

ADMINISTRATION BUILDING ON CAMPBELL AVE - PHASE ONE (DATA CENTER)

ROANOKE CITY PUBLIC SCHOOLS

RRMM ARCHITECTS, PC

ARCHITECTURE / PLANNING / INTERIORS

28 Church Avenue SW
Roanoke, VA 24011
(540) 344-1212

IFB 3092 - ATTACHMENT 1

MARK	DATE	BY	DESCRIPTION



DATE	PROJECT	DESIGNED	DRAWN	CHECKED	JWH	BLH	CAP
05/27/2022	18106-09						



CONSULTANTS		OWNER
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BUILDING CODE DESIGN SUPPORTING DATA

PROJECT BASIC DESCRIPTION:
THE PROJECT INCLUDES LEVEL 2 ALTERATION TO PROVIDE A NEW DATA CENTER AND MATERIALS LIFT. DESIGN OCCUPANT LOAD, PLUMBING FIXTURE COUNTS, EGRESS ELEMENTS ARE UNCHANGED.

APPLICABLE CODES: BUILDING CODES: 2015 VIRGINIA EXISTING BUILDING CODE (VEBC)
ICC/ANSI A117.1 2009
2010 ADA STANDARDS FOR ACCESSIBLE DESIGN

GROSS BUILDING AREAS: 134,510 GSF EXISTING, UNCHANGED

USE GROUP (PER IBC 302.1): EXISTING, UNCHANGED
NON-SEPARATED MIXED USE
GROUP "B" BUSINESS
GROUP "S2" STORAGE (WAREHOUSE)

CONSTRUCTION TYPE: TYPE IIB UNPROTECTED

DESIGN AREA: DATA CENTER = 975 GROSS SF
ELECTRICAL CLOSET = 140 GROSS SF
TOTAL DESIGN AREA = 1,115 GROSS SF

FIRE PROTECTION SYSTEM: EXISTING BUILDING IS PARTIALLY SPRINKLERED
DATA CENTER TO RECEIVE FM200 SYSTEM WITH PRE-ACTION SYSTEM
AS A PART OF THIS WORK. BUILDING WILL BE FULLY SPRINKLERED
IN SUBSEQUENT PHASE OF THIS PROJECT.

OCCUPANT LOAD: OCCUPANT LOAD OF NEW ROOMS IS 8. BUILDING IS PARTIALLY
OCCUPIED, OVERALL OCCUPANT LOAD IS REDUCED FROM PRIOR
CAPACITY.

TOILET FIXTURES: N/A EXISTING, UNCHANGED

FIRE RESISTANCE RATING REQUIREMENTS
PER IBC TABLE 601.6(2)

EXTERIOR BEARING WALLS	0 HR.
EXTERIOR NON-BEARING WALLS	0 HR. (GREATER THAN 10' SEPARATION)
INTERIOR BEARING WALLS	0 HR.
INTERIOR NON-BEARING WALLS	0 HR.
STRUCTURAL FRAME	0 HR.
FLOOR/CEILING CONSTRUCTION	0 HR.
ROOF/CEILING CONSTRUCTION	0 HR.
FIRE BARRIER WALLS	0 HR.
STAIR SHAFT	EXISTING
ENCLOSED SPACE UNDER STAIRS	EXISTING
ELEVATOR SHAFT	EXISTING
CORRIDORS	EXISTING
ROOF COVERING CLASSIFICATION	MIN CLASS B
DRAFTSTOPPING	NOT REQUIRED WITH NON-COMBUSTIBLE CONSTRUCTION
INTERIOR FINISHES	CLASS B AND CLASS C DEPENDING ON FUNCTION

MEANS OF EGRESS:

REQUIRED EXITS	EXISTING, UNCHANGED
TRAVEL DISTANCE	EXISTING, UNCHANGED
EGRESS CAPACITY	EXISTING, UNCHANGED
TOTAL ALLOWABLE STORY/HEIGHT	GROUP B - 4 STORIES / 75' GROUP S2 - 4 STORIES / 75'
EXISTING STORY / HEIGHT	3 STORY + BASEMENT / 61' BASEMENT FLOOR TO PENTHOUSE FLOOR

ARCHITECTURAL MATERIAL LEGEND

	CONTINUOUS WOOD BLOCKING
	CONCRETE MASONRY UNIT
	CAST-IN-PLACE CONCRETE
	STEEL
	EARTH / COMPACT FILL
	BATT INSULATION
	POROUS FILL / GRAVEL
	RIGID INSULATION
	GYPSUM BOARD
	RESILIENT FLOORING / PLASTIC LAMINATE
	ALUMINUM
	FINISHED WOOD
	WOOD BLOCKING
	BRICK
	GLASS
	ACOUSTICAL TILE
	PLYWOOD
	CERAMIC TILE - LARGE SCALE
	SAND / MORTAR / PLASTER
	GRAVEL

ROANOKE CITY PUBLIC SCHOOLS
ADMINISTRATION BUILDING ON CAMPBELL (AOC)
PHASE ONE (DATA CENTER)
201 Campbell Ave SW
Roanoke, VA 24011
DRAWING TITLE SHEET

SHEET
G-001

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STRUCTURAL NOTES:

LOAD CHART:	
BUILDING CODE:	2015 VIRGINIA UNIFORM STATEWIDE BUILDING CODE
	PART I - VIRGINIA CONSTRUCTION CODE
	PART II - VIRGINIA EXISTING BUILDING CODE
	2015 INTERNATIONAL BUILDING CODE
	2015 INTERNATIONAL EXISTING BUILDING CODE
	ASCE 7-10
RISK CATEGORY:	2015 IBC TABLE 1604.5 II
FLOOR DEAD LOAD:	BEYOND SELF WEIGHT OF STRUCTURAL SYSTEM
	DATA ROOM FLOOR 15 PSF
FLOOR LIVE LOAD:	LIVE LOAD REDUCTION HAS NOT BEEN USED ASCE 7 - TABLE 4-1
	DATA ROOM FLOOR 100 PSF
SPECIAL LOADS:	LIST SPECIAL LOADS HERE OR SHOW ON PLANS
	ROOF UNIT 600 LBS
	FLOOR UNIT (DATA ROOM AREA) 2500 LBS
ROOF DEAD LOAD:	BEYOND SELF WEIGHT OF STRUCTURAL SYSTEM 30 PSF
ROOF LIVE LOAD:	MINIMUM UNIFORM DESIGN LOAD 20 PSF
SNOW:	
	SNOW IMPORTANCE FACTOR, I_s 1.0
	GROUND SNOW LOAD, P_g 30 PSF
	FLAT ROOF SNOW LOAD, P_f 21 PSF
	SNOW EXPOSURE FACTOR, C_e 1.0
	THERMAL FACTOR, C_t 1.0
	SLOPE FACTOR, C_s 1.0
	RAIN ON SNOW SURCHARGE 0 PSF
WIND:	FOR REFERENCE ONLY
	PROCEDURE DIRECTIONAL (CH. 27 ASCE 7)
	BASIC WIND SPEED, V 115 MPH
	ALLOWABLE STRESS DESIGN WIND SPEED, V_{ASD} 90 MPH
	WIND EXPOSURE CATEGORY B
	INTERNAL PRESSURE COEFFICIENT, GCF_i +0.18
	COMPONENTS & CLADDING SEE CHART
SEISMIC:	FOR REFERENCE ONLY
	SEISMIC IMPORTANCE FACTOR, I_e 1.0
	MAPPED SPECTRAL RESPONSE, S_s 19.00%
	MAPPED SPECTRAL RESPONSE, S_1 6.40%
	SITE CLASS D
	SPECTRAL RESPONSE COEFFICIENT, S_{DS} 0.20%
	SPECTRAL RESPONSE COEFFICIENT, S_{D1} 10.20%
	SEISMIC DESIGN CATEGORY B
	SEISMIC FORCE RESISTING SYSTEM ASCE 7 - TABLE 12.2-1
	NOT APPLICABLE - ALTERATION
ICE:	
	ICE THICKNESS 1.0 INCH
	GUST SPEED 30 MPH
RAIN:	
	15-MINUTE PRECIPITATION INTENSITY 5.32 IN./HR.
	60-MINUTE PRECIPITATION INTENSITY 2.82 IN./HR.
RAILINGS:	
	UNIFORM LOAD - ANY DIRECTION - APPLIED TO TOP 50 PLF
	CONCENTRATED LOAD - ANY DIRECTION - APPLIED TO TOP 200 LBS
	COMPONENTS (OVER 1 SQUARE FOOT) 50 LBS
SOIL:	
	NET ALLOWABLE BEARING PRESSURE 2000 PSF

STRUCTURAL NOTES (RENOVATION):

- SPECIAL INSPECTIONS ARE REQUIRED BY THE BUILDING CODE. REFER TO PROJECT SPECIFICATIONS, AND STATEMENT OF SPECIAL INSPECTIONS FOR SPECIFIC REQUIREMENTS.
 - CONTRACTOR SHALL COORDINATE INSPECTIONS WITH A MINIMUM OF 48 HOUR NOTICE TO INSPECTOR.
 - CONTRACTOR SHALL PROVIDE FULL ACCESS TO ALL ITEMS NECESSARY FOR INSPECTION - IF ITEMS NEED TO BE REMOVED FOR ACCESS, CONTRACTOR SHALL REMOVE AT NO COST TO OWNER.
- STRUCTURAL REVIEW AND DESIGN IS LIMITED TO THE AREAS INDICATED. STRUCTURAL ENGINEER ASSUMES NO RESPONSIBILITY FOR THE EXISTING BUILDING STRUCTURE EXCEPT AS SPECIFICALLY MODIFIED OR INDICATED.
- STRUCTURAL DRAWINGS SHALL BE USED IN CONJUNCTION WITH ARCHITECTURAL, CIVIL, MECHANICAL, PLUMBING AND ELECTRICAL DRAWINGS AND SPECIFICATIONS.
- CONTRACTOR SHALL VERIFY THE REQUIREMENT OF OTHER TRADES FOR SLEEVES, CHASES, HANGERS, INSERTS, ANCHORS, HOLES AND ADDITIONAL ITEMS TO BE PLACED OR SET SIMULTANEOUS WITH STRUCTURAL WORK.
- DETAILS SHOWN ARE TYPICAL AND APPLY TO SIMILAR OR LIKE CONDITIONS.
- DO NOT SCALE DRAWINGS, FOLLOW DIMENSIONS ON PLANS.
- DO NOT CHANGE THE SIZE, LENGTH OR SPACING OF STRUCTURAL ELEMENTS WITHOUT APPROVAL OF STRUCTURAL ENGINEER.
- DESIGN, ADEQUACY, AND SAFETY OF ERECTION BRACING, SHORING AND TEMPORARY SUPPORTS IS THE SOLE RESPONSIBILITY OF CONTRACTOR. CONTRACTOR IS RESPONSIBLE FOR COMPLYING WITH OSHA SAFETY REGULATIONS.
- CONTRACTOR SHALL VERIFY FLOOR OR ROOF MOUNTED MECHANICAL EQUIPMENT WEIGHTS, FLOOR, ROOF OR WALL OPENINGS SIZES AND LOCATIONS, AND SIZES OF EQUIPMENT PADS, WITH ARCHITECTURAL AND MECHANICAL DRAWINGS AND SUPPLIERS. NOTIFY ENGINEER IF LOADS ARE HIGHER THAN THOSE SHOWN.
- CONTRACTOR SHALL VERIFY EXISTING CONDITIONS INCLUDING DIMENSIONS TO EXISTING STRUCTURES, UTILITIES, FRAMING, FOUNDATIONS AND HIDDEN CONDITIONS AND COORDINATE THESE CONDITIONS WITH THE CONTRACT DOCUMENTS. NOTIFY THE ARCHITECT AND ENGINEER OF EXISTING CONDITIONS THAT ARE NOT AS SHOWN.
- PRIOR TO CUTTING OR DRILLING ANY NEW PENETRATION:
 - INSPECT BOTH SIDES OF SLAB OR WALL FOR BEAMS OR OTHER ELEMENTS THAT CAN BE HARMED BY PENETRATION. ADJUST PENETRATIONS TO MISS STRUCTURAL ELEMENTS.
- IF REINFORCEMENT IN CONCRETE SLAB OR WALL IS CUT OR DAMAGED BEYOND WHAT IS INDICATED TO BE REMOVED, CONTACT THE ARCHITECT AND STRUCTURAL ENGINEER PRIOR TO PROCEEDING FURTHER WITH ANY INSTALLATIONS WITHIN THIS PENETRATION.
- BEAMS/JOISTS/COLUMNS: DO NOT CUT, CORE, DAMAGE EXISTING BEAMS, JOISTS, COLUMNS OR OTHER MAJOR STRUCTURAL ELEMENTS OF THE BUILDING UNLESS SPECIFICALLY DETAILED. SHOULD ACCIDENTAL DAMAGE OCCUR, CONTACT THE ARCHITECT AND STRUCTURAL ENGINEER PRIOR TO PROCEEDING.
- NEW PIPE INSTALLATION:
 - WHEN NEW PIPE RUNS OF 3-INCH OR LARGER DIAMETER ARE INSTALLED PARALLEL TO EXISTING BEAMS OR JOISTS, SUPPORT PIPE(S) FROM 2 ADJACENT BEAMS/JOIST BY USE OF UN-STRUT OR SIMILAR PRODUCT WITHOUT DAMAGE TO THE BEAM OR JOIST.
 - WHEN NEW PIPE RUNS OF 3-INCH OR LARGER DIAMETER ARE INSTALLED PERPENDICULAR TO EXISTING BEAMS/JOISTS, SUPPORT PIPE(S) FROM EACH BEAM/JOIST WITHOUT DAMAGE TO THE BEAM OR JOIST.

31 00 00 EARTHWORK FOR STRUCTURES:

- SUBGRADES AND COMPACTED FILL SHALL BE OBSERVED BY A GEOTECHNICAL ENGINEER REGISTERED AS A PROFESSIONAL ENGINEER IN THE COMMONWEALTH OF VIRGINIA TO VERIFY CONFORMANCE. OBSERVING ENGINEER SHALL APPROVE SUBGRADES PRIOR TO CONCRETE PLACEMENT.
- SLAB-ON-GRADE PREPARATION:
 - UNDERLAIN BY MINIMUM 6 INCHES THICK NO. 57 CRUSHED STONE BED. DO NOT PLACE HORIZONTAL PIPE/CONDUIT WITHIN THE STONE BED.
 - REMOVE ROCK PINNACLES WITHIN ZONE OF SLAB OR STONE SUB-BASE TO AT LEAST THE BOTTOM ELEVATION OF THE STONE SUB-BASE.
- FILL:
 - CONSIST OF MATERIALS CLASSIFYING NO. 57 CRUSHED STONE AGGREGATE - CONSOLIDATED INTO PLACE.
 - SUBGRADES REQUIRING UNDERCUTTING SHALL BE FILLED WITH NO. 57 STONE TO THE ORIGINAL DESIGN SUBGRADE ELEVATION.
 - DO NOT PLACE COMPACTED FILL ON FROZEN OR OVER-WET SUBGRADES.
- UNSATURABLE, LOOSE OR SOFT SOIL SHALL BE REMOVED FROM THE EXCAVATION PRIOR TO PLACING FILL, STONE OR CONCRETE. DISTURBED, UNSATURABLE, OR EXCAVATED MATERIAL OCCURRING BELOW 45 DEGREES FROM HORIZONTAL BEGINNING AT THE BOTTOM MOST OUTER EDGE OF WALLS OR FOUNDATIONS SHALL BE REPLACED WITH COMPACTED FILL.
- BLASTING IS NOT PERMITTED.
- IF NON-UNIFORM ROCK OR DISINTEGRATED ROCK IS ENCOUNTERED AT FOUNDATION DESIGN SUBGRADE ELEVATION, UNDERCUT THIS MATERIAL ONE FOOT MINIMUM AND REPLACE WITH COMPACTED FILL.
- EVIDENCE OF KARST ACTIVITY OR SINKHOLES SHALL BE BROUGHT TO THE ATTENTION OF THE STRUCTURAL ENGINEER PRIOR TO PROCEEDING.
- SLOPE EXCAVATIONS, INSTALL SWALES AND/OR DEWATERING PUMPS TO MAINTAIN DRY SOIL CONDITIONS AND PREVENT STANDING WATER IN EXCAVATIONS FOR FOUNDATIONS AND SLABS.

03 00 00 CONCRETE AND REINFORCEMENT:

- GENERAL CONCRETE SHALL BE:

LOCATION	WEIGHT	STRENGTH (PSI)	AIR (%)(+/- 1%)	SLUMP (IN)(+/- 1/2)	MAX W/C RATIO	EXPOSURE CATEGORY
INTERIOR SLAB-ON-GRADE & WALLS	NW	3000	< 3	4	0.52	F0
EXTERIOR SLAB-ON-GRADE	NW	4500	5.5-6	4	0.48	F1

