATIC TRANSFER SWITCH SCHEDULE

PLAN MARK	ATS TYPE	TRANSITION	NEUTRAL	VOLTAGE	POLES	ATS SZE	SCCR	NEMA ENCLOSURE	ACCESSORIES	APPROVED MANUFACTURERS
ATS-PC CR1	AUTO - B/I	CT	SWN	208/120V	3	800A	65,000	1	TDES, CS1P, CS2P, LTR, BTR, LSR	RUSSELECTRIC RPTCS SERIES
ATS-PC EQ1	AUTO - B/I	CT	SWN	208/120V	3	800A	65,000	1	TDES, CS1P, CS2P, LTR, BTR, LSR	RUSSELECTRIC RPTCS SERIES
ATS-PC LS1	AUTO - B/I	CT	SWN	208/120V	3	400A	42,000	1	TDES, CS1P, CS2P, LTR, BTR, LSR	RUSSELECTRIC RPTCS SERIES

ACCESSORIES LEGEND	
BTR	BLOCK TRANSFER FUNCTION
CS1P	AUXILIARY CONTACT CLOSED IN SOURCE 2 POSITION
CS2P	AUXILIARY CONTACT CLOSED IN SOURCE 2 POSITION
ELEV	ELEVATOR EMERGENCY TO NORMAL PRESIGNAL
LSR	LOAD SHED FUNCTION
LTR	LOAD TEST CIRCUIT
NET	ETHERNET AND SERIAL CONNECTIVITY
PM	POWER MONITORING METER
RA	REMOTE ANNUNCIATOR
RC	REMOTE CONTROL CIRCUIT
RT	REMOTE TRANSFER CONTROL
SER	SERVICE ENTRANCE RATED
SP	SURGE PROTECTION
TDES	TIME DELAY
TI	TRANSFER INHIBIT

TYPE LEGEND	
A	AUTOMATIC
AUTO - B/I	AUTO. BYPASS ISOLATION
M	MANUAL
SS	SOLID STATE

TRANSITION LEGEND	
CT	CLOSED TRASITION
DT	DELAY TRANSITION - CENTER OFF
OT	OPEN TRANSITION

NEUTRAL LEGEND	
-	NO NEUTRAL
ON	OVERLAPPED SWITCHED NEUTRAL
SN	SOLID NEUTRAL
SWN	SWITCHED NEUTRAL

FEEDER SCHEDULE

FEEDER NUMBER	TOTAL SETS	PHASE CONDUCTORS		NEUTRAL CONDUCTOR (1 PER SET)	GROUNDING CONDUCTOR (1 PER SET)	EMT CONDUIT SIZE (1 PER SET)
		QUANTITY (PER SET)	SIZE			
30/N/G	1	3	10	10	10	3/4"
60/N/G	1	3	6	6	10	1"
100/N/G	1	3	3	3	8	1-1/4"
125/N/G	1	3	1	1	6	1-1/2"
400/N/G	1	3	500kcmil	500kcmil	3	3"
800/N/G	2	3	500kcmil	500kcmil	1/0	3-1/2"
1600/N/G	4	3	600kcmil	600kcmil	4/0	3-1/2"