FIELD SAMPLING SHALL BE OBTAINED FROM MIDDLE OF BATCH

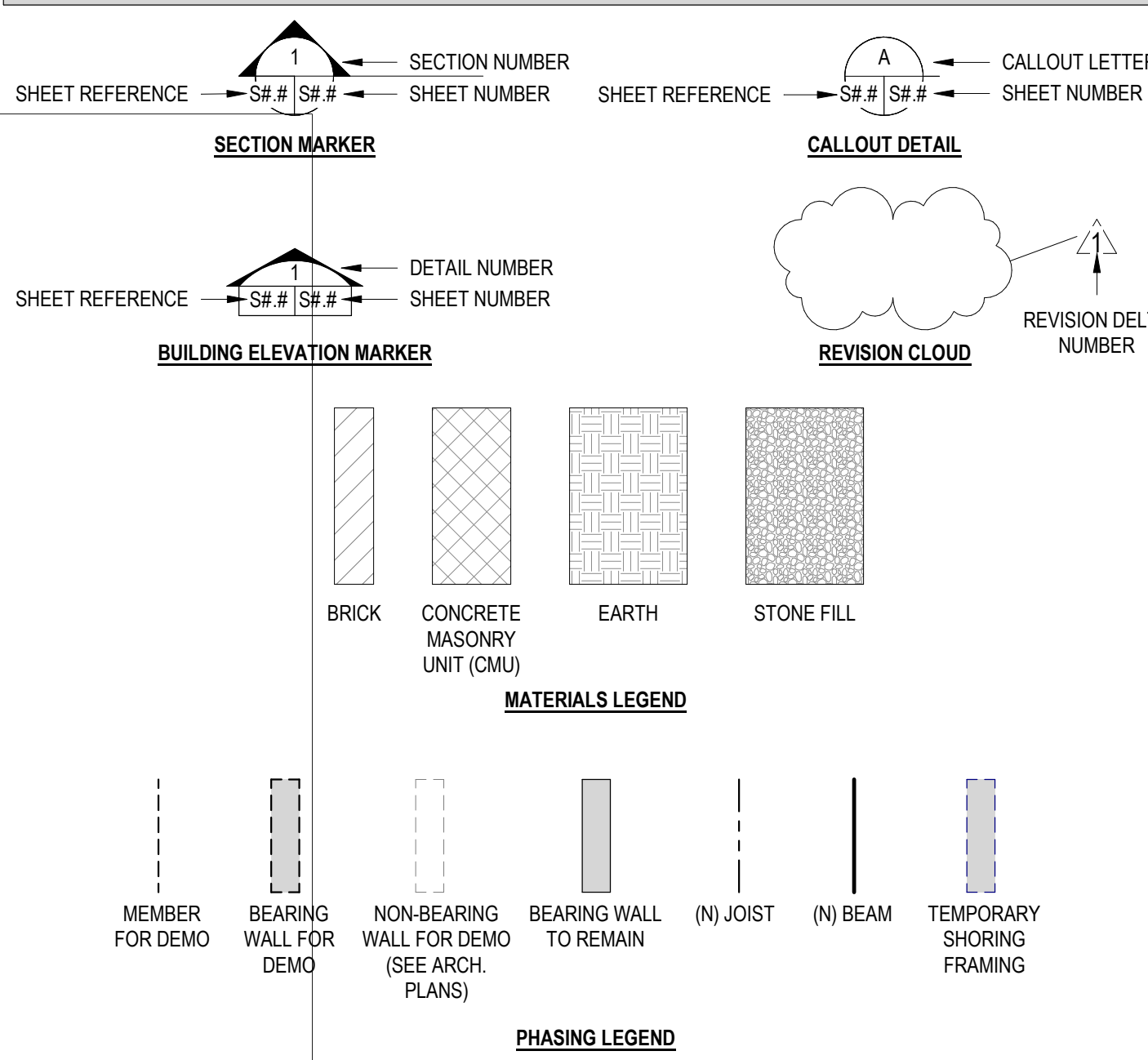
 - NORMAL WEIGHT (NW) CONCRETE SHALL BE 145 - 150 PCF
 - SLUMPS ABOVE ARE PRIOR TO ADDITION OF PLASTICIZERS OR MID RANGE WATER REDUCER. MAXIMUM SLUMP AFTER APPROVED ADJUSTIVES SHALL BE (8) INCHES MAXIMUM.
- MATERIALS:
 - CEMENT: ASTM C 150 TYPE III
 - FLY ASH: ASTM C618 CLASS C OR F, 20% MAX.
 - AGGREGATE: ASTM C33, GRADED, 1-1/2 INCH MAXIMUM
 - CONCRETE WORK SHALL BE IN FULL ACCORDANCE WITH:
 - AMERICAN CONCRETE INSTITUTE (ACI) 301, 315, AND 318
 - CRSI RECOMMENDED PRACTICE OF PLACING REINFORCING BARS
 - ACI 117 FOR PLACEMENT TOLERANCES (CONCRETE AND REINFORCEMENT)
 - ACI 302.1 CONCRETE FLOOR AND SLAB CONSTRUCTION
 - ACI 308 AND ACI 305 COLD/HOT WEATHER CONCRETING
 - ACI 308.1 FOR CURING OF CONCRETE
 - ACI 308RS GUIDE FOR CONSOLIDATION OF CONCRETE
 - ACI 347-04 (CHAPTER 5) GUIDE TO FORMWORK FOR CONCRETE
 - ACI "MANUAL OF STANDARD PRACTICES FOR DETAILING REINFORCED CONCRETE STRUCTURES"
- SLABS-ON-GRADE:
 - CEMENTITIOUS MATERIAL CONTENT IN ACCORDANCE WITH TABLE 8.4.4b OF ACI 302.1.
 - FINE AGGREGATE, NATURAL
 - MINIMUM MODULUS OF RUPTURE (MOR) PER ASTM C 496:
 - 3000 PSI MIX - 492 PSI
 - 4500 PSI MIX - 604 PSI
- REINFORCING:
 - ASTM A615, GRADE 60 FOR DEFORMED BARS
 - DEVELOPMENT LENGTH FOR REINFORCEMENT (db = BAR DIAMETER):

STRENGTH	#6 AND SMALLER	#7 AND LARGER	HOOK, LDH
3000 PSI	44 db	55 db	22 db
4500 PSI	36 db	45 db	18 db
 - DEVELOPMENT LENGTH MINIMUM OF 12 INCHES. HOOK DEVELOPMENT LENGTH MINIMUM 6 INCHES. DEVELOPMENT LENGTH ADJUSTMENTS:
 - TOP BAR REINFORCING: ABOVE MULTIPLIED BY 1.3
 - CLASS B TENSION LAPS: ABOVE MULTIPLIED BY 1.3
 - SPLICES SHALL BE CLASS B TENSION SPLICES UNLESS NOTED. MECHANICAL OR WELDED SPLICES SHALL DEVELOP 125% OF THE BAR YIELD STRENGTH
 - CONCRETE CLEAR COVER SHALL BE (UNLESS NOTED OTHERWISE):
 - BELOW GRADE (UNFORMED) 3"
 - BELOW GRADE (FORMED) 2"
 - EXPOSED TO WEATHER OR WATER 2"
 - PROVIDE DOWELS IN FOUNDATIONS TO MATCH THE SIZE AND QUANTITY AS VERTICAL WALL REINFORCEMENT.
 - PROVIDE CORNER BARS AT CORNERS AND INTERSECTING WALLS.
- CONCRETE FINISHES:
 - COORDINATE FLOOR SLAB LAYOUT WITH ARCHITECTURAL DRAWINGS FOR EXACT LIMITS, EXTENT OF DEPRESSIONS AND FINISHES.
 - EXTERIOR SIDEWALKS, RAMPS, STEPS AND PLATFORMS SHALL RECEIVE A NONSLIP BROOM FINISH
 - WALLS/GRADEBEAMS SHALL RECEIVE A SMOOTH FORM FINISH.
 - PROVIDE 1-INCH CHAMFER AT EXPOSED CONCRETE CORNERS
- POXY GROUTING OF DEFORMED BAR DOWELS OR ANCHOR RODS INTO EXISTING OR HARDENED CONCRETE SHALL BE INSTALLED ACCORDING TO EPOXY MANUFACTURERS RECOMMENDATION TO PROVIDE FULL DEVELOPMENT OF THE BAR OR BOLT FOR THE SPECIFIC CONCRETE STRENGTH AT POINT OF ATTACHMENT
 - APPLY LOADS ONLY AFTER EPOXY HAS REACHED FULL STRENGTH.
 - ALL PARTS OF ANCHORING SYSTEM (RODS, NUTS, WASHERS, BITS, EPOXY, ETC) SHALL BE FROM A SINGLE SUPPLIER.
- NO REPAIR OR RUBBING OF CONCRETE SHALL BE MADE PRIOR TO INSPECTION BY ARCHITECT/ENGINEER OR OWNER'S REPRESENTATIVE.

05 12 00 STRUCTURAL STEEL:

- STRUCTURAL STEEL SHALL BE IN ACCORDANCE WITH:
 - ANSI/AISC 360-10 "SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS" - ALLOWABLE STRESS DESIGN
 - ANSI/AISC 341-10 "SEISMIC PROVISIONS FOR STRUCTURAL STEEL BUILDINGS" - ALLOWABLE STRESS DESIGN
 - AISC 303-10 "CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES"
 - AWS D1.1 "STRUCTURAL WELDING CODE - STEEL"
 - AISC "SPECIFICATION FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS."
- MATERIALS SHALL COMPLY WITH:
 - STRUCTURAL STEEL SHAPES (EXCEPT W & C) ASTM A572 GR 50 or ASTM A992 GR 50
 - STRUCTURAL STEEL W&C SHAPES ASTM A992 GRADE 50
 - STRUCTURAL PLATES & BAR ASTM A36 OR ASTM A572 GRADE 50
 - STRUCTURAL BOLTS ASTM A325
 - STRUCTURAL NUTS ASTM A563
 - STRUCTURAL WASHERS ASTM F436
 - ANCHOR RODS ASTM F1554 GRADE 36
 - GROUT ASTM C1107 NON-METALLIC, NON-SHRINK
- CONNECTIONS SHALL BE:
 - CONNECTIONS SHALL BE:
 - IN ACCORDANCE WITH AISC SPECIFICATIONS
 - DESIGNED AND DETAILED FOR THE REACTIONS SHOWN ON THE DRAWINGS OR MINIMUM PERMITTED BY AISC. USE 2 BOLTS MINIMUM PER CONNECTION OR THE EQUIVALENT WELD
 - IF REACTIONS ARE NOT INDICATED, DESIGN SHEAR CONNECTIONS FOR HALF THE MAXIMUM TOTAL UNIFORM LOAD INDICATED IN TABLE 3.6 OF THE STEEL CONSTRUCTION MANUAL (6 KIPS MM).
 - MINIMUM BOLT SIZE SHALL BE 3/4 INCH A325
 - SHALL BE IN ACCORDANCE WITH PARTS 9 THROUGH 15 OF THE STEEL CONSTRUCTION MANUAL.
 - BOLTS SHALL BE INSTALLED SNUG TIGHT UNLESS INDICATED OTHERWISE
 - EXTENDED SHEAR TAB CONNECTIONS ARE NOT PERMITTED WITHOUT PRIOR WRITTEN PERMISSION OF THE STRUCTURAL ENGINEER. IF PERMITTED, DESIGN SHALL BE PER AISC DESIGN GUIDE FOR EXTENDED SHEAR TAB CONNECTIONS.
 - PROTECTION OF EXISTING BUILDING: CONTRACTOR SHALL PROTECT THE EXISTING BUILDING DURING STRUCTURAL MODIFICATIONS.
 - DO NOT OVERHEAT EXISTING STEEL DURING WELDING OPERATIONS TO A MANNER TO WEAKEN THE STEEL. IF HEAT GENERATED IS HIGH ENOUGH TO TEMPORARILY WEAKEN STEEL FRAME, INSTALL SHORING AND MAINTAIN UNTIL WORK IS COMPLETE.
 - IF DAMAGE TO EXISTING STRUCTURE DOES OCCUR, INSTALL OR LEAVE SHORING IN PLACE AND CONTACT ENGINEER FOR DIRECTIONS. DO NOT PROCEED WITH WORK ON DAMAGED MEMBERS WITHOUT SPECIFIC DIRECTIONS.
 - PROTECT ALL AREAS FROM WELDING SPARKS BY USE OF WELDING MATS OR OTHER NON-FLAMMABLE PROTECTIVE DEVICES.

GENERAL NOTES FOR SECTIONS AND DETAILS



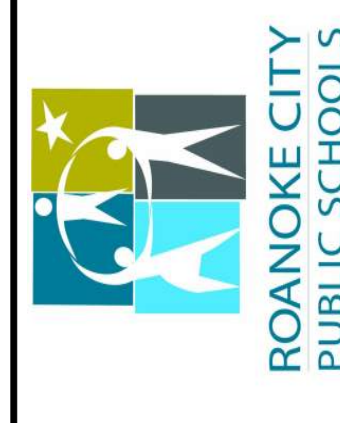
STRUCTURAL ABBREVIATIONS

ABBREVIATION	DESCRIPTION	ABBREVIATION	DESCRIPTION
AESS	ARCHITECTURALLY EXPOSED STRUCTURAL STEEL	LLV	LONG LEG VERTICAL
AFF	ABOVE FINISH FLOOR	LSH	LONG SIDE HORIZONTAL
AHU	AIR HANDLING UNIT	LSV	LONG SIDE VERTICAL
ALT	ALTERNATE	LVL	LAMINATED VENEER LUMBER
ANC	ANCHOR	MANUF	MANUFACTURER
ARCH	ARCHITECT/ARCHITECTURE	MATL	MATERIAL
BLDG	BUILDING	MAX	MAXIMUM
BD/DECK	BOTTOM OF DECK	MJC	MASONRY CONTROL JOINT
BOT	BOTTOM	MECH	MECHANICAL
BRG	BEARING	MID	MIDDLE
C-C	CENTER TO CENTER	MIN	MINIMUM
CJ	CONTROL JOINT	MOS	MIDDLE OF SLAB
CL	CENTER LINE	MS	MIDDLE STRIP
CLR	CLEAR	(N)	NEW
CMU	CONCRETE MASONRY UNIT	NIC	NOT IN CONTRACT
COL	COLUMN	NS	NEAR SIDE
CONC	CONCRETE	NTS	NOT TO SCALE
CONT	CONTINUOUS	OC	ON CENTER
COORD	COORDINATE	OPH	OPPOSITE HAND
CSJ	CONSTRUCTION JOINT	OPNG	OPENING
CTJ	CONTROL JOINT	PERIM	PERIMETER
CU	CONDENSING UNIT	PL	PLATE
CS	COLUMN STRIP	PLCS	PLACES
DBL	DOUBLE	PLYWD	PLYWOOD
DIA	DIAMETER	PSI	POUNDS SQUARE INCH
DM	DIMENSION	FSF	FOUNDS SQUARE FOOT
DN	DOWN	R	RADIUS
DWS	DRAWINGS	PT	PRESSURE TREATED
DWL(S)	DOWEL (S)	RC	ROUGH CUT
(E)	EXISTING	RD	ROOF DRAIN
EA	EACH	REF	REFERENCE
EF	EACH FACE	REINF	REINFORCEMENT
EJ	EXPANSION JOINT	REQD	REQUIRED
EL	ELEVATION	SF	STEPPED FOUNDATION
ELEV	ELEVATOR	SHT	SHEET
EOD	EDGE OF DECK	SIM	SIMILAR
EQ	EQUIPMENT	SL	SLOPE
EQ SP	EQUAL SPACE	SLH	SHORT LEG HORIZONTAL
EW	EACH WAY	SLV	SHORT LEG VERTICAL
EXIST	EXISTING	SPA	SPACES
EXP	EXPANSION	SPECS	SPECIFICATIONS
EXT	EXTERIOR	SS	STAINLESS STEEL
FD	FULL DEPTH CLIP CONNECTION	STD	STANDARD
FDN	FOUNDATION	STR	STRUCTURAL
FF	FINISH FLOOR	TFDN	TOP OF FOUNDATION
FM FLR	FINISH FLOOR	T&B	TOP AND BOTTOM
FRMS	FRAMING	THK	THICKNESS/THICK
FS	FAR SIDE	TOF	TOP OF FOUNDATION
FV	FIELD VERIFY	TOM	TOP OF MASONRY
GA	GUAGE/GAGE	TOS	TOP OF STEEL
GALV	GALVANIZED	TS	THICKENED SLAB
HORIZ	HORIZONTAL	TYP	TYPICAL
HSS	HOLLOW STRUCTURAL SHAPE	UNO	UNLESS NOTED OTHERWISE
INFOR	INFORMATION	VERT	VERTICAL
INT	INTERIOR	VIF	VERIFY IN FIELD
JOIST	JOIST	W	WITH
LBS	POUNDS	WP	WORK POINT
LD	DEVELOPMENT LENGTH	WWF	WELOED WIRE FABRIC
LG	LONG	WOB	WEB OPENING (SEE SCHEDULE)
LLH	LONG LEG HORIZONTAL		

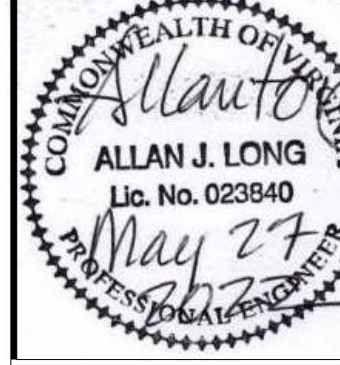
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S-101	STRUCTURAL PLANS

DESCRIPTION
BY
MARK DATE
REVISIONS

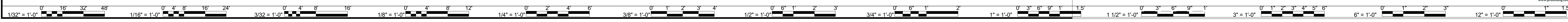


DATE: 06/27/2022
PROJECT: PE2021109
DESIGNED: AL
DRAWN: JWS
CHECKED: AL



PROJECT: ROANOKE CITY PUBLIC SCHOOLS
ADMINISTRATION BUILDING ON CAMPBELL (AOC)
PHASE ONE (DATA CENTER)
201 Campbell Ave SW
Roanoke, VA 24011
DRAWING: STRUCTURAL NOTES, LEGENDS, & ABBREVIATIONS

SHEET
S-001



ABBREVIATIONS

#	NUMBER	CCTV	CLOSED CIRCUIT TELEVISION	DWG	DRAWING	FRMG	FRAMING	JT	JOINT	NRC	NOISE REDUCTION COEFFICIENT	REINF	REINFORCE, REINFORCED,	TG	TONGUE & GROOVE
& +	AND	CEM	CEMENT	DWR	DRAWER	FRP	FIBERGLASS REINFORCED PLASTIC	KIT	KITCHEN	NTS	NOT TO SCALE	REM	REMOVE	THK	THICK, THICKNESS
+/-	PLUS OR MINUS	CEM TOP	CEMENT TOPPING			FRT	FIRE RETARDANT TREATED	KO	KNOCKOUT	OA	OVERALL	REOD	REQUIRED	THRES	THRESHOLD
@	AT	CER	CERAMIC	E	EAST	FT	FOOT, FEET	KV	KILOVOLT	OC	ON CENTER	REQMT	REQUIREMENT	THRU	THROUGH
°	DEGREES	CF	CUBIC FOOT	EA	EACH	FTG	FOOTING	KVA	KILOVOLT AMPERE	OD	OUTSIDE DIAMETER	RESIL	RESILIENT	TO	TOP OF
Ø	DIAMETER	CFLSHG	COUNTER FLASHING	EF	EXHAUST FAN	FUM	FUME HOOD	KW	KILOWATT	OFI	OWNER FURNISHED / CONTRACTOR INSTALLED	RET	RETURN	TOC	TOP OF CURB
Ω	ARC LENGTH	CFM	CUBIC FEET PER MINUTE	EFS	EXTERIOR FINISH SYSTEM	FUR	FURRED, FURRING			OF/CI	OWNER FURNISHED / CONTRACTOR INSTALLED	REV	REVISION, REVISIONS, REVISED	TOM	TOP OF MASONRY
A/C	AIR CONDITIONING	CG	CORNER GUARD	EIFS	EXTERIOR INSULATION FINISH SYSTEM	FURN	FURNITURE			OF/VI	OWNER FURNISHED / VENDOR INSTALLED	RFG	ROOFING	TOS	TOP OF STEEL
AB	ANCHOR BOLT	CHAM	CHAMFER	EJ	EXPANSION JOINT	FURR	FURRING	L	LENGTH, LONG, LOW	OH	OVERHEAD	RFL	REFLECT, REFLECTED, REFLECTIVE	TOW	TOP OF WALL
ABV	ABOVE	CI	CAST IRON	ELAS	ELASTOMERIC			LAB	LABORATORY	OPNG	OPENING	RH	RIGHT HAND	TP	TOILET PARTITION
ACM	ASBESTOS CONTAINING MATERIAL	CIP	CAST IN PLACE	ELEC	ELECTRICAL	G	GAS	LAM	LAMINATE	OPP	OPPOSITE	RL	RAIN LEADER	TPT	TEXTURED PAINT
ACP	ACOUSTIC CEILING PANEL	CIR	CIRCLE	ELEV	ELEVATION, ELEVATOR	GA	GAUGE	LAV	LAVATORY	PAR	PARALLEL	RM	ROOM	TRTD	TREATED
ACT	ACOUSTIC CEILING TILE	CJ	CONTROL JOINT	EM	ENTRANCE MAT	GAL	GALLON	LB	POUND	PART	PARTIAL	RO	ROUGH OPENING	TSC	TEACHERS STORAGE CABINET
ADDN	ADDITION	CK	CAULK, CAULKING	EMER	EMERGENCY	GALV	GALVANIZED	LF	LINEAR FEET	OPNG	OPENING	RSHT	RESILIENT SHEET	TTD	TOILET TISSUE DISPENSER
ADH	ADHESIVE	CLG	CEILING	ENCL	ENCLOSE, ENCLOSURE	GB	GRAB BAR	LG	LAMINATED GLASS	P	PLATE	RT	RUBBER TILE / RUBBER TREAD	TV	TELEVISION
ADJ	ADJUSTABLE	CLO	CLOSET	EP	ELECTRICAL PANELBOARD	GC	GENERAL CONTRACT, CONTRACTOR	LH	LEFT HAND	PAR	PARALLEL	RTU	ROOF TOP UNIT	TW	TEACHERS WARDROBE
ADJ	ADJUSTABLE	CLR	CLEAR	EPDM	ETHYLENE PROPYLENE DIENE MONOMER	GCMU	GLAZED FIBER REINFORCED CONCRETE	LN	LINEAR	PART	PARTIAL			TYP	TYPICAL
AGG	AGGREGATE	CM	CENTIMETER, CENTIMETERS	EPS	EXPANDED POLYSTYRENE	GEN	GENERAL	LK	LOCKER	PC	PRE-CAST, PIECE	S	SOUTH	UG	UNDERCUT
AHU	AIR HANDLING UNIT	CMP	CORRUGATED METAL PIPE	EPX	EPOXY	GFRG	GLASS FIBER REINFORCED CONCRETE	LLH	LONG LEG HORIZONTAL	PE	PEDESTAL	S/S	STAINLESS STEEL, SERVICE SINK	UC	UNDER GROUND
AHU	AIR HANDLING UNIT	CMU	CONCRETE MASONRY UNIT	EQ	EQUAL	GL	GLASS, GLAZING	LLV	LONG LEG VERTICAL	PED	PERFORATE (D)	SAB	SOUND ATTENUATION BLANKET	UH	UNIT HEATER
AL	ALUMINUM	CNTR	COUNTER	EQ	EQUAL	GPM	GALLONS PER MINUTE	LP	LOW POINT	PERF	PERFORATE (D)	SAN	SANITARY SEWER	UNF	UNFINISHED
ALT	ALTERNATE	CO	CLEAN OUT	EQ	EQUAL	GR	GRADE / GROUT	LTG	LIGHTING	PERM	PERIMETER	SAPC	SUSPENDED ACOUSTIC PANEL CEILING	UON	UNLESS OTHERWISE NOTED
AMP, A	AMPERE	COL	COLUMN	EST	ESTIMATE	GSU	GLAZED STRUCTURAL UNIT	LTL	LIGHTING	PIP	POURED IN PLACE	SC	SOLID CORE, SEALED CONCRETE	V	VOLT, VALLEY
ANCH	ANCHOR, ANCHORAGE	COMM	COMMUNICATION	EWC	ELECTRIC WATER COOLER	GWB	GYP SUM WALLBOARD	LVR	LOUVER	PL	PROPERTY LINE / PLASTIC LAMINATE	SC	SOLID CORE, SEALED CONCRETE	VAC	VACUUM
ANOD	ANODIZED	COMP	COMPOSITE	EXCA	EXCAVATE	GWT	GLAZED WALL TILE	LW	LIGHTWEIGHT	PLAM	PLASTIC LAMINATE	SCHED	SCHEDULE	VAR	VARNISH
AP	ACCESS POINT	CONC	CONCRETE	EXH	EXHAUST	GYP	GYP SUM	M	METER	PLAS	PLASTER	SCW	SOLID CORE WOOD	VB	VENTED BASE
APC	ARCHITECTURAL PRECAST CONCRETE	CONN	CONNECTION	EXIST	EXISTING	H	HIGH	MIS	MOP SINK	PLUMB	PLUMBING	SD	SOAP DISPENSER, STORM DRAIN	VCT	VINYL COMPOSITION TILE
APPROX	APPROXIMATE	CONST	CONSTRUCTION	EXP	EXPOSED / EXPANSION	H/C	HANDICAPPED	MACH	MACHINE	PLYWD	PLYWOOD	SEC	SECTION	VEN	VENEER
AR	ABUSE RESISTANT	CONT	CONTINUOUS	EXP C	EXPANSION CONSTRUCTION	HB	HOSE BIB	MAINT	MAINTENANCE	PNL	PANEL	SF	SQUARE FEET	VERT	VERTICAL
ARCH	ARCHITECT, ARCHITECTURAL	CONTR	CONTRACT, CONTRACTOR	EXT	EXTERIOR	HC	HOLLOW CORE	MANUF	MANUFACTURE, MANUFACTURER	POLY	POLYURETHANE	SFGL	SAFETY GLASS	VEST	VESTIBULE
ASB	ASBESTOS	CORR	CORRUGATED	FAB	FABRICATE	HD	HAND	MAR	MARBLE	PORT	PORCELAIN TILE	SHLVG	SHELVING	VR	VAPOR RETARDER
ASPH	ASPHALT	CPT	CARPET	FAS	FASTEN, FASTENER	HDBD	HARDBOARD	MAS	MASONRY	PORTB	PORCELAIN TILE BASE	SHM	SECURITY HOLLOW METAL	VTR	VENT THRU ROOF
ATTEN	ATTENUATION	CRS	COURSE, COURSES	FBS	FACE BRICK	HDWD	HARDWOOD	MATL	MATERIAL	PPT	PRESERVATIVE PRESSURE TREATED	SHT	SHEET	VT	VINYL TILE
AUTO	AUTOMATIC	CSMT	CASEMENT	FB	FACE BRICK	HDWR	HARDWARE	MAX	MAXIMUM	PR	PAIR	SHTH	SHEATHING	VTR	VENT THRU ROOF
AVG	AVERAGE	CSWK	CASEWORK	FCVD	FLASH COVERED	HGT	HEIGHT	MB	MARKERBOARD	PREFAB	PREFABRICATE, PREFABRICATED	SIM	SIMILAR	VWC	VINYL WALL COVERING
AWP	ACOUSTIC WALL PANEL	CT	CERAMIC TILE	FD	FLOOR DRAIN, FIRE DAMPER	HM	HOLLOW METAL	MECH	MECHANIC, MECHANICAL	PREFIN	PRE-FINISHED	SLR	SEALER	W	WEST, WIDE, WIDTH
BC	BOTTOM OF CURB	CTB	CERAMIC TILE BASE	FDN	FOUNDATION	HORIZ	HORIZONTAL	MED	MEDIUM	PRJ SC	PROJECTION SCREEN	SN	STAGE NOSE	W/	WITH
BD	BOARD	CU FT	CUBIC FEET	FE	FIRE EXTINGUISHER	HP	HIGH POINT	MEMB	MEMBRANE	PRT	PORCELAIN TILE	SND	SANITARY NAPKIN DISPOSER	W/O	WITHOUT
BEJ	BUILDING EXPANSION JOINT	CU YD	CUBIC YARD	FEC	FIRE EXTINGUISHER CABINET	HR	HOUR	MIR	MIRROR	PS	PENCIL SHARPENER	SOF	SPRAY-ON FIREPROOFING	WAIN	WAINSCOT
BETW	BETWEEN	CUH	CABINET UNIT HEATER	FEJ	FLOOR EXPANSION JOINT	HTG	HEATING	MM	MILLIMETER	PSF	POUNDS PER SQUARE FOOT	SPEC	SPECIFICATION, SPECIFICATIONS	WB	WOOD BASE
BIT	BITUMINOUS	CW	COLD WATER	FF	FINISH FLOOR	HVAC	HEATING, VENTILATION AND AIR CONDITIONING	MOD	MODIFIED	PSI	POUNDS PER SQUARE INCH	SPK	SPEAKER	WC	WATER CLOSET
BL	BLEACHER FINISH	CWFP	CEMENTITIOUS WOOD FIBER PANELS	FFE	FINISH FLOOR ELEVATION	HW	HOT WATER	MOV	MOVABLE	PT	PAINT	ST	STAIN, STONE	WD	WOOD / WOOD FLOORING
BLDG	BUILDING	D	DEEP, DEPTH, DRAIN	FG	FIBER REINFORCED GYP SUM BOARD	HW	HOT WATER	MR	MIRROR	PTD	PAINTED	SS	SOLID SURFACE	WDB	WOOD BASE
BLK	BLOCK	DBL	DOUBLE	FGL	FIBERGLASS	HW	HOT WATER	MISC	MISCELLANEOUS	PTN	PARTITION	ST	STAIN, STONE	WDW	WINDOW
BLKG	BLOCKING	DEM	DEMOLITION	FH	FIRE HYDRANT	HW	HOT WATER HEATER	MLD	MOLDING	PTV	POLYVINYL CHLORIDE / PVC EDGE BAND	STC	SOUND TRANSMISSION CLASS	WGL	WIRE GLASS
BM	BEAM	FHC	FIRE HOSE CABINET	FIN	FINISH, FINISHED	ID	INSIDE DIAMETER	MM	MILLIMETER	QTY	QUANTITY	STD	STANDARD	WH	WATER HEATER
BO	BOTTOM OF	FIN	FINISH, FINISHED	FIX	FIXTURE	IN	INCH	NO	MASONRY OPENING	R	RISER, RIDGE	STFT	STOREFRONT	WI	WROUGHT IRON
BOT, B	BOTTOM	FLR	FLOOR	FLEX	FLEXIBLE	INCL	INCLUDE, INCLUDED, INCLUDING	MOD	MODIFIED	R/W	RIGHT OF WAY	STRUC	STRUCTURAL	WMS	WIRE MANAGEMENT SLOT
BRG	BEARING	FLSHG	FLASHING	FLR	FLOOR	INFO	INFORMATION	MOV	MOVABLE	RA	RETURN AIR	SUB	SUBSTITUTE	WP	WATERPROOFING
BRK	BRICK	DIAG	DIAGONAL	FLUR	FLUORESCENT	INST	INSTALLATION	MR	MAP RAIL	RAD	RADIUS	SUSP	SUSPENDED	WPT	WORKING POINT
BS	BOTH SIDES	DIM	DIMENSION	FLUR	FLUORESCENT	INSUL	INSULATE, INSULATED, INSULATION	MT	MOUNT	RAS	RESILIENT ATHLETIC SURFACING	SYM	SYMMETRICAL, SYMMETRY	WR	WASTE RECEPTACLE
BSMT	BASEMENT	DISP	DISPOSAL	FND	FEMININE NAPKIN DISPENSER	INT	INTERIOR	MTD	MOUNTED, MOUNTING	RB	REFLECTED CEILING PLAN	SYN	SYNTHETIC	WT	WEIGHT
BTWN, B/W	BETWEEN	DIV	DIVISION	FND	FEMININE NAPKIN DISPENSER	INTRLK	INTERLOCK	MTL	METAL	RCP	REFLECTED CEILING PLAN	SYS	SYSTEM	WWF	WELDED WIRE FABRIC
BUR	BUILT-UP ROOFING	DL	DEAD LOAD	FOC	FACE OF CONCRETE	INV	INVERT	MWP	MEMBRANE WATERPROOFING	RD	ROOF DRAIN	T	TREAD	WWM	WELDED WIRE MESH
BVL	BEVELED	DMT	DEMOUNTABLE	FOM	FACE OF MASONRY	JAN	JANITOR	N	NORTH	REC	RECEPTACLE	T&B	TOP & BOTTOM		
C	CARPET	DN	DOWN	FOS	FACE OF STUDS	JB	JUNCTION BOX	N/C	NO CHARGE	RECP	RECEPTACLE	TB	TACK BOARD		
CAB	CABINET	DPG	DAMP PROOFING	FP	FIREPROOF	JC	JUNCTION CLOSET	NAT	NATURAL	REF	REFERENCE	TEL	TELEPHONE		
CAP	CAPACITY	DPR	DISPENSER	FPL	FIREPLACE	JCT	JUNCTION	NIC	NOT IN CONTRACT	REFRIG	REFRIGERATOR	TEMP	TEMPORARY, TEMPERED		
CB	CHALKBOARD	DR	DOOR, DISPLAY RAIL	FRG	(GLASS) FIBER REINFORCED GYP SUM	JST	JOIST	NO	NO			TERR	TERRAZZO		
CC	CUBICAL CURTAIN	DS	DOWNSPOUT	FRM	FRAME, FRAMED			NOM	NOMINAL						

DATE	05/27/2022	DESIGNED	JWH	DRAWN	BLH	CHECKED	CAP
PROJECT	18106-09						



DATE	05/27/2022	DESIGNED	JWH	DRAWN	BLH	CHECKED	CAP
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RRMM ARCHITECTS, PC
28 Church Ave SW
Roanoke, Virginia 24011
(540)344-1212



ARCHITECTURAL GRAPHIC SYMBOLS

DOOR TAG - BUILDING DIV/DOOR NUMBER LOCATION SUFFIX (IF REQ'D)

LOUVER TYPE

NEW WORK KEY NOTE

DEMOLITION KEY NOTE

EXTERIOR / INTERIOR / INTERIOR CASEWORK ELEVATION IDENTIFICATION NUMBER

SHEET NUMBER WHERE ELEVATION IS LOCATED

SIGNAGE TYPE

SIGNAGE NO. ARCH NO.

ROOM ROOM NAME BLDG DIV / CONST NO.

WINDOW TYPE

CURTAIN WALL TYPES (REF A600 SERIES DRAWINGS) CURTAIN WALL

HOLLOW METAL FRAME TYPES (REF A600 SERIES DRAWINGS) HOLLOW METAL FRAME

WINDOW FRAME TYPES (REF A600 SERIES DRAWINGS) STOREFRONT

TOILET ACCESSORIES

PARTITION TYPE (SEE PARTITION LEGEND)

ELEVATION REFERENCE

CONTROL JOINT

BUILDING SECTION REFERENCE

SECTION REFERENCE

ENLARGED PLAN OR DETAIL REFERENCE

MAIN DRAWING TITLE

DRAWING TITLE WITH REFERENCE SYMBOL

TITLE - DRAWING TITLE
SCALE: 1/8" = 1'-0"

TITLE - DRAWING NUMBER DESIGNATION
DRAWING TITLE
DRAWING REFERENCE NUMBER
DRAWING SCALE
DRAWING SHEET NUMBER

PARTITION TYPE SCHEDULE NOTES

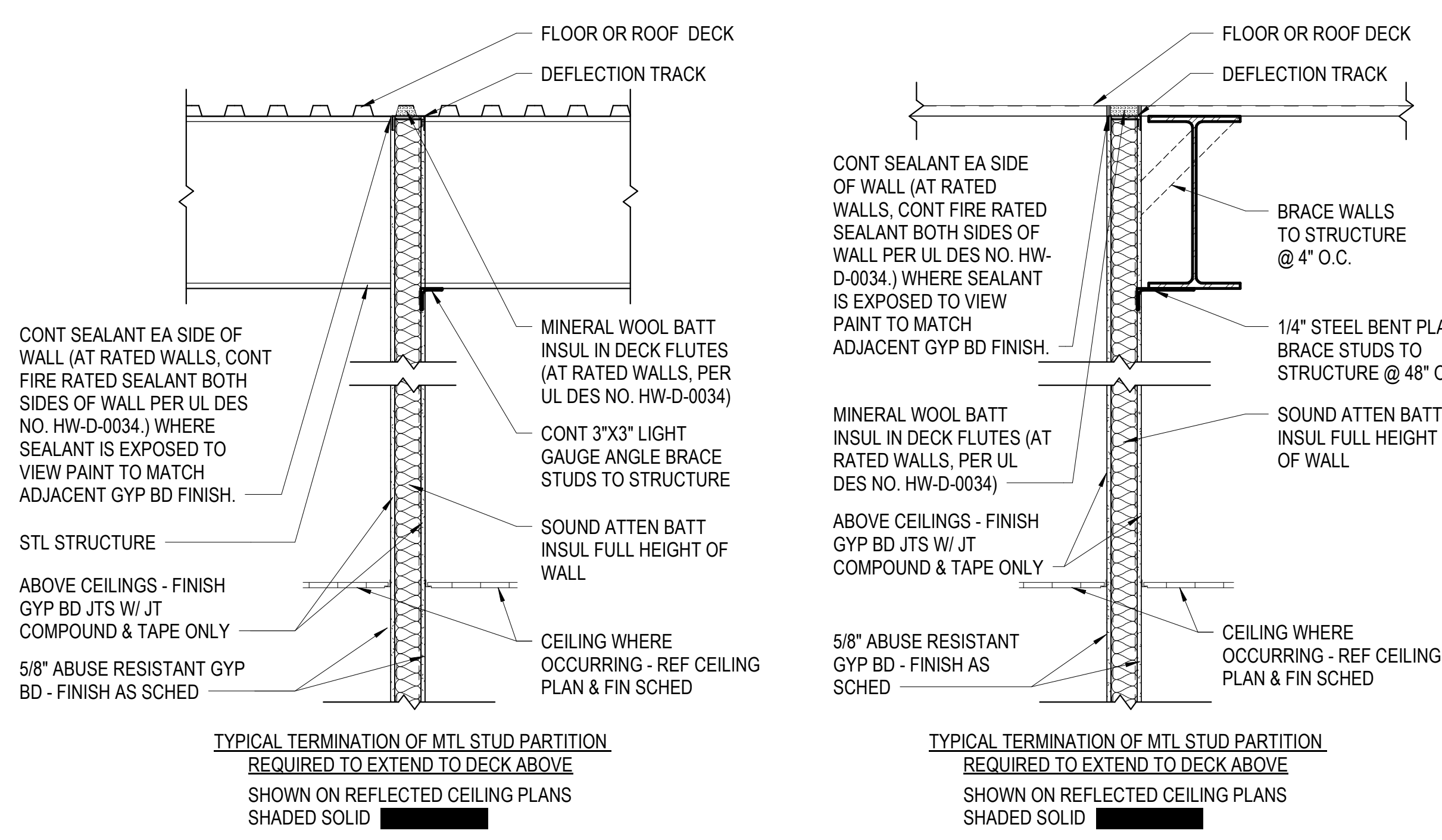
- SEE FLOOR PLANS FOR DIMENSIONS OF PARTITIONS.
- UL = UNDERWRITERS LABORATORIES.
- FM = FACTORY MUTUAL.
- ALL PARTITION TYPES ARE NON-LOAD BEARING UNLESS NOTED OTHERWISE.
- SEAL TOP OF WALL AT STRUCTURAL (ROOF/FLOOR) DECK, AT PERIMETER, AT WALL INTERSECTIONS, AT FLOOR, AND AT ALL PENETRATIONS. USE FIRE RATED SEALANT AS REQUIRED TO SEAL IN ACCORDANCE W/ JOINT SYSTEM UL HWD0039 @ CMU AND UL HWD0034 @ GYP SUM BOARD PARTITIONS, WHERE PARTITIONS ARE INDICATED TO BE FIRE RATED.
- INSTALL 5" ACOUSTIC BATT INSULATION IN ACCORDANCE WITH USG FIRE - RESISTANT ASSEMBLY MANUAL ACOUSTICAL PERFORMANCE TEST NUMBER RL-TL-84-140

PARTITION TYPE NOTES

- PARTITION TERMINATION LOCATION & CONDITIONS MAY VARY. REFER TO REFLECTED CEILING PLANS FOR PARTITION TERMINATION LEGEND FOR TYPICAL TERMINATION DETAILS.
- REFERENCE TESTING LAB CHART ON SHEET A-001 FOR UL ASSEMBLIES ASSOCIATED WITH FIRE RESISTANCE RATED PARTITIONS.
- PARTITION TYPES DO NOT INCLUDE ALL APPLIED FINISHES. REFER TO FINISH SCHEDULE.
- USE FIRE RATED GYP SUM BOARD AT FIRE RATED GYP SUM BOARD PARTITIONS.