OVERCURRENT DEVICE COORDINATION

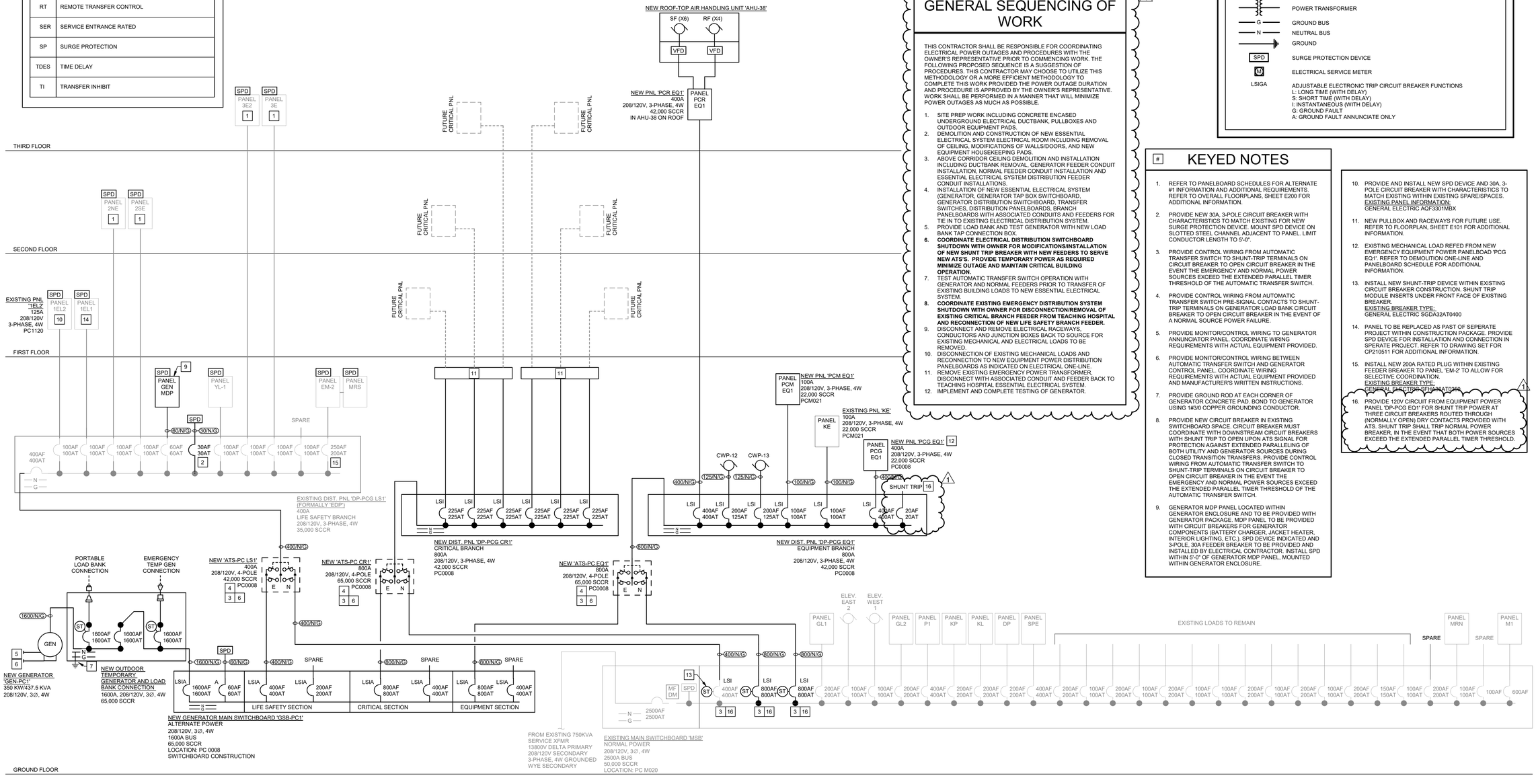
CIRCUIT BREAKER EQUIPMENT: BASIS OF DESIGN

ELECTRICAL EQUIPMENT			CIRCUIT BREAKER TYPE			ESSENTIAL ELECTRICAL SYSTEM DESIGNATION PER NEC 517	MINIMUM COORDINATION INTERVAL WITH UPSTREAM DEVICES	NOTES
EQUIPMENT DESIGNATION	MANUFACTURER	MODEL	MAIN	BRANCH	FEATURE			
GEN-PC1	ABB	SPECTRA BOLT-ON AV5	--	SS	LSIA	ESSENTIAL SYSTEM	0.1S	
GSB-PC1	ABB	RELIAGEAR AV5	SS	SKHC8/SGHC4/ XT1S125	LSIA	ESSENTIAL SYSTEM	0.1S	1,2
DP-PCG LS1	ABB,GE (EXISTING)	A SERIES II	SGHA	SFHA/TEY		LIFE SAFETY BRANCH	0.1S	1,2
DP-PCG CR1	ABB	RELIAGEAR neXT	--	XT5N400	LSIA	CRITICAL BRANCH	0.1S	1,2
DP-PCG EQ1	ABB	RELIAGEAR neXT	--	XT5N400/ XT4N250	LSIA	EQUIPMENT BRANCH	0.1S	1,2
PCG EQ1	ABB	RELIAGEAR RQ	XT5N400	THHQB	LSI	EQUIPMENT BRANCH	0.1S	1,2
PCR EQ1	ABB	RELIAGEAR RQ	--	TXQB/ XT1S125	LSI	EQUIPMENT BRANCH	0.1S	1,2
PCM EQ1	ABB	RELIAGEAR RQ	XT4N250	THHQB	LSI	EQUIPMENT BRANCH	0.1S	1,2