TESTING LAB CHART

PARTITIONS			
PARTITION TYPE	1 HR RATING	2 HR RATING	
S6BR	UL U419		
CEILINGS			
CEILING TYPE	1 HR RATING	2 HR RATING	



METAL STUD PARTITION TERMINATION

S6BR FIRE RESISTANCE RATED PARTITION - REFERENCE TESTING LAB CHART

PARTITION TERMINATION	NOTE 5
CEILING LINE	METAL STUDS @16\"/>
FLOOR LINE	1 LAYER 5/8\"/>
ACTUAL DIMENSION 'X'	4 7/8"
STUD SIZE	3 5/8"
CMU SIZE	-

S3 PARTITION TERMINATION

PARTITION TERMINATION	NOTE 5
CEILING LINE	METAL STUDS @16\"/>
FLOOR LINE	1 LAYER 5/8\"/>
ACTUAL DIMENSION 'X'	4 1/4"
STUD SIZE	3 5/8"
CMU SIZE	-

PROJECT: ROANOKE CITY PUBLIC SCHOOLS
ADMINISTRATION BUILDING ON CAMPBELL (AOC)
PHASE ONE (DATA CENTER)
201 Campbell Ave SW
Roanoke, VA 24011

DRAWING: ARCHITECTURAL GENERAL INFORMATION

SHEET: A-001

DEMOLITION GENERAL NOTES

- REFER TO MECHANICAL AND ELECTRICAL DRAWINGS FOR ADDITIONAL DEMOLITION INFORMATION.
- ALL DEMOLITION WORK NOTED ON THESE DRAWINGS INVOLVES THE REMOVAL OF EXISTING CONSTRUCTION UNDER CONTRACT, AND SHALL BE COORDINATED WITH CORRESPONDING NEW WORK FLOOR PLANS AND DETAILS. REMOVE EXISTING CONSTRUCTION AS INDICATED AND REQUIRED FOR THE INSTALLATION OF NEW WORK.
- DETAILS OF EXISTING CONDITIONS, ACTUAL FIELD CONDITIONS WHICH ARE CONCEALED BY EXISTING CONSTRUCTION MAY VARY SOMEWHAT FROM THOSE INDICATED IN DRAWINGS. ALL WORK THAT RELATES TO, OR IS IN ANY WAY AFFECTED BY EXISTING CONDITIONS WHICH VARY FROM THOSE INDICATED SHALL BE MODIFIED AS REQUIRED BY FIELD CONDITIONS AND MEASUREMENTS. REPORT DISCREPANCIES TO THE ARCHITECT BEFORE PROCEEDING WITH AFFECTED ASPECTS OF CONSTRUCTION OR DEMOLITION.
- THE DEMOLITION DRAWINGS INDICATE MAJOR ITEMS TO BE DEMOLISHED. MISCELLANEOUS ABANDONED CONDUIT, WALL PENETRATIONS (IE. SCREWS, NAILS & MASONRY ANCHORS), WOOD BLOCKING AND OTHER VARIOUS ITEMS FASTENED TO EXISTING WALLS MAY NOT BE INDICATED ON THE DRAWINGS. REMOVE SUCH ITEMS THAT ARE NOT USED IN, OR CONCEALED BY, NEW WORK, PATCH AND REPAIR DAMAGE TO THE WALLS WHERE SUCH ITEMS ARE REMOVED.
- PATCH AND REPAIR WALLS AND FLOORS AT REMOVED CONSTRUCTION PRIOR TO NEW WALL INSTALLATION.
- NO MATERIAL OR EQUIPMENT SHALL BLOCK EXIT ACCESS CORRIDORS OR THE PATH TO THE NEAREST EXIT DISCHARGE DOOR WHILE THE MEANS OF EGRESS IS REQUIRED BY THE BUILDING OCCUPANTS.
- NO DEMOLITION WASTE SHALL BE ALLOWED TO ACCUMULATE IN CORRIDORS, BUILDING COMMON AREAS, OR OUTSIDE OF THE BUILDING.

DEMOLITION KEYNOTES

(ALL NOTES MAY NOT BE USED ON THIS SHEET)

- REMOVE EXISTING CARPET, STRIP CARPET ADHESIVE TO LEAVE CLEAN EXPOSED CONCRETE SLAB
- REMOVE EXISTING MAIL CHUTE AND SUPPORT FRAME BELOW, ENLARGE EXISTING FLOOR OPENING TO ACCOMODATE NEW LIFT (SEE STRUCTURAL DWGS)
- REMOVE PORTION OF EXISTING WALL TO EXPOSE CHASE, REPLACE WALL AS INDICATED
- REMOVE PORTION OF EXISTING RAILING TO PROVIDE OPENING ALIGNING WITH NEW LIFT ACCESS GATES (VERIFY DIMS / LOCATION WITH LIFT VENDOR PRIOR TO DEMOLITION)
- REMOVE EXISTING MAIL CHUTE AND SUPPORT FRAME BELOW, PREPARE OPENING FOR INFILL (SEE STRUCTURAL DWGS)

NEW WORK GENERAL NOTES

- COORDINATE THE WORK OF ALL TRADES. VERIFY LOCATIONS AND EXTENT OF INSERTS, ANCHORS, PENETRATIONS, ETC, REQUIRED BY PLUMBING, MECHANICAL AND ELECTRICAL TRADES.
- CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS AND NOTIFY ARCHITECT OF ANY DISCREPANCIES OR DETERMINATION OF DIMENSIONAL ADJUSTMENTS.
- AFTER REMOVAL OF EXISTING FLOOR COVERINGS, USE LEVELING AND PATCHING COMPOUND(S) TO CORRECT SURFACE IRREGULARITIES PRIOR TO INSTALLATION OF NEW FLOOR FINISHES AS NEEDED.
- PATCH, REPAIR, AND PAINT ALL GWB SURFACES TO REMAIN EXPOSED TO CREATE A SEAMLESS TRANSITION AND UNIFORM APPEARANCE BETWEEN NEW AND EXISTING.
- COORDINATE WITH OWNER FOR LOCATIONS OF CONCEALED BLOCKING IN WALLS. THIS BLOCKING MUST BE FIRE RETARDANT.
- TYPICAL NEW WALL CONSTRUCTION IS TYPE S688 UNLESS OTHERWISE NOTED.
- ALL NEW WALLS EXTEND TO DECK ABOVE UNLESS OTHERWISE NOTED.
- FIXTURES AND EQUIPMENT ARE SHOWN DIAGRAMMATICALLY. SEE PLUMBING, MECHANICAL, ELECTRICAL, AND FIRE SUPPRESSION DRAWINGS FOR LOCATIONS AND DETAILED INFORMATION.

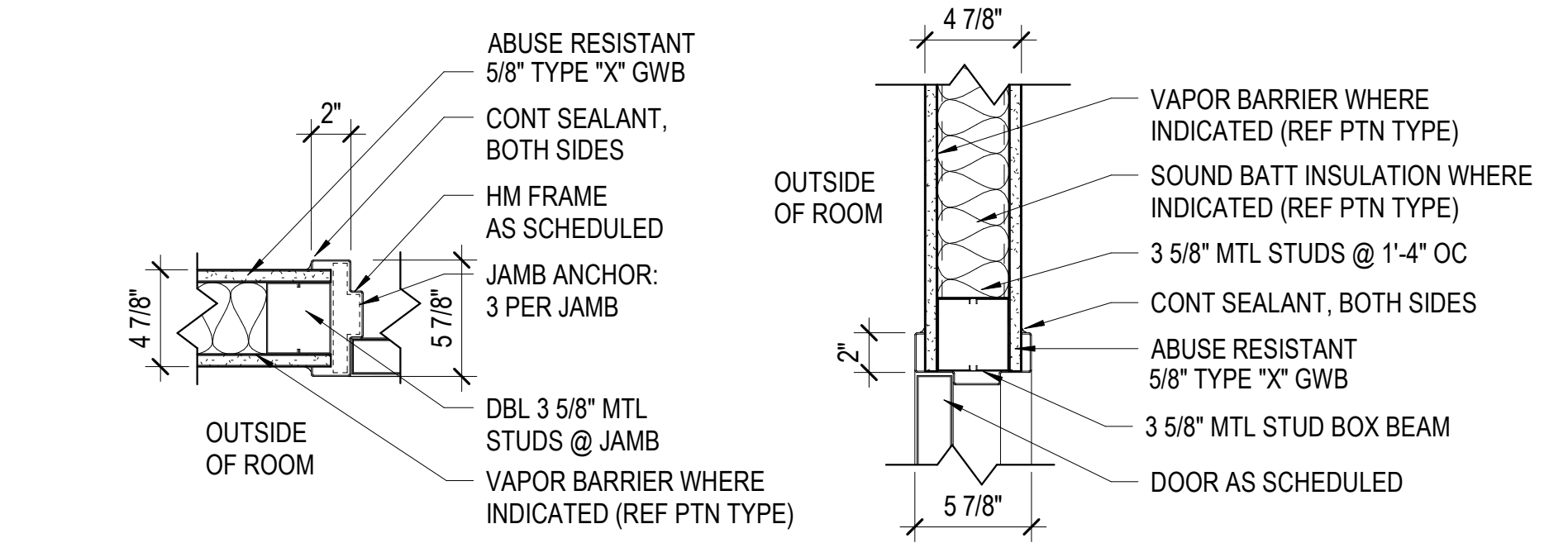
NEW WORK KEYNOTES

(ALL NOTES MAY NOT BE USED ON THIS SHEET)

- CONT. VAPOR BARRIER OVER OUTSIDE FACE OF STUDS
- 3/4" FRP PLYWOOD OVER GWB FLOOR TO CEILING FULL LENGTH OF WALL
- OMEGA GUARDRAIL AND POST SYSTEM SIMPLIFIEDSAFETY.COM (OR APPROVED EQUAL). PROVIDE DOUBLE RAIL SYSTEM WITH CORNER KIT AND POSTS, ATTACH TO SLAB PER MANUFACTURER'S INSTRUCTIONS
- CONCRETE EQUIPMENT PAD OVER EXISTING CONCRETE SLAB (SEE STRUCTURAL DWGS)
- PFLOW INDUSTRIES - 21 SERIES HYDRAULIC MATERIALS LIFT (SHOWN DASHED) (OWNER FURNISHED/VENDOR INSTALLED) CONTRACTOR SHALL PROVIDE WORK REQUIRED FOR THE INSTALLATION OF THE LIFT BY VENDORS FORCES AS PER THE DRAWINGS INCLUDING BUT NOT LIMITED TO CONCRETE EQUIPMENT PAD, OPENING IN FLOOR ABOVE, ELECTRICAL WORK, AND RAILING MODIFICATIONS. (SEE STRUCTURAL AND ELECTRICAL DRAWINGS) CONTRACTOR SHALL COORDINATE ITS EFFORTS AND SCHEDULE WITH OWNER / VENDORS INSTALLATION FORCES.
- WELD NEW VERTICAL RAILING POST MATCHING EXISTING TO ALIGN WITH EDGES OF LIFT
- OPENING IN EXISTING FLOOR SLAB FOR MATERIALS LIFT (SEE STRUCTURAL DWGS)
- ALIGN FACE OF FINISH WITH EXISTING CONSTRUCTION
- DATA RACKS (OWNER FURNISHED/CONTRACTOR INSTALLED)
- PROVIDE SUPPORTING STRUCTURE AND INFILL OPENING IN CONCRETE SLAB (SEE STRUCTURAL DWGS)
- PROVIDE ACCESS CONTROL SYSTEM AT DOOR (SEE ELECTRICAL DWGS)

DOOR SCHEDULE

NO.	TYPE	MATL	SIZE			FRAME			RATING (MIN)	HDWR SET	NOTES
			WIDTH	HEIGHT	THICKNESS	TYPE	MAT	HEAD			
101	A	HM	4'-0"	7'-0"	1 3/4"	HM-1	HM	E6/A-101	E5/A-101	20	1
102	A	HM	4'-0"	7'-0"	1 3/4"	HM-1	HM	E6/A-101	E5/A-101	20	2

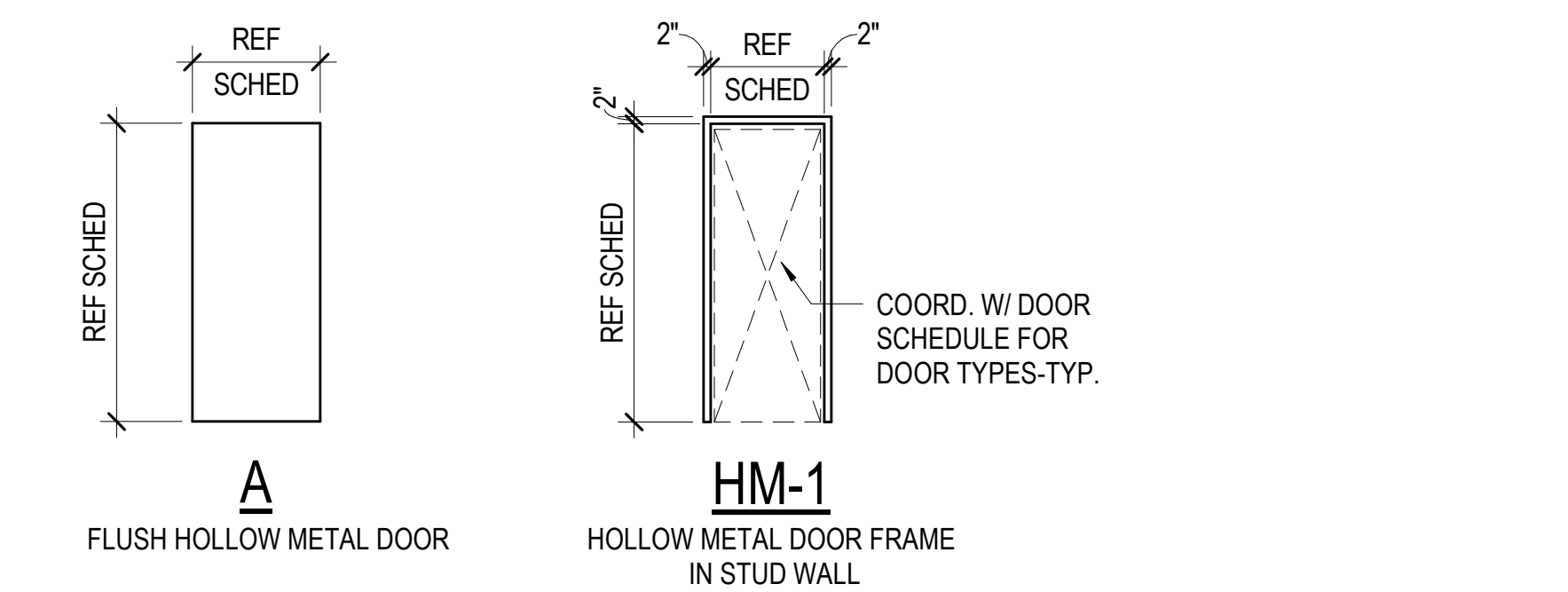


DETAIL - JAMB

A-101 SCALE: 1 1/2" = 1'-0"

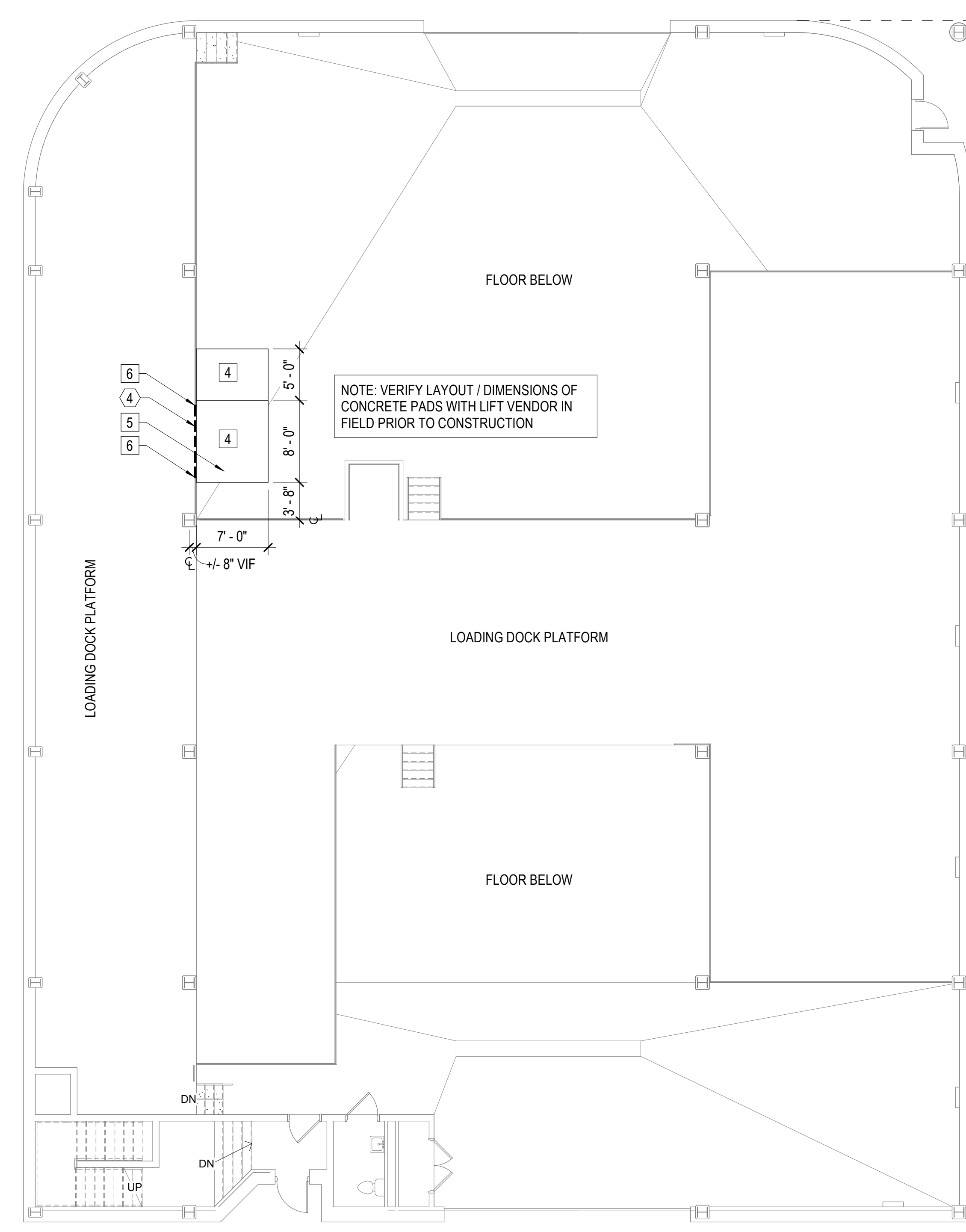
DETAIL - HEAD

A-101 SCALE: 1 1/2" = 1'-0"



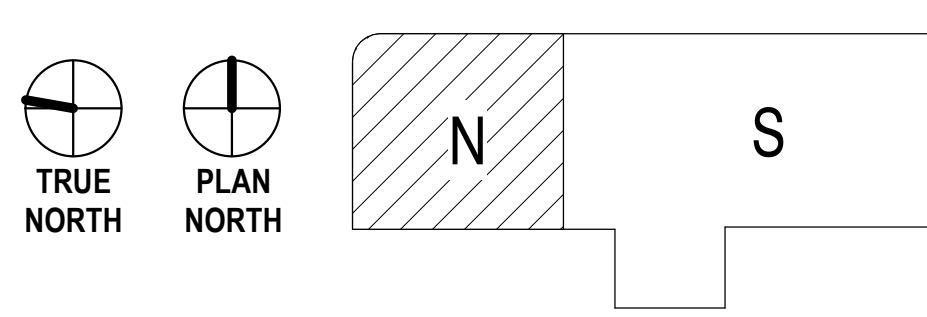
TYPICAL DOOR AND FRAME TYPES

(COORDINATE WITH FLOOR PLAN & DOOR SCHEDULE FOR DOOR & FRAME FIRE RATINGS)



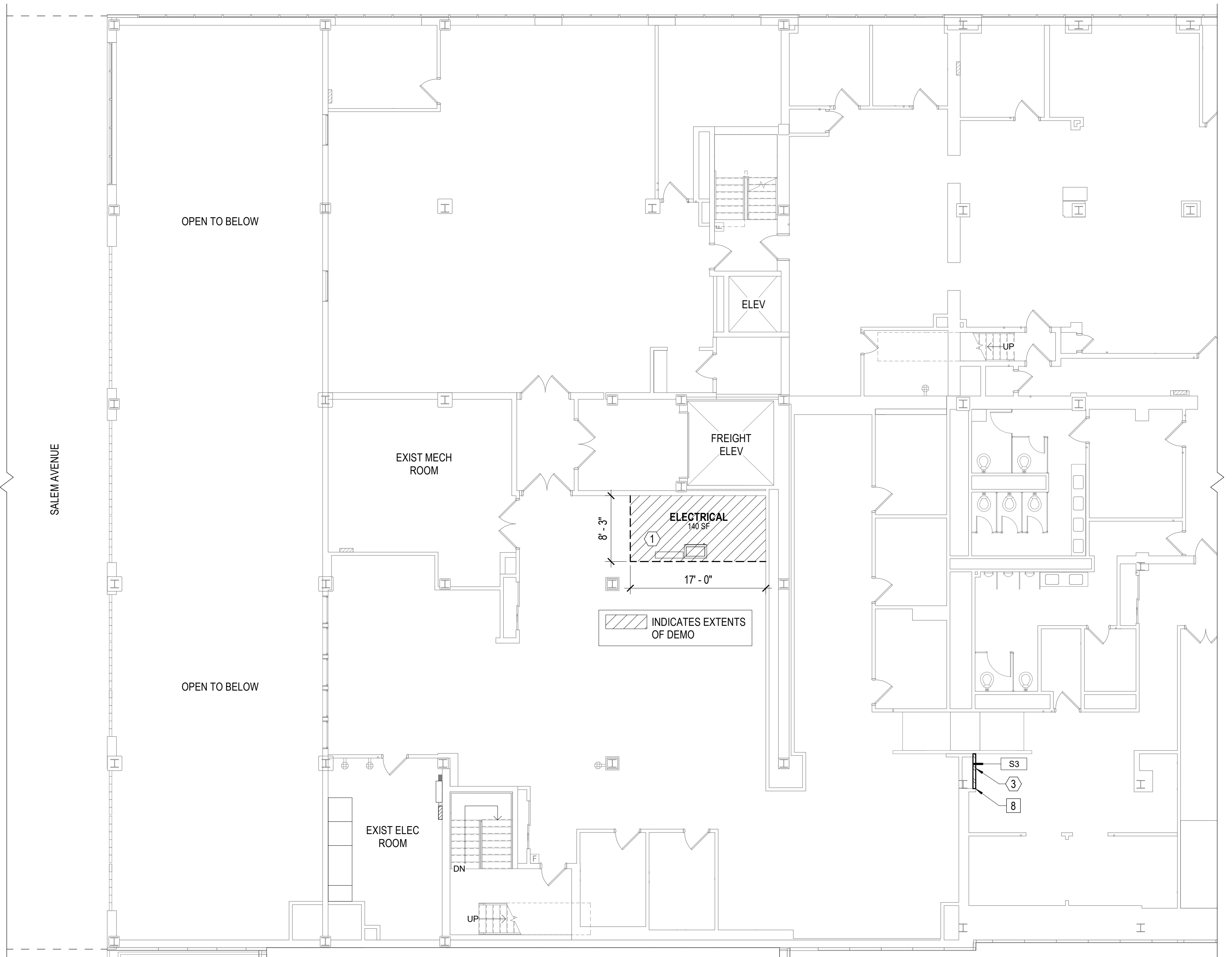
BASEMENT COMBINED DEMOLITION / NEW WORK PLAN - NORTH

SCALE: 1/8" = 1'-0"



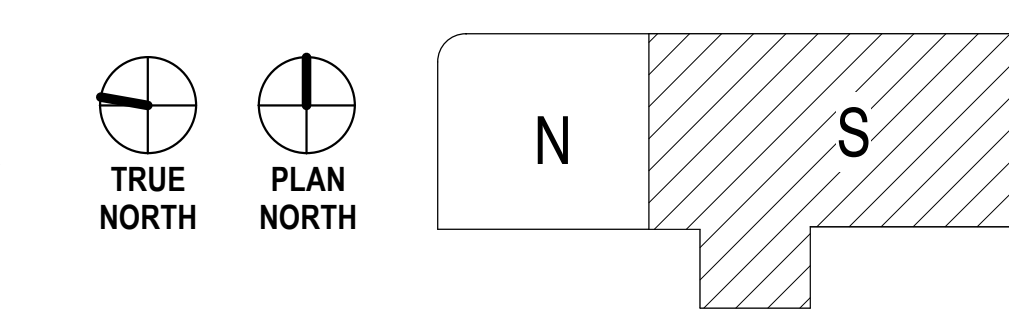
KEY PLAN NORTH

SCALE: 12" = 1'-0"



MEZZANINE COMBINED DEMOLITION / NEW WORK PLAN

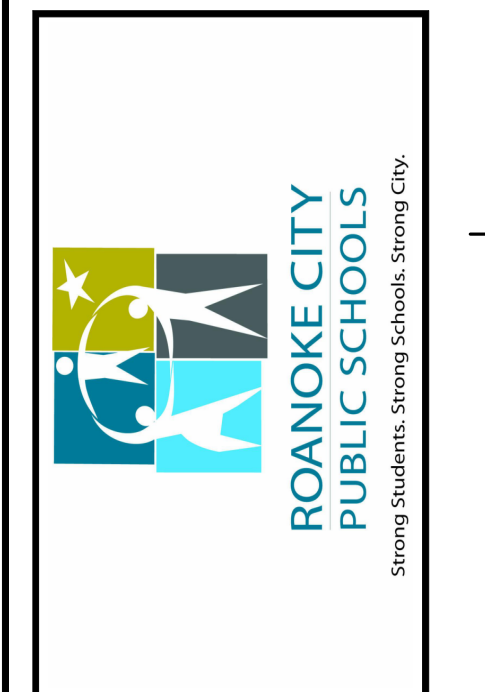
SCALE: 1/8" = 1'-0"



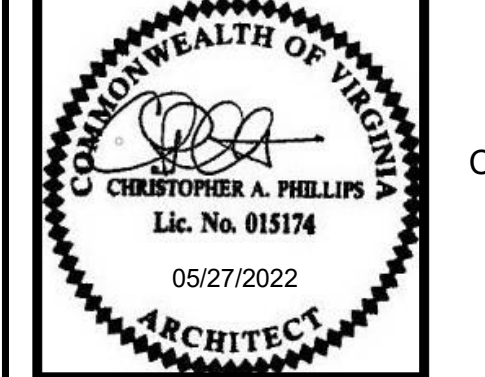
KEY PLAN SOUTH

SCALE: 12" = 1'-0"

DESCRIPTION	
BY	
MARK	DATE
REVISIONS	



DATE	05/27/2022	DESIGNED	JWH	DRAWN	BLH	CHECKED	CAP
PROJECT	18106-09						



ROANOKE CITY PUBLIC SCHOOLS
ADMINISTRATION BUILDING ON CAMPBELL (AOC)
PHASE ONE (DATA CENTER)
 201 Campbell Ave SW
 Roanoke, VA 24011

WAREHOUSE / MEZZANINE - DEMO / NEW WORK PLANS

SHEET
A-101

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REFLECTED CEILING PLAN LEGEND (ALL SYMBOLS MAY NOT BE USED)

	2'-0" x 2'-0" LAY-IN ACOUSTICAL TILE CEILING IN SUSPENDED GRID		HORN / STROBE
	SUPPLY DIFFUSER		OCCUPANCY SENSOR
	RETURN AIR GRILLE		CLEAN AGENT NOZZLE
	LIGHT FIXTURE		SMOKE DETECTOR
	LIGHT FIXTURE WITH INTEGRAL BATTERY BACKUP		CEILING HEIGHT

PARTITION TERMINATION LEGEND

	PARTITION WHICH PENETRATES THE CLG & TERMINATES 4" ABV FINISHED CLG (UNLESS INDICATED OTHERWISE)
	SOUND PARTITION WHICH CONTINUES THROUGH CEILING TO BOTTOM OF MTL DECK OR STRUCTURE ABOVE (UNLESS NOTED OTHERWISE). AT GYP BD PARTITION PROVIDE BATT INSUL IN VOIDS IN DECK FOR SOUND TRANSMISSION BLOCKING OR CONT SEALANT AT CMU PTN INSTALL CONC OR BATT INSUL IN VOIDS.

NOTE: EXTERIOR WALLS OR WALLS IN WHICH THE UPPER PORTIONS ARE EXTERIOR ARE TYPICALLY NOT RENDERED, REFER TO WALL SECTIONS FOR EXTERIOR WALL TERMINATION.

REF CLG PLAN KEYNOTES

- CABLE TRAY SUSPENDED BELOW CEILING, SEAL ALL PENETRATIONS IN ACOUSTIC CEILING TILES (SEE ELECTRICAL DWGS)
- DROP CEILING SYSTEM - ARMSTRONG CLEAN ROOM WITH INTEGRAL GASKET AND HOLD DOWN CLIPS (OR APPROVED EQUAL)

REF CEILING PLAN GENERAL NOTES

- REFER TO FLOOR PLANS AND WALL SECTIONS FOR ADDITIONAL INFORMATION.
- REFER TO ELECTRICAL LIGHTING PLANS FOR WALL MOUNTED AND UNDER-CABINET FIXTURES NOT INDICATED.
- SPRINKLER HEADS (NOT INDICATED) TO BE CENTERED IN ACP OR W/ IN SPACE IN GYP. BD CLG.
- REFER TO MECH. AND ELEC DRAWINGS FOR CEILING-MOUNTED FIXTURE TYPES & DIFFUSER LOCATIONS. NOTIFY ARCHITECT (PRIOR TO INSTALLATION) OF CONFLICTS WITH LOCATIONS INDICATED ON DRAWINGS. ADDITIONAL FIXTURES OR OTHER CEILING MATERIALS SHOWN ON ELECTRICAL OR MECHANICAL DRAWINGS BUT NOT SHOWN ON RCP'S ARE INCLUDED IN THE BASE BID.
- SUPPLY AND DIFFUSER GRILLES ARE INDICATED DIAGRAMMATICALLY IN RCP FOR LOCATION ONLY. REFER TO MECHANICAL DWG'S FOR ACTUAL SIZE AND TYPE TO BE PROVIDED.
- 24"x24" ACOUSTICAL CEILING PANELS (ACP) WILL BE THROUGHOUT.
- REFER TO DETAIL A-001 FOR TYPICAL PARTITION TERMINATIONS AT STRUCTURAL ELEMENTS WITH ALL EXTENSIONS OF FINISHES & SOUND ATTEN.
- AT LOCATIONS WHERE AN ACOUSTICAL CEILING PANEL (ACP) WILL BE 5' OR LESS IN WIDTH, USE A 24" X 48" ACP OF THE SAME TYPE AND MANUFACTURER. FOR EXAMPLE: IN LIEU OF A 3' X 24" ACP NEXT TO A 24" X 24" ACP, THE PANEL SHALL BE 27" X 24" AND EXTEND TO THE WALL OR SOFFIT.