INFORMATION PROVIDED AS A BASIS OF DESIGN ONLY. PRIOR TO ORDERING ANY ELECTRICAL EQUIPMENT, CONTRACTOR SHALL CONFIRM SELECTED EQUIPMENT COORDINATES TO THE TIME INTERVAL LISTED.

1. DOWNSTREAM CIRCUIT BREAKERS MUST ALSO COORDINATE TO COORDINATION INTERVAL SPECIFIED IN PERVIOUS COLUMN.

2. PROVIDE ADJUSTABLE TRIP CHARACTERISTICS (L/S/I) AS REQUIRED TO ACHIEVE COORDINATION INTERVAL SPECIFIED. CONTRACTOR TO COODINATE REQUIREMENTS WITH EQUIPMENT VENDOR PRIOR TO BID. REFER TO SPECIFICATION 26 05 73 FOR ADDITIONAL INFORMATION.



GENERAL SEQUENCING OF WORK

THIS CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING ELECTRICAL POWER OUTAGES AND PROCEDURES WITH THE OWNER'S REPRESENTATIVE PRIOR TO COMMENCING WORK. THE FOLLOWING PROPOSED SEQUENCE IS A SUGGESTION OF PROCEDURES. THIS CONTRACTOR MAY CHOOSE TO UTILIZE THIS METHODOLOGY OR A MORE EFFICIENT METHODOLOGY TO COMPLETE THIS WORK PROVIDED THE POWER OUTAGE DURATION AND PROCEDURE IS APPROVED BY THE OWNER'S REPRESENTATIVE. WORK SHALL BE PERFORMED IN A MANNER THAT WILL MINIMIZE POWER OUTAGES AS MUCH AS POSSIBLE.

1. SITE PREP WORK INCLUDING CONCRETE ENCASED UNDERGROUND ELECTRICAL DUCTBANK, PULLBOXES AND OUTDOOR EQUIPMENT PADS.
2. DEMOLITION AND CONSTRUCTION OF NEW ESSENTIAL ELECTRICAL SYSTEM ELECTRICAL ROOM INCLUDING REMOVAL OF CEILING, MODIFICATIONS OF WALLS/DOORS, AND NEW EQUIPMENT HOUSEKEEPING PADS.
3. ABOVE CORRIDOR CEILING DEMOLITION AND INSTALLATION INCLUDING DUCTBANK REMOVAL, GENERATOR FEEDER CONDUIT INSTALLATION, NORMAL FEEDER CONDUIT INSTALLATION AND ESSENTIAL ELECTRICAL SYSTEM DISTRIBUTION FEEDER CONDUIT INSTALLATIONS.
4. INSTALLATION OF NEW ESSENTIAL ELECTRICAL SYSTEM (GENERATOR, GENERATOR TAP BOX SWITCHBOARD, GENERATOR DISTRIBUTION SWITCHBOARD, TRANSFER SWITCHES, DISTRIBUTION PANELBOARDS, BRANCH PANELBOARDS WITH ASSOCIATED CONDUITS AND FEEDERS FOR TIE IN TO EXISTING ELECTRICAL DISTRIBUTION SYSTEM.
5. PROVIDE LOAD BANK AND TEST GENERATOR WITH NEW LOAD BANK TAP CONNECTION BOX.
6. **COORDINATE ELECTRICAL DISTRIBUTION SWITCHBOARD SHUTDOWN WITH OWNER FOR MODIFICATIONS/INSTALLATION OF NEW SHUNT TRIP BREAKER WITH NEW FEEDERS TO SERVE NEW ATS'S. PROVIDE TEMPORARY POWER AS REQUIRED MINIMIZE OUTAGE AND MAINTAIN CRITICAL BUILDING OPERATION.**
7. TEST AUTOMATIC TRANSFER SWITCH OPERATION WITH GENERATOR AND NORMAL FEEDERS PRIOR TO TRANSFER OF EXISTING BUILDING LOADS TO NEW ESSENTIAL ELECTRICAL SYSTEM.
8. **COORDINATE EXISTING EMERGENCY DISTRIBUTION SYSTEM SHUTDOWN WITH OWNER FOR DISCONNECTION/REMOVAL OF EXISTING CRITICAL BRANCH FEEDER FROM TEACHING HOSPITAL AND RECONNECTION OF NEW LIFE SAFETY BRANCH FEEDER.**
9. DISCONNECT AND REMOVE ELECTRICAL RACEWAYS, CONDUCTORS AND JUNCTION BOXES BACK TO SOURCE FOR EXISTING MECHANICAL AND ELECTRICAL LOADS TO BE REMOVED.
10. DISCONNECTION OF EXISTING MECHANICAL LOADS AND RECONNECTION TO NEW EQUIPMENT POWER DISTRIBUTION PANELBOARDS AS INDICATED ON ELECTRICAL ONE-LINE.
11. REMOVE EXISTING EMERGENCY POWER TRANSFORMER, DISCONNECT WITH ASSOCIATED CONDUIT AND FEEDER BACK TO TEACHING HOSPITAL ESSENTIAL ELECTRICAL SYSTEM.
12. IMPLEMENT AND COMPLETE TESTING OF GENERATOR.