DEMOLITION GENERAL NOTES

SEE SHEET A-101

DEMOLITION KEYNOTES

SEE SHEET A-101

NEW WORK GENERAL NOTES

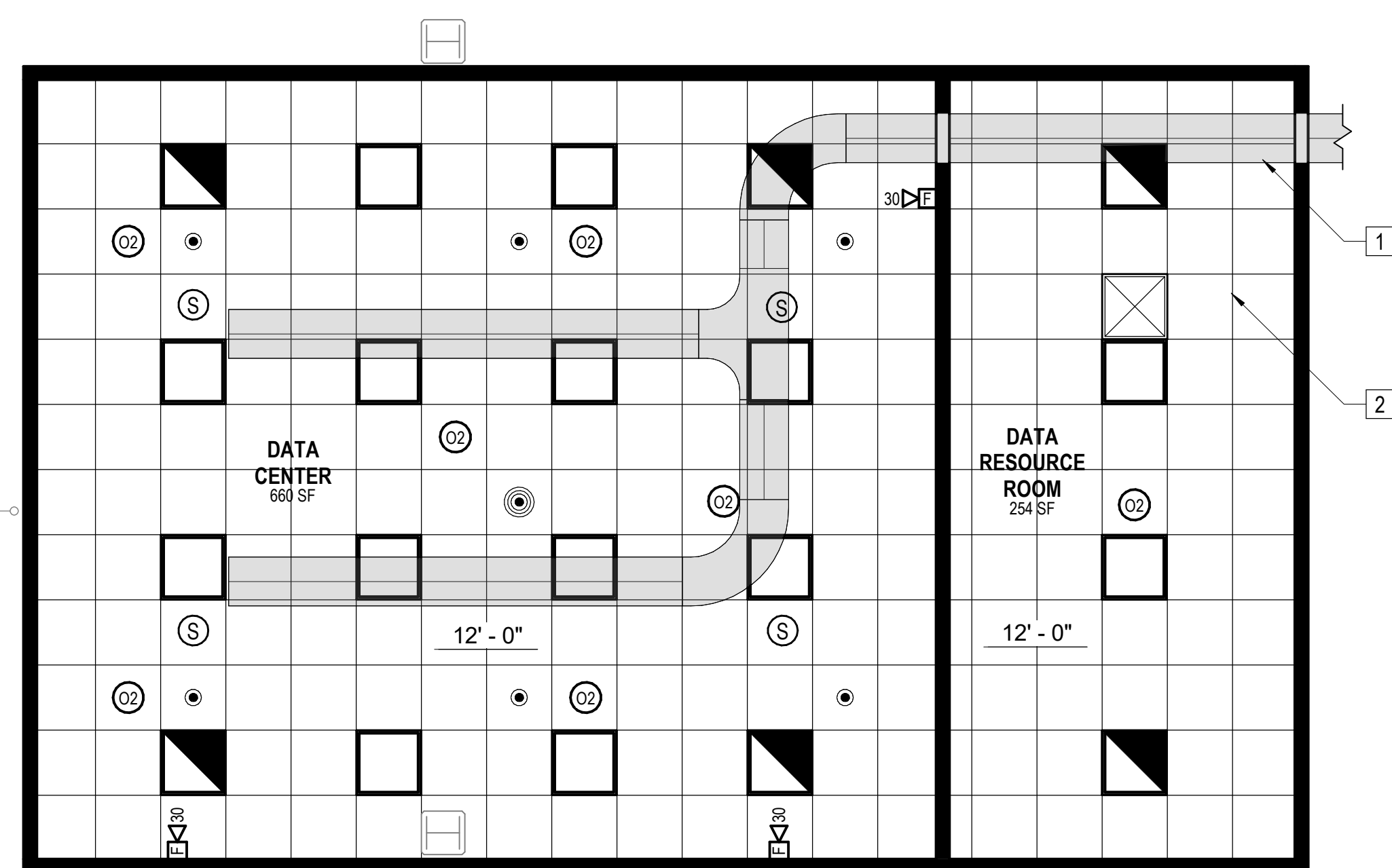
SEE SHEET A-101

NEW WORK KEYNOTES

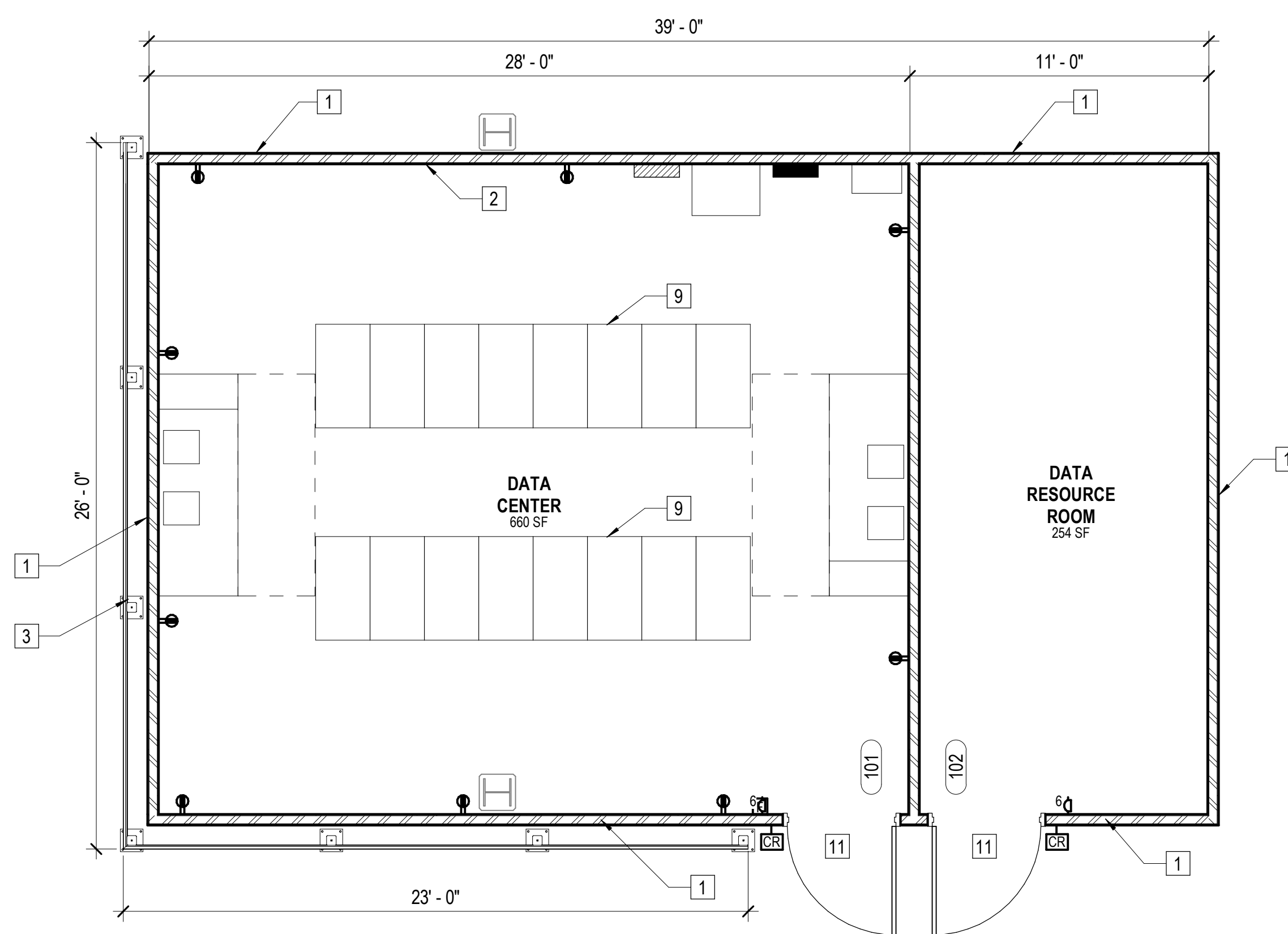
SEE SHEET A-101

DATA CENTER AIR SEALING NOTES

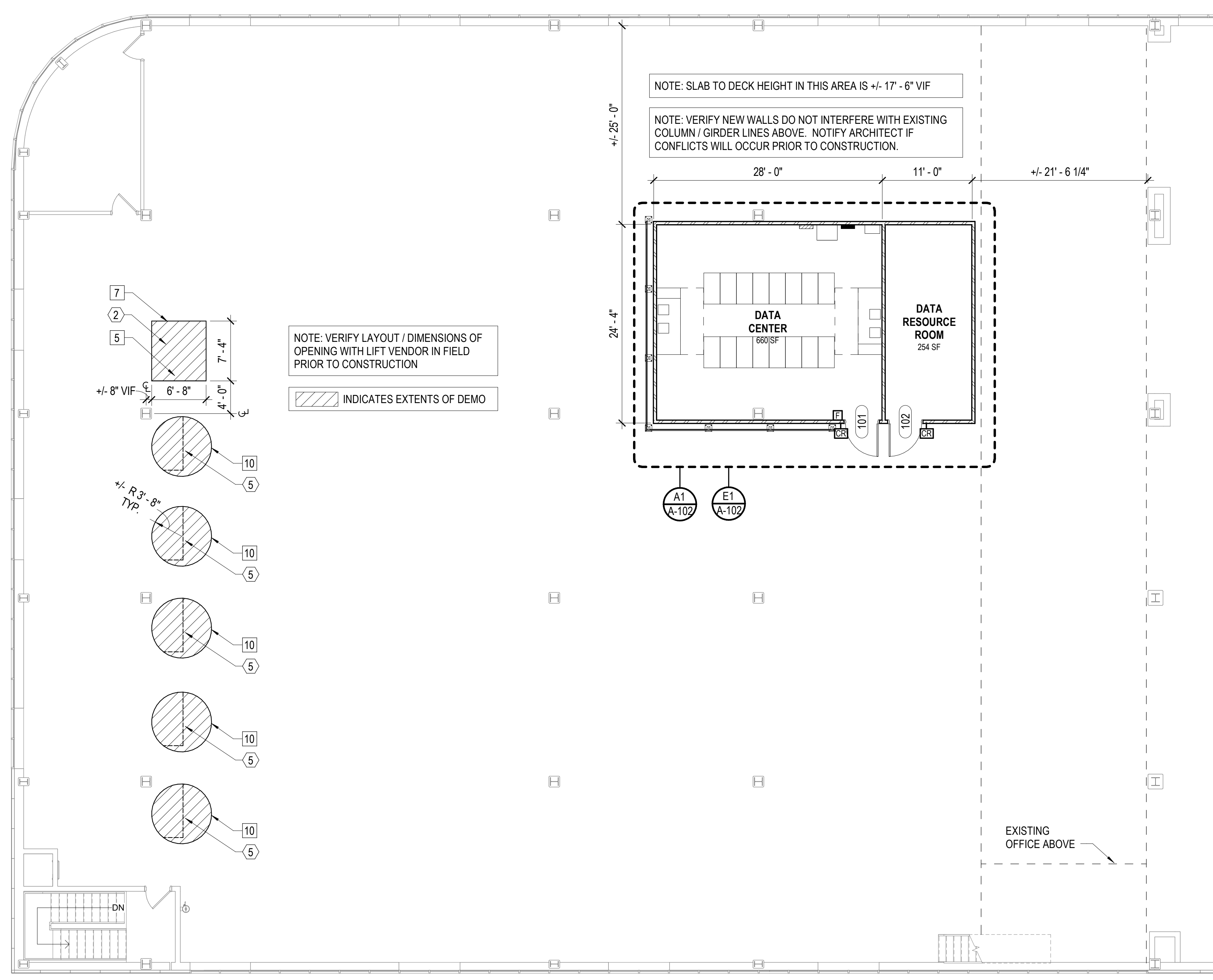
- ALL WALLS EXTEND FULL HEIGHT AND SHALL BE SEALED AT SLAB AND DECK ABOVE. PROVIDE UL RATING AS PER TESTING LAB CHART A-001.
- SEAL ALL JOINTS IN GWB AT PERIMETER AND IN CORNERS. SET BOTTOM TRACK OF DATA CENTER STUD WALLS IN CONTINUOUS BED OF SEALANT.
- FIRE CAULK AND SEAL ANY PENETRATION IN RATED WALLS.
- SEAL ANY PENETRATIONS IN ACOUSTIC CEILING TILES.
- DOORS SHALL BE PROVIDED WITH WEATHER STRIPPING AND DOOR SWEEP (SEE DOOR HARDWARE SPECS FOR ADDITIONAL INFORMATION)



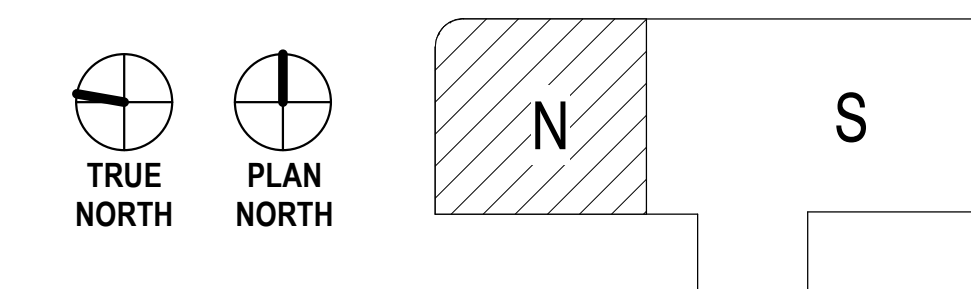
E1 ENLARGED RCP - DATA CENTER
A-102 SCALE: 1/4" = 1'-0"



A1 ENLARGED NEW WORK PLAN - DATA CENTER
A-102 SCALE: 1/4" = 1'-0"



SECOND FLOOR COMBINED DEMOLITION / NEW WORK PLAN - NORTH
SCALE: 1/8" = 1'-0"

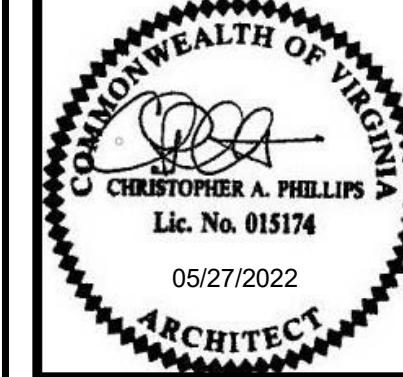


KEY PLAN NORTH
NOT TO SCALE

DESCRIPTION	
BY	
MARK DATE	
REVISIONS	



DATE	05/27/2022	DESIGNED	JWH	DRAWN	BLH	CHECKED	CAP
PROJECT	18106-09						



PROJECT
ROANOKE CITY PUBLIC SCHOOLS
ADMINISTRATION BUILDING ON CAMPBELL (AOC)
PHASE ONE (DATA CENTER)
 201 Campbell Ave SW
 Roanoke, VA 24011

DRAWING
DATA CENTER - DEMO / NEW WORK / REF. CLNG. PLANS

SHEET
A-102

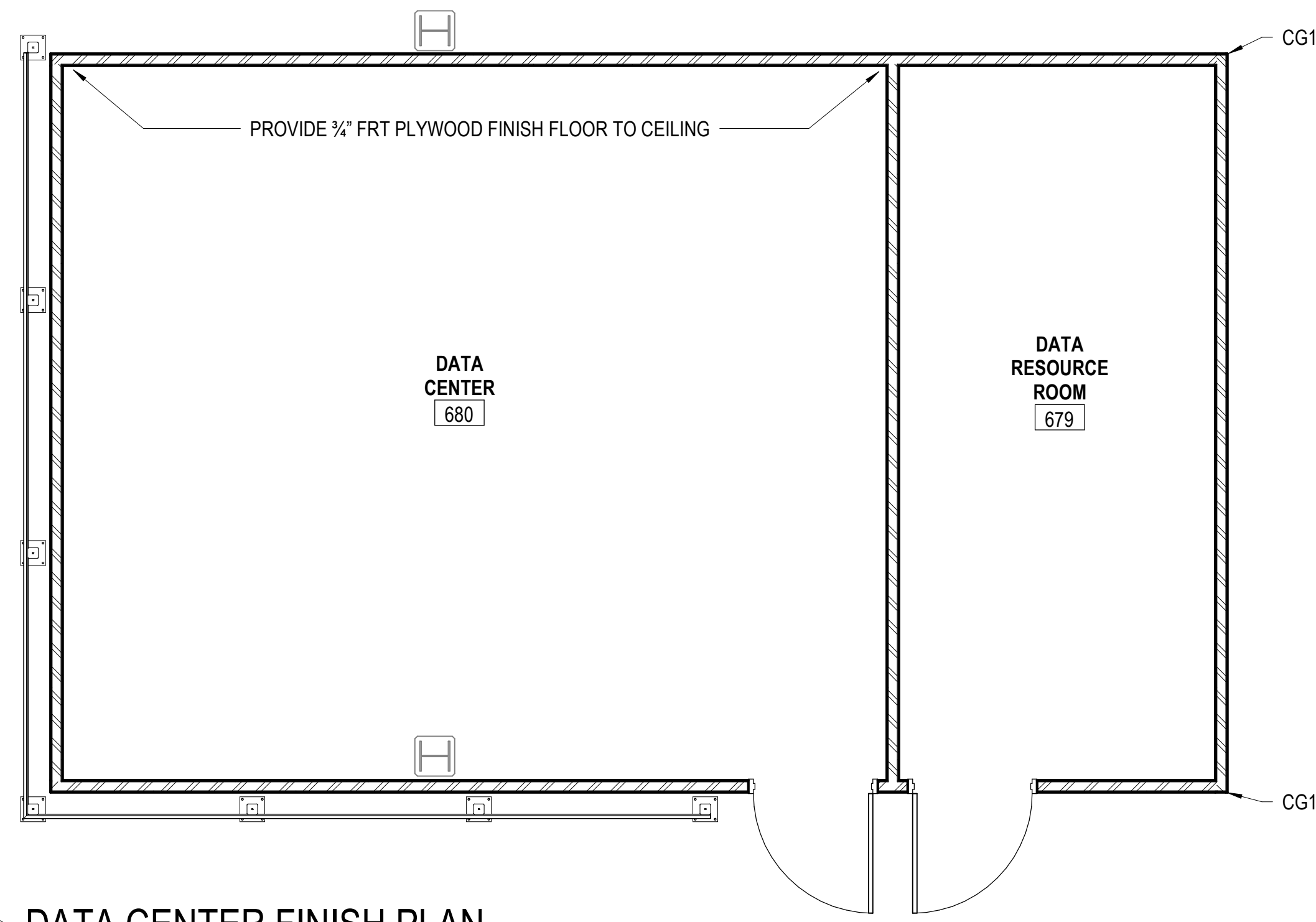
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FINISH SCHEDULE DATA CENTER									
ROOM NUMBER	ROOM NAME	FLOOR	WALL BASE	WALLS				CEILING	NOTES
				N	S	E	W		
SECOND FLOOR									
679	DATA RESOURCE ROOM	SC1	RB1	PT1	PT1	PT1	PT1	ACT2	
680	DATA CENTER	EPX1	EPXB1	--	PT1	PT1	PT1	ACT1	

GENERAL FINISH NOTES

- A. FACE OF ALL WALLS OUTSIDE OF DATA CENTER AND DATA RESOURCE ROOM TO BE PAINTED PT1 FULL HEIGHT AND RECEIVE RB1 BASE

FINISH LEGEND DATA CENTER					
SYMBOL	PRODUCT	MANUFACTURER	PRODUCT # / STYLE	COLOR	NOTES
FLOOR					
EPX1	EPOXY FLOORING	SHERWIN WILLIAMS	FASTOP DECO FLAKE SL45	TBD	--
SC1	SEALED CONCRETE	SHERWIN WILLIAMS	--	--	--
BASE					
EPXB1	EPOXY BASE	SHERWIN WILLIAMS	FASTOP DECO FLAKE SL45	TBD	4" INTEGRAL COVE BASE WITH MT1
RB1	RESILIENT BASE	JOHNSONITE	COLOR MATCH SERIES	TBD	4" INTEGRAL COVE BASE
WALLS					
PT1	PAINT	SHERWIN WILLIAMS	REFER TO SPECIFICATION FOR PRODUCT TYPE PER SUBSTRATE	SW7648 BIG CHILL (WHITE)	--
CEILINGS					
ACT1	ACOUSTICAL CEILING TILE	ARMSTRONG	CLEAN ROOM VL	WHITE	24 x 24" TILE, 15/16" CLEAN ROOM GRID, GASKETED
ACT2	ACOUSTICAL CEILING TILE	ARMSTRONG	1713 SCHOOL ZONE FINE FISSURED	WHITE	24 x 24" TILE, 15/16" GRID
MISCELLANEOUS					
CG1	CORNER GUARD	CONSTRUCTION SPECIALTIES INC	CO-8 CORNER GUARD	STAINLESS STEEL	6'-0" H
MT1	METAL TRIM	SCHLUTER	SCHIENE E80	STAINLESS STEEL	5/16", USE WITH EPXB1

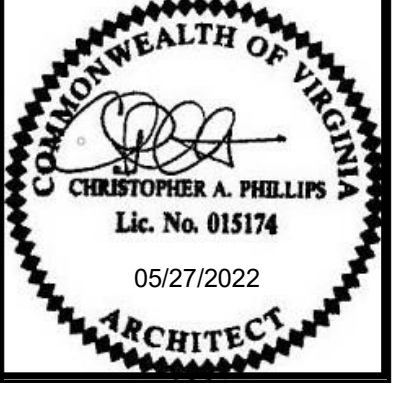


DATA CENTER FINISH PLAN
A1
A-103 SCALE: 1/4" = 1'-0"

DESCRIPTION
BY
MARK DATE
REVISIONS



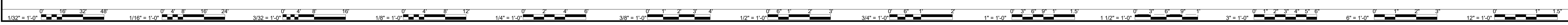
DATE	05/27/2022	DESIGNED	JWH	DRAWN	BLH	CHECKED	CAP
PROJECT	18106-09						

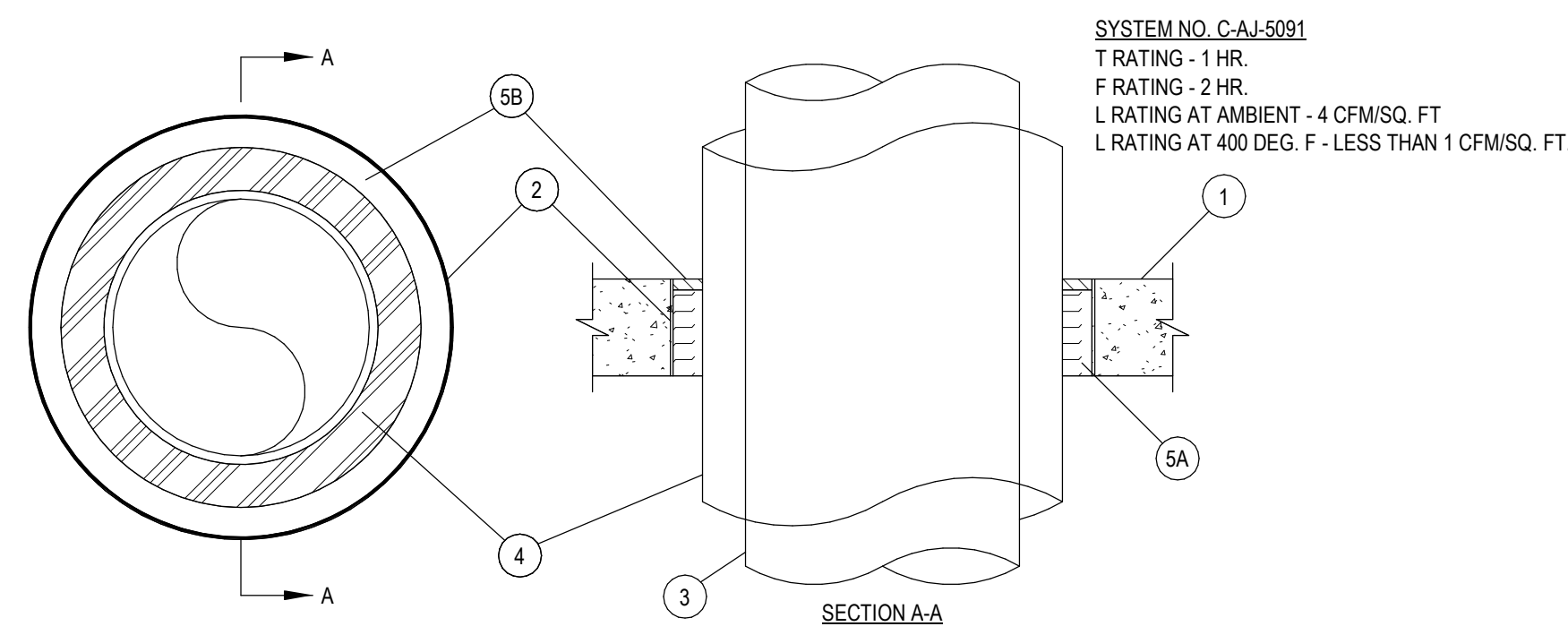


PROJECT
ROANOKE CITY PUBLIC SCHOOLS
ADMINISTRATION BUILDING ON CAMPBELL (AOC)
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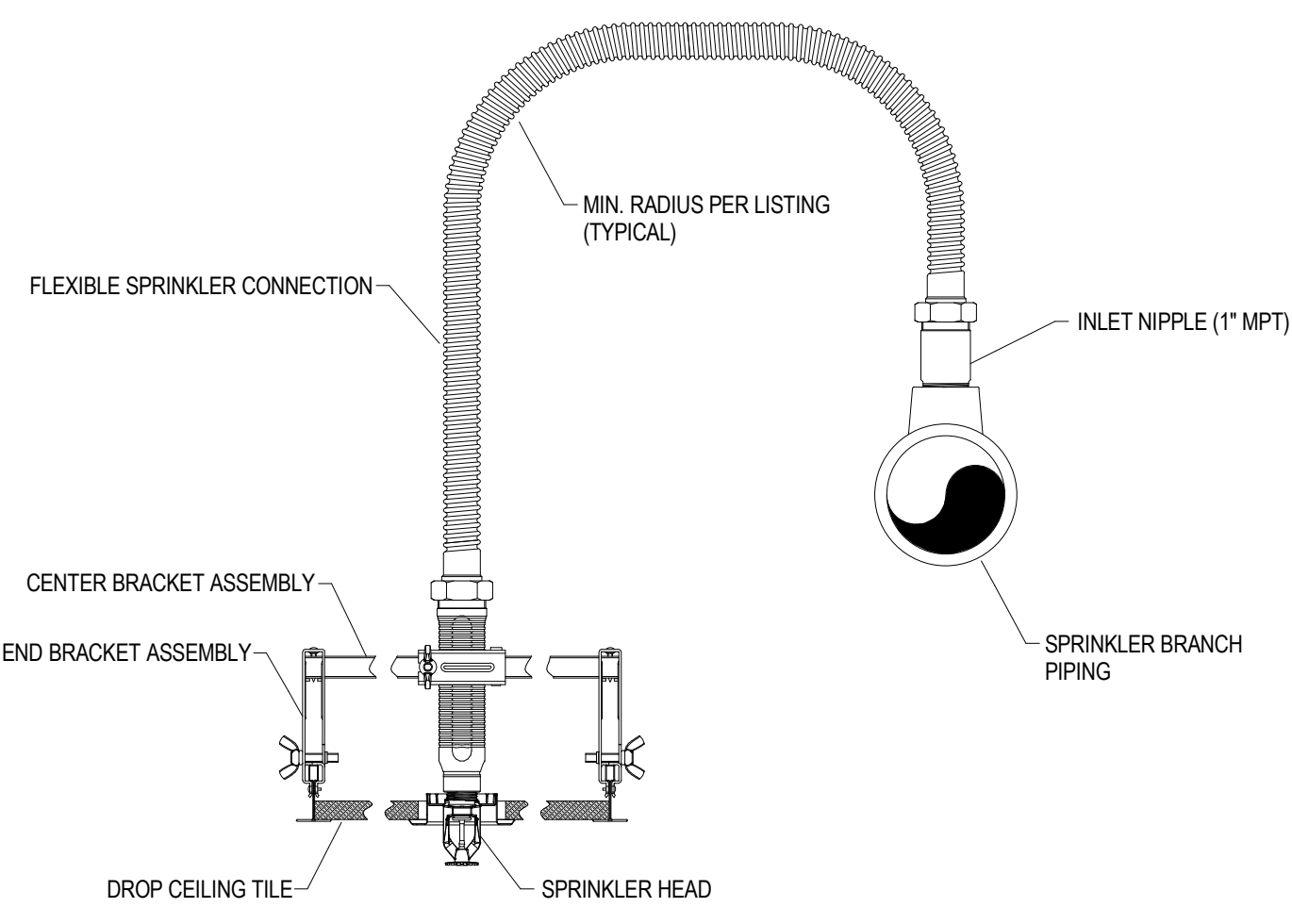
DRAWING
DATA CENTER - FINISH PLAN AND SCHEDULES

SHEET
A-103





- FLOOR OR WALL ASSEMBLY - MIN 4-1/2 IN. THICK REINFORCED LIGHTWEIGHT OR NORMAL WEIGHT (100-150 PCF) CONCRETE. WALL MAY ALSO BE CONSTRUCTED OF ANY UL CLASSIFIED CONCRETE BLOCKS. MAX DIAM OF OPENING IS 19-1/2 IN. SEE CONCRETE BLOCKS (CAZ7) CATEGORY IN THE FIRE RESISTANCE DIRECTORY FOR NAMES OF MANUFACTURERS.
- METALLIC SLEEVE - (OPTIONAL) - NOM 20 IN. DIAM (OR SMALLER) SCHEDULE 10 (OR HEAVIER) STEEL PIPE.
- THROUGH PENETRATIONS - ONE METALLIC PIPE OR TUBING TO BE INSTALLED EITHER CONCENTRICALLY OR ECCENTRICALLY WITHIN THE FIRESTOP SYSTEM. PIPE OR TUBING TO BE RIGIDLY SUPPORTED ON BOTH SIDES OF FLOOR OR WALL ASSEMBLY. THE FOLLOWING TYPES AND SIZES OF METALLIC PIPES OR TUBING MAY BE USED:
 - STEEL PIPE - NOM 12 IN. DIAM (OR SMALLER) SCHEDULE 10 (OR HEAVIER) STEEL PIPE.
 - IRON PIPE - NOM 12 IN. DIAM (OR SMALLER) CAST OR DUCTILE IRON PIPE.
 - COPPER PIPE - NOM 6 IN. DIAM (OR SMALLER) REGULAR (OR HEAVIER) COPPER PIPE.
 - COPPER TUBING - NOM 6 IN. DIAM (OR SMALLER) TYPE L (OR HEAVIER) COPPER TUBING.
- PIPE COVERING - NOM 2 IN. THICK HOLLOW CYLINDRICAL HEAVY DENSITY (MIN 3.5 PCF) GLASS FIBER UNITS JACKETED ON THE OUTSIDE WITH AN ALL-SERVICE JACKET. LONGITUDINAL JOINTS SEALED WITH METAL FASTENERS OR FACTORY-APPLIED, SELF-SEALING LAP TAPE. TRANSVERSE JOINTS SECURED WITH METAL FASTENERS OR WITH BUTT TAPE SUPPLIED WITH THE PRODUCT. THE ANNULAR SPACE BETWEEN THE INSULATED PIPE AND THE EDGE OF THE PERIPHERY OF THE OPENING SHALL BE MIN 1/2 IN. TO A MAX 2-1/4 IN.
 - PIPE COVERING - (NOT SHOWN) - AS AN ALTERNATE TO ITEM 4, MAX 2 IN. THICK CYLINDRICAL CALCIUM SILICATE (MIN 14 PCF) UNITS SIZED TO THE OUTSIDE DIAM OF THE PIPE OR TUBE MAY BE USED. PIPE INSULATION SECURED WITH STAINLESS STEEL BANDS OR MIN 8 AWG STAINLESS STEEL WIRE SPACED MAX 12 IN. OC. THE ANNULAR SPACE SHALL BE MIN 1/2 IN. TO A MAX 2-1/4 IN.
 - FIRESTOP SYSTEM - THE FIRESTOP SYSTEM SHALL CONSIST OF THE FOLLOWING:
 - PACKING MATERIAL - MIN 4 IN. THICKNESS OF MIN 4 PCF MINERAL WOOL BATT INSULATION FIRMLY PACKED INTO OPENING AS A PERMANENT FORM. PACKING MATERIAL TO BE RECESSED FROM TOP SURFACE OF FLOOR OR FROM BOTH SURFACES OF WALL AS REQUIRED TO ACCOMMODATE THE REQUIRED THICKNESS OF FILL MATERIAL.
 - FILL VOID OR CAVITY MATERIAL - SEALANT - MIN 1/2 IN. THICKNESS OF FILL MATERIAL APPLIED WITHIN THE ANNULUS. FLUSH WITH TOP SURFACE OF FLOOR OR WITH BOTH SURFACES OF THE WALL.



FLEXIBLE SPRINKLER CONNECTION DETAIL
NO SCALE

ROOM SEALING GUIDELINES:

- GENERAL CONTRACTOR: WALLS, CEILING, & FLOORS:**
- POROUS BLOCK WALLS MUST BE SEALED SLAB-TO-SLAB TO PREVENT GAS FROM PASSING THROUGH THE BLOCK. TWO OR THREE COATS OF PAINT ARE TYPICALLY REQUIRED.
 - PROTECTED AREAS SHOULD BE ENCLOSED WITH WALL PARTITIONS WHICH EXTEND SLAB-TO-SLAB. IN AREAS WHERE THIS IS NOT POSSIBLE, ALL CEILING TILES SHOULD BE CLIPPED DOWN AND OPENINGS CAULKED. UPGRADED GYPSUM BOARD CEILING TILES ARE RECOMMENDED (GRDSTONE FIRE-SHIELD).
 - ALL WALLS SHOULD BE CAULKED AROUND THE INSIDE PERIMETER OF THE ROOM WHERE THE WALLS REST ON THE FLOOR, WHERE THE WALLS INTERSECT AT THE CORNERS AND WHERE THE WALLS INTERSECT WITH THE CEILING ABOVE.
 - ANY PENETRATION, INCLUDING ALL CONDUIT, CABLE TRAYS, OUTLETS, SWITCHES AND WIRE TROUGHS MUST BE FIRE CAULKED AND SEALED.
 - IF A RAISED FLOOR CONTIGUES OUT OF THE PROTECTED SPACE, BULKHEADS MUST BE INSTALLED UNDER THE FLOOR DIRECTLY UNDER THE PARTITIONS. THESE BULKHEADS MUST BE CAULKED TOP AND BOTTOM.
 - ALL FLOOR DRAINS SHOULD HAVE TRAPS AND THE TRAPS SHOULD BE DESIGNED TO HAVE WATER IN THEM AT ALL TIMES OR CHARGED WITH MINERAL OIL.
 - SPECIAL ATTENTION SHOULD BE GIVEN TO SEALING ANY CRACKS BELOW THE SUSPENDED CEILING.
- GENERAL CONTRACTOR: DOORS & WINDOWS:**
- ALL DOORS MUST HAVE A THRESHOLD AND/OR SWEEP INSTALLED.
 - EGRESS DOORS SHOULD SWING OUT OF THE PROTECTED SPACE.
 - DOORS MAY REQUIRE WEATHER STRIPPING AROUND THE JAM TO ENSURE AN AIR TIGHT SEAL.
 - LATCHING MECHANISMS ARE NECESSARY AND DOOR CLOSERS MAY BE REQUIRED.
 - F DOORS MUST REMAIN OPEN, AN ELECTROMAGNETIC DOOR HOLDER WILL BE REQUIRED AND RELEASED PRIOR TO AGENT DISCHARGE.
 - ALL TYPES OF WINDOWS OR OTHER TYPES OF OPENINGS MUST BE FIRE CAULKED AND SEALED.
- MECHANICAL CONTRACTOR: HVAC SPECIALTIES:**
- TO ENSURE THE PROTECTED AREA IS AIR TIGHT, DAMPERS MAY BE REQUIRED IN THE DUCTWORK AT THE PERIMETER WALLS OF EACH PROTECTED SPACE.
 - DAMPERS MUST BE SPRING LOADED OR MOTOR OPERATED TO PROVIDE 100% AIR SHUT OFF.
 - ALL DAMPERS ARE TO BE UL 555S TO MEET THE 5% MINIMUM LEAKAGE REQUIREMENTS.
 - ALL HVAC IN THE PROTECTED SPACE SHALL BE SHUT/DOWN PRIOR TO AGENT DISCHARGE. SELF-CONTAINED HVAC UNITS MAY CONTINUE TO RUN IF APPROVED BY THE A/E.
 - HVAC SHUT DOWN CONTROL RELAYS SHOULD BE INSTALLED TO WITHIN 3 FT. OF EACH UNIT.
 - ALL EXHAUST FANS SHOULD BE DAMPERED. FIRE ALARM SYSTEM CONTROL RELAYS ARE USED TO SHUT/DOWN ANY FANS.
 - ALL FRESH AIR INTAKES SHOULD BE DAMPERED AND CLOSED USING FIRE ALARM SYSTEM CONTROL RELAYS.
- ELECTRICAL CONTRACTOR: POWER AND INTERFACE WIRING:**
- 120 VAC DEDICATED 15 AMP CIRCUIT TO THE SUPPRESSION CONTROL PANEL IS REQUIRED.
 - POWER TO ALL DAMPERS - CONTROL RELAYS WITHIN 3 FT. OF DAMPER.
 - FIRE ALARM MONITORING - CONTACTS FOR ALARM, SUPERVISORY AND TROUBLE CONDITIONS ARE AVAILABLE WITHIN THE FIRE CONTROL PANEL. CONNECTION IS HANDLED BY FIRE SYSTEM CONTRACTOR.
 - PURGE SYSTEM CONTROL WIRING TO HVAC UNITS AND EXHAUST FANS ARE INTERFACED WITH THE FIRE ALARM SYSTEM CONTROL PANEL. CONNECTION IS HANDLED BY THE FIRE SYSTEM CONTRACTOR.

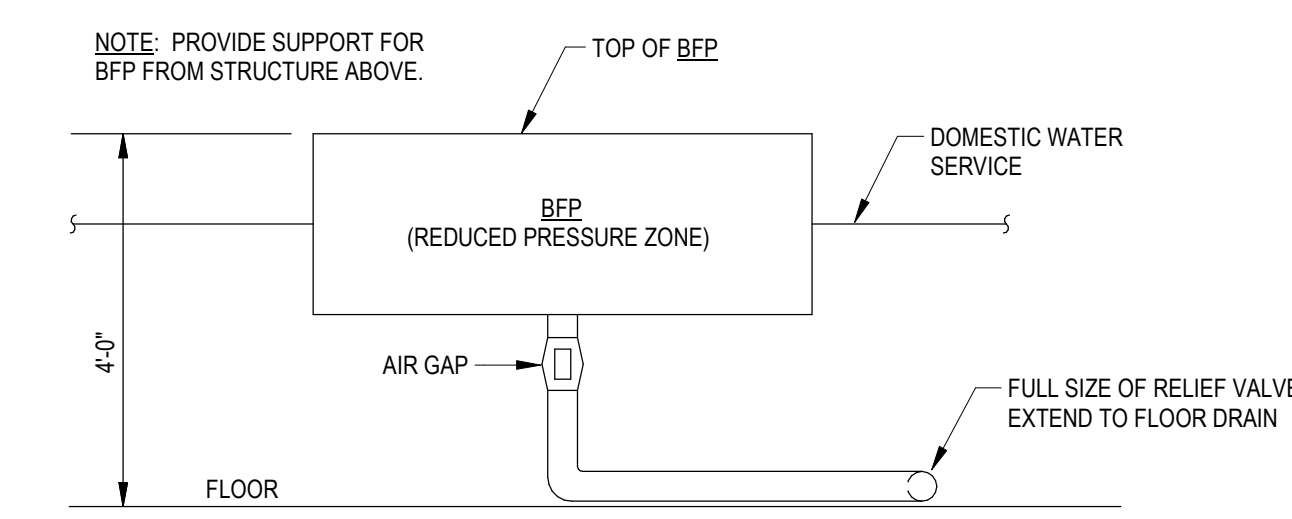
SPRINKLER SYSTEM GENERAL NOTES:

- THE EXISTING SPRINKLER SYSTEM IN THE RENOVATED AREAS SHALL BE MODIFIED AS REQUIRED TO PROVIDE FULL SPRINKLER COVERAGE IN ACCORDANCE WITH NFPA 13-2016 AND THE 2018 VIRGINIA CONSTRUCTION CODE.
- INSTALLATION SHALL BE ACCOMPLISHED BY A CONTRACTOR WHO IS DULY LICENSED AND ACCREDITED IN THE INSTALLATION OF AUTOMATIC SPRINKLER SYSTEMS AND FIRE PROTECTION EQUIPMENT FOR THE PAST THREE YEARS.
- EXISTING SPRINKLER HEADS SHALL BE REMOVED. NEW SPRINKLER HEADS SHALL BE RECESSED PENDENT IN FINISHED CEILINGS, AND UPRIGHT IN SPACES OPEN TO STRUCTURE.
- PIPING SHALL BE FERROUS PIPING (WELDED AND SEAMLESS), ASTM A795, ASTM A53 OR ASTM A153 IN ACCORDANCE WITH NFPA 13-2016.
- CONTRACTOR SHALL COORDINATE THE LOCATIONS OF ALL SPRINKLERS AND SPRINKLER PIPING WITH OTHER PIPES, DUCTS, LIGHTS, EQUIPMENT, CONDUIT, STRUCTURAL SYSTEMS, CEILING SUPPORTS, AND FRAMING BEFORE INSTALLATION. SPRINKLER PIPING SHALL NOT BE INSTALLED WHERE ITS LOCATION INHIBITS EQUIPMENT FILTER AND MAINTENANCE ACCESS OR INFRINGES UPON CLEARANCE DICTATED BY THE NATIONAL ELECTRIC CODE. ALL SPRINKLERS TO BE CENTERED IN CEILING TILES. "CENTER OF TILE."
- THE SPRINKLER SYSTEM IN THE DATA CENTER (680) SHALL LIGHT HAZARD DESIGNED TO PROVIDE 0.10 GPM/SQ. FT. OVER 1500 SQ. FT. PLUS A 100 GPM HOSE ALLOWANCE. THE SYSTEM SHALL BE WET USING 155 DEG. F. SPRINKLER HEADS AND COVER NO MORE THAN 225 SQ. FT. PER HEAD.
- THE SPRINKLER SYSTEM IN DATA RESOURCE ROOM (679) SHALL BE ORDINARY HAZARD GROUP 2 DESIGNED TO PROVIDE 0.15 GPM/SQ. FT. OVER 1500 SQ. FT. PLUS A 250 GPM HOSE ALLOWANCE. THE SYSTEM SHALL BE WET USING 155 DEG. F. SPRINKLER HEADS AND COVER NO MORE THAN 130 SQ. FT. PER HEAD.
- PROVIDE FIRESTOPPING AT ALL LOCATIONS WHERE PIPES PENETRATE RATED WALL ASSEMBLIES.
- THE EXISTING SPRINKLER SYSTEM SERVING AREAS NOT BEING RENOVATED MUST BE MAINTAINED DURING CONSTRUCTION.