KEYED NOTES

1. REFER TO PANELBOARD SCHEDULES FOR ALTERNATE #1 INFORMATION AND ADDITIONAL REQUIREMENTS. REFER TO OVERALL FLOORPLANS, SHEET E200 FOR ADDITIONAL INFORMATION.
2. PROVIDE NEW 30A, 3-POLE CIRCUIT BREAKER WITH CHARACTERISTICS TO MATCH EXISTING FOR NEW SURGE PROTECTION DEVICE. MOUNT SPD DEVICE ON SLOTTED STEEL CHANNEL ADJACENT TO PANEL. LIMIT CONDUCTOR LENGTH TO 5'-0".
3. PROVIDE CONTROL WIRING FROM AUTOMATIC TRANSFER SWITCH TO SHUNT-TRIP TERMINALS ON CIRCUIT BREAKER TO OPEN CIRCUIT BREAKER IN THE EVENT THE EMERGENCY AND NORMAL POWER SOURCES EXCEED THE EXTENDED PARALLEL TIMER THRESHOLD OF THE AUTOMATIC TRANSFER SWITCH.
4. PROVIDE CONTROL WIRING FROM AUTOMATIC TRANSFER SWITCH PRE-SIGNAL CONTACTS TO SHUNT-TRIP TERMINALS ON GENERATOR LOAD BANK CIRCUIT BREAKER TO OPEN CIRCUIT BREAKER IN THE EVENT OF A NORMAL SOURCE POWER FAILURE.
5. PROVIDE MONITOR/CONTROL WIRING TO GENERATOR ANNUNCIATOR PANEL. COORDINATE WIRING REQUIREMENTS WITH ACTUAL EQUIPMENT PROVIDED.
6. PROVIDE MONITOR/CONTROL WIRING BETWEEN AUTOMATIC TRANSFER SWITCH AND GENERATOR CONTROL PANEL. COORDINATE WIRING REQUIREMENTS WITH ACTUAL EQUIPMENT PROVIDED AND MANUFACTURER'S WRITTEN INSTRUCTIONS.
7. PROVIDE GROUND ROD AT EACH CORNER OF GENERATOR CONCRETE PAD. BOND TO GENERATOR USING 1#3/0 COPPER GROUNDING CONDUCTOR.
8. PROVIDE NEW CIRCUIT BREAKER IN EXISTING SWITCHBOARD SPACE. CIRCUIT BREAKER MUST COORDINATE WITH DOWNSTREAM CIRCUIT BREAKERS WITH SHUNT TRIP TO OPEN UPON ATS SIGNAL FOR PROTECTION AGAINST EXTENDED PARALLELING OF BOTH UTILITY AND GENERATOR SOURCES DURING CLOSED TRANSITION TRANSFERS. PROVIDE CONTROL WIRING FROM AUTOMATIC TRANSFER SWITCH TO SHUNT-TRIP TERMINALS ON CIRCUIT BREAKER TO OPEN CIRCUIT BREAKER IN THE EVENT THE EMERGENCY AND NORMAL POWER SOURCES EXCEED THE EXTENDED PARALLEL TIMER THRESHOLD OF THE AUTOMATIC TRANSFER SWITCH.
9. GENERATOR MDP PANEL LOCATED WITHIN GENERATOR ENCLOSURE AND TO BE PROVIDED WITH GENERATOR PACKAGE. MDP PANEL TO BE PROVIDED WITH CIRCUIT BREAKERS FOR GENERATOR COMPONENTS (BATTERY CHARGER, JACKET HEATER, INTERIOR LIGHTING, ETC.). SPD DEVICE INDICATED AND 3-POLE, 30A FEEDER BREAKER TO BE PROVIDED AND INSTALLED BY ELECTRICAL CONTRACTOR. INSTALL SPD WITHIN 5'-0" OF GENERATOR MDP PANEL, MOUNTED WITHIN GENERATOR ENCLOSURE.
10. PROVIDE AND INSTALL NEW SPD DEVICE AND 30A, 3-POLE CIRCUIT BREAKER WITH CHARACTERISTICS TO MATCH EXISTING WITHIN EXISTING SPARE/SPACES.
EXISTING PANEL INFORMATION:
GENERAL ELECTRIC AQF3301MBX
11. NEW PULLBOX AND RACEWAYS FOR FUTURE USE. REFER TO FLOORPLAN, SHEET E101 FOR ADDITIONAL INFORMATION.
12. EXISTING MECHANICAL LOAD REFED FROM NEW EMERGENCY EQUIPMENT POWER PANELBOAD 'PCG EQ1'. REFER TO DEMOLITION ONE-LINE AND PANELBOARD SCHEDULE FOR ADDITIONAL INFORMATION.
13. INSTALL NEW SHUNT-TRIP DEVICE WITHIN EXISTING CIRCUIT BREAKER CONSTRUCTION. SHUNT TRIP MODULE INSERTS UNDER FRONT FACE OF EXISTING BREAKER.
EXISTING BREAKER TYPE:
GENERAL ELECTRIC SGDA32AT0400
14. PANEL TO BE REPLACED AS PAST OF SEPERATE PROJECT WITHIN CONSTRUCTION PACKAGE. PROVIDE SPD DEVICE FOR INSTALLATION AND CONNECTION IN SPERATE PROJECT. REFER TO DRAWING SET FOR CP210511 FOR ADDITIONAL INFORMATION.
15. INSTALL NEW 200A RATED PLUG WITHIN EXISTING FEEDER BREAKER TO PANEL 'EM-2' TO ALLOW FOR SELECTIVE COORDINATION.
EXISTING BREAKER TYPE:
GENERAL ELECTRIC SFHA36AT0200
16. PROVIDE 120V CIRCUIT FROM EQUIPMENT POWER PANEL 'DP-PCG EQ1' FOR SHUNT TRIP POWER AT THREE CIRCUIT BREAKERS ROUTED THROUGH (NORMALLY OPEN) DRY CONTACTS PROVIDED WITH ATS. SHUNT TRIP SHALL TRIP NORMAL POWER BREAKER, IN THE EVENT THAT BOTH POWER SOURCES EXCEED THE EXTENDED PARALLEL TIMER THRESHOLD.

ONE-LINE DIAGRAM GENERAL NOTES

1. SHORT CIRCUIT CURRENT AND AIC RATINGS LISTED FOR ELECTRICAL EQUIPMENT ARE THE MINIMUM REQUIREMENTS FOR THE BUS BRACING AND DEVICE RATINGS. ALL EQUIPMENT SHALL BE FULLY RATED UNLESS SPECIFICALLY NOTED AS SERIES RATED. ELECTRICAL CONTRACTOR IS REQUIRED TO PROVIDE ARC FLASH HAZARD AND PERSONNEL PROTECTIVE EQUIPMENT LABELS FOR EACH INDICATED PIECE OF ELECTRICAL EQUIPMENT.
2. ALL FUSED SWITCHES AND CIRCUIT BREAKERS SHOWN ON ONE-LINE DIAGRAM ARE 3-POLE. UNLESS NOTED OTHERWISE.
3. "AF" INDICATES CIRCUIT BREAKER/FUSIBLE SWITCH FRAME SIZE.
4. "AT" INDICATES CIRCUIT BREAKER TRIP SETTING (FOR ADJUSTABLE TRIP TYPE CIRCUIT BREAKERS)/FUSE SIZE.
5. THE VARIABLE FREQUENCY DRIVE AND DISCONNECT SCHEME SHOWN ON ONE-LINE DIAGRAM REQUIRES SPECIFIC INTERLOCKING OF EQUIPMENT. IT IS THE ELECTRICAL CONTRACTOR'S RESPONSIBILITY TO COORDINATE ALL REQUIRED AUXILIARY CONTACTS OF EQUIPMENT AND FURNISH AND INSTALL ALL CABLES, CONDUIT, TERMINATIONS, ETC. FOR A COMPLETE INTERLOCKING SYSTEM.
6. FIELD VERIFY ALL EXISTING CONDITIONS.

ONE-LINE DIAGRAM SYMBOLS

- XX/XX — FUSIBLE SWITCH (SIZE/FUSE)
- DRAWOUT CIRCUIT BREAKER
- XX/XX — CIRCUIT BREAKER (FRAME/TRIP)
- MB / DM — MICROPROCESSOR BASED DIGITAL MONITOR
- MOTOR STARTER
- CONTACTOR
- GEN — GENERATOR
- POWER TRANSFORMER
- G — GROUND BUS
- N — NEUTRAL BUS
- GROUND
- SPD — SURGE PROTECTION DEVICE
- Ω — ELECTRICAL SERVICE METER
- LSIGA — ADJUSTABLE ELECTRONIC TRIP CIRCUIT BREAKER FUNCTIONS
  L: LONG TIME (WITH DELAY)
  S: SHORT TIME (WITH DELAY)
  I: INSTANTANEOUS (WITH DELAY)
  G: GROUND FAULT
  A: GROUND FAULT ANNUNCIATE ONLY

1 ELECTRICAL ONE-LINE DIAGRAM
NO SCALE

bcdDESIGNGROUP
12101 W 110th Street, Suite 100
Overland Park, KS 66210
913.232.2123
MO Certificate of Authority Number A-2011033299

Project Team:

ROSS & BARUZZINI, INC.
6 SOUTH OLD ORCHARD | ST. LOUIS, MO 63119
314.918.8383
Missouri Certificate of Authority #000148

BOB D. CAMPBELL 7 CO.
4338 BELLEVIEW AVENUE
KANSAS CITY, MO 64111
Missouri Certificate of Authority #000442

CROCKETT ENGINEERING CONSULTANTS
1000 W NIFONG BLVD, BLDG. 1,
COLUMBIA, MO 65203
573.447.0292
Missouri Certificate of Authority #2005151001

Project Title:
MPC 1st Floor Infrastructure Upgrades Serving Level 1
CP210251
University of Missouri, Columbia, Missouri

Allan Robert Hendrikse, Engineer
PE-2004017185

Issue Date: 02.25.2021

Issue:	Date:
1 ADDENDUM 1	03.12.2021

Drawn by: MJS

bcdg Project #: 12275.42
MU Project #: CP210251

E700
ELECTRICAL ONE-LINE DIAGRAM

BID SET - ADDENDUM #1