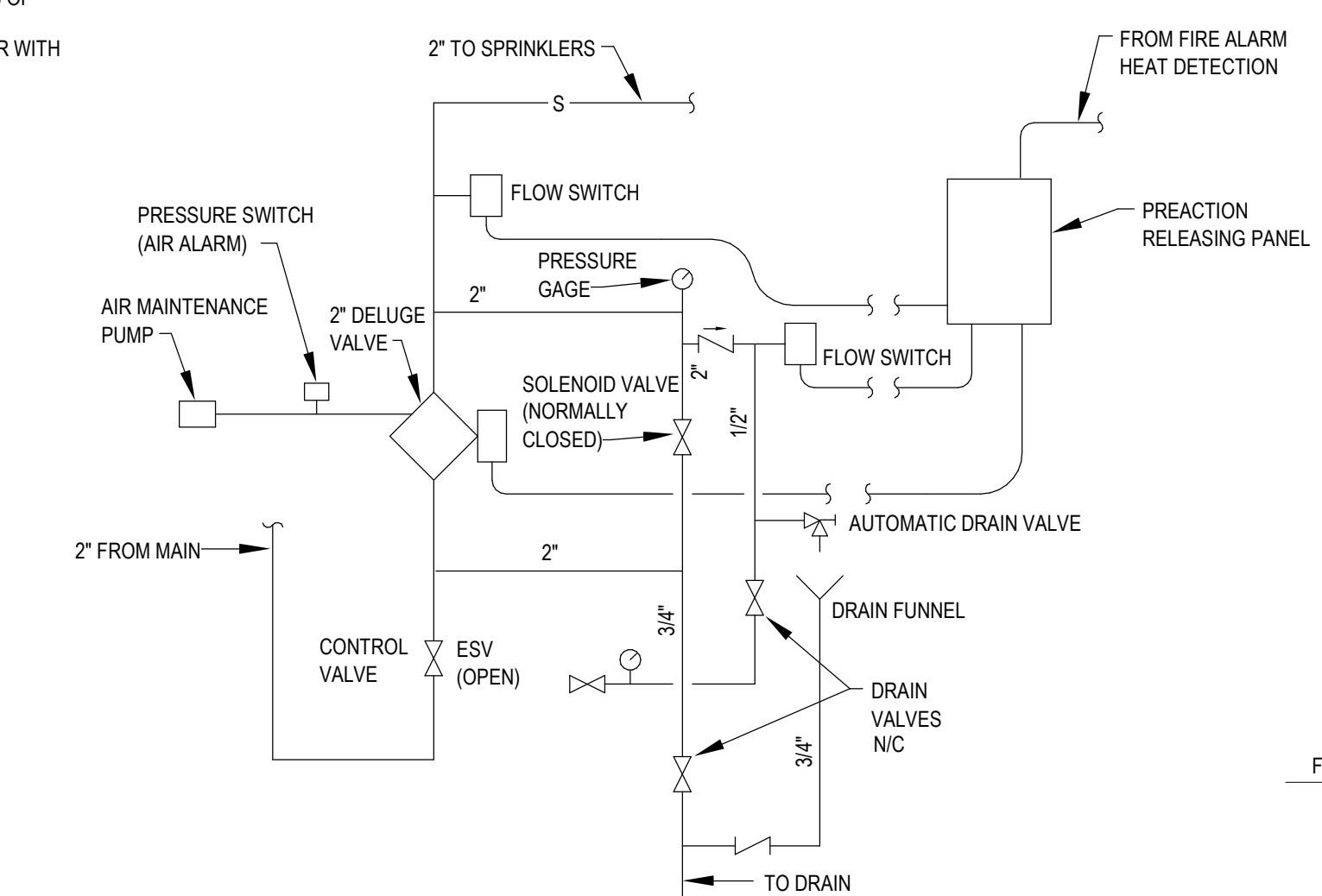
FM-200 SYSTEM GENERAL NOTES:

- NEW DATA CENTER IS TO BE PROTECTED BY A FM-200 CLEAN AGENT FIRE SUPPRESSION SYSTEM AS WELL AS A BACK-UP DOUBLE INTERLOCK PRE-ACTION FIRE SUPPRESSION SYSTEM. SEE SHEET SP-001 FOR SYSTEM SPECIFICATIONS.
- NOTIFICATION DEVICES (STROBES) INCLUDED WITH THE FM-200 SYSTEM ARE EXCLUSIVELY FOR THE FM-200 SYSTEM, AND ARE IN ADDITION TO AND SEPARATE FROM SIMILAR DEVICES SHOWN ON THE FIRE ALARM DRAWINGS.
- PROVIDE PENETRATION FIRESTOPPING AT ALL LOCATIONS WHERE SPRINKLER PIPING PENETRATES WALLS, INCLUDING PENETRATIONS ABOVE CEILING.
- TOTAL ESTIMATED FM-200 SYSTEM CAPACITY IS 320 LBS. DIMENSIONS OF THE PROTECTED DATA CENTER IS AS FOLLOWS: 27.916 FT X 27.583 FT X 12 FEET, EQUALING A TOTAL OF 9240 CUBIC FEET.

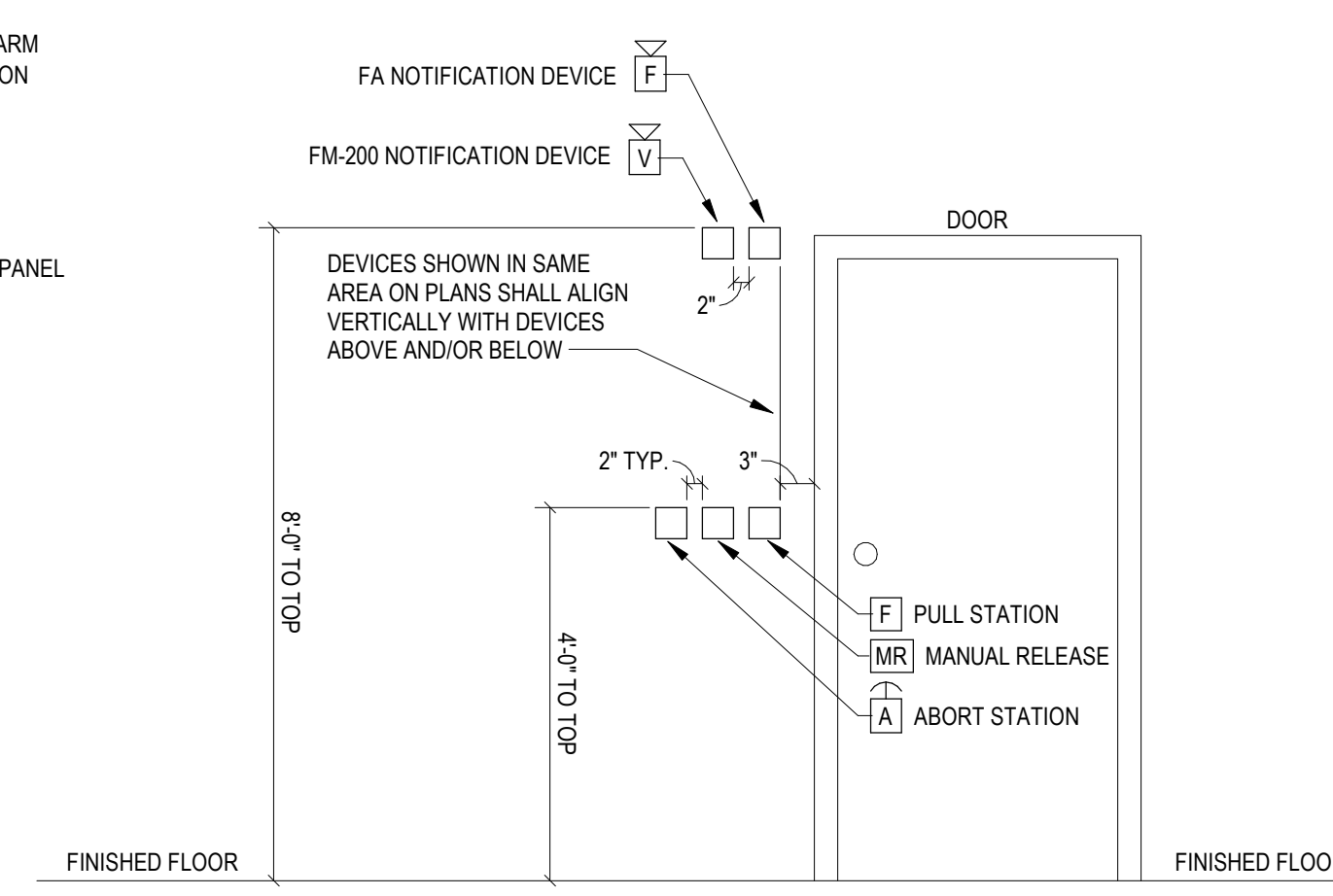
FLOOR OR WALL PIPE PENETRATION FIRESTOP SYSTEM
SCHEMATIC



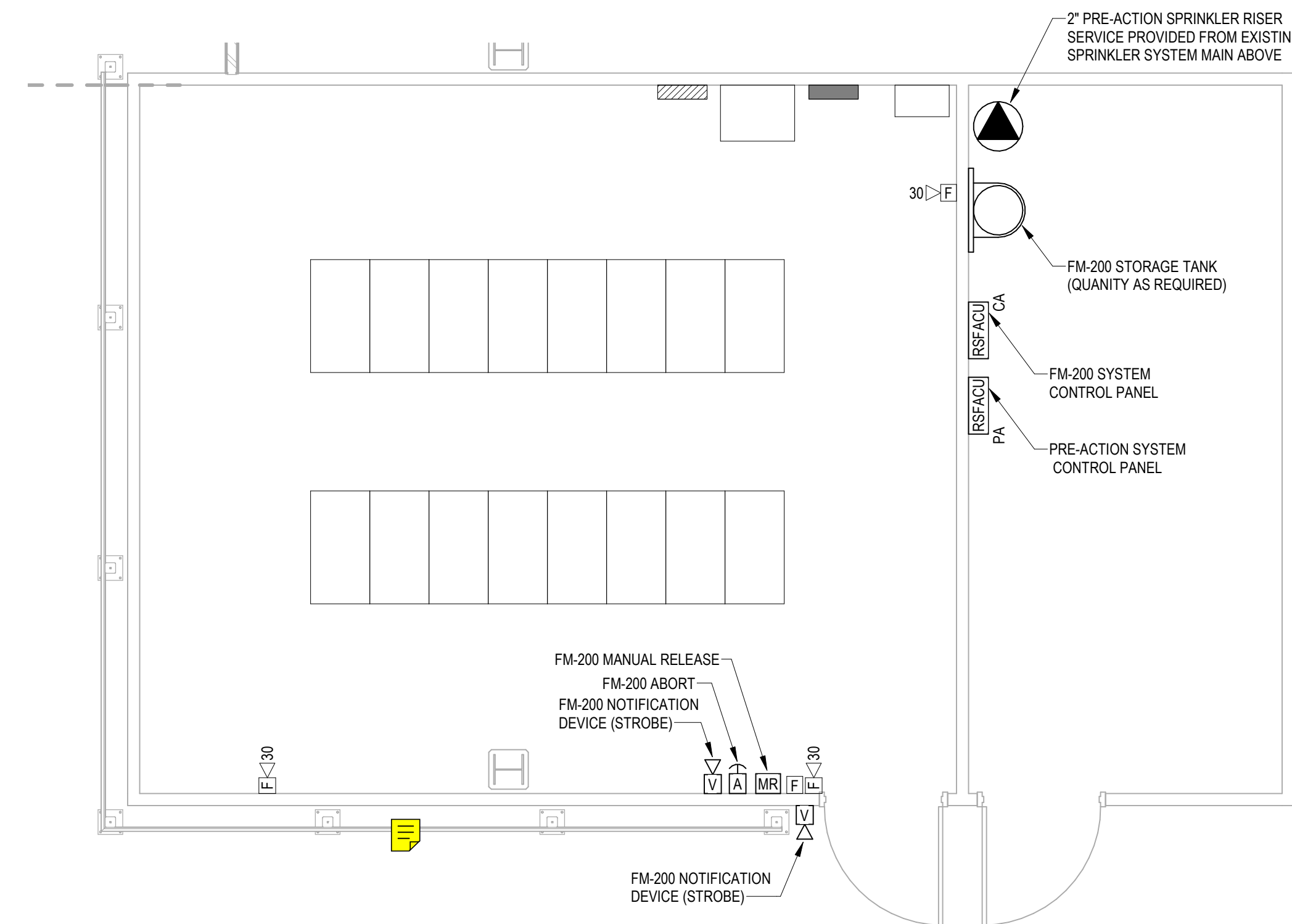
BACKFLOW PREVENTER DRAIN DETAIL
NO SCALE



PREACTION VALVE DETAIL
NO SCALE

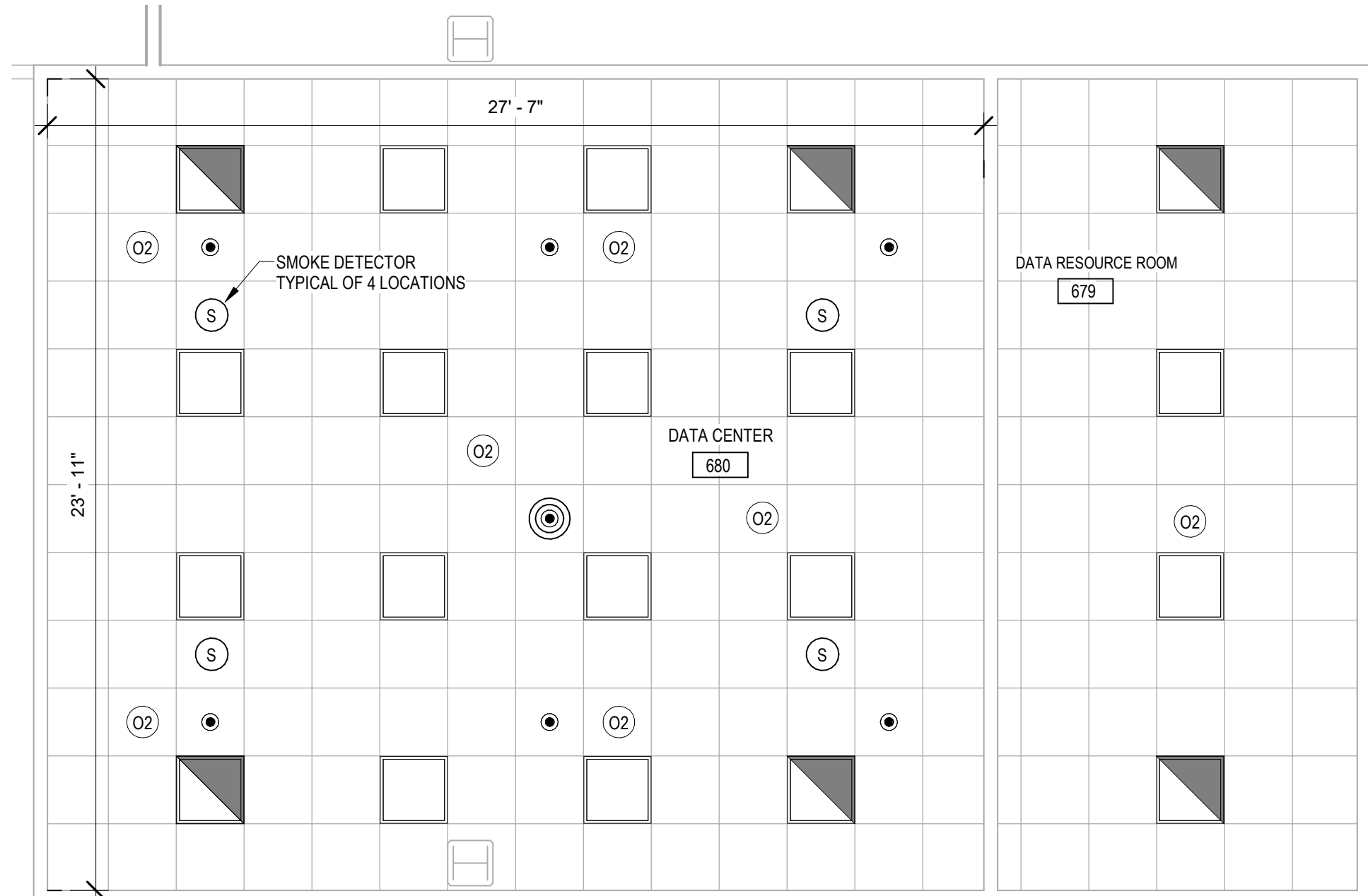


FIRE ALARM DEVICE LOCATION DETAIL
NO SCALE

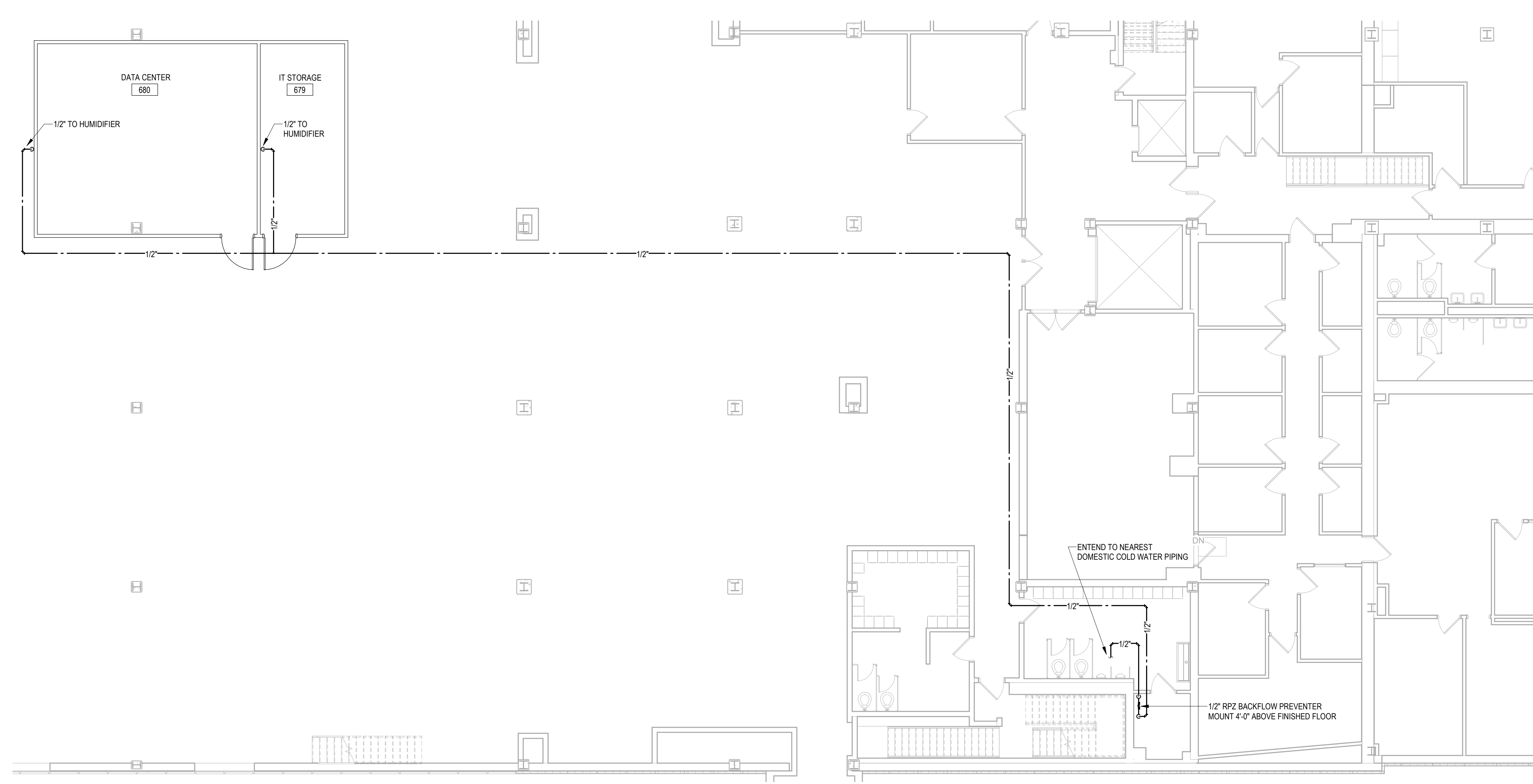


NEW SECOND FLOOR PLAN - DATA CENTER - FIRE SUPPRESSION
SCALE 1/4" = 1'-0"

SPRINKLER HEAD SCHEDULE		
QTY.	SYMBOL	DESCRIPTION
6	●	QUICK RESPONSE PENDENT SPRINKLER - 5.6 "K" FACTOR - RECESSED
1	⊙	CLEAN AGENT NOZZEL - CEILING MOUNTED



NEW SECOND FLOOR NEW DATA CENTER REFLECTED CEILING - FIRE SUPPRESSION
SCALE 1/4" = 1'-0"



NEW SECOND FLOOR PLAN - DATA CENTER - PLUMBING
SCALE 1/8" = 1'-0"

L P A
LAWRENCE PERRY & ASSOCIATES
Consulting Engineers

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Roanoke, Virginia 24011 Fax: (540) 344-3410
Comm. No.: 21125
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DESCRIPTION	
BY	
MARK DATE	
REVISIONS	

ROANOKE CITY PUBLIC SCHOOLS
2000 Students, 2000+ Staff, 2000+ City

DATE	05/27/2022	JNS
PROJECT	18106-09	JNS
DESIGNED		JNS
DRAWN		MGW
CHECKED		

RRMM ARCHITECTS, PC
28 Church Ave SW
Roanoke, Virginia 24011
(540)344-1212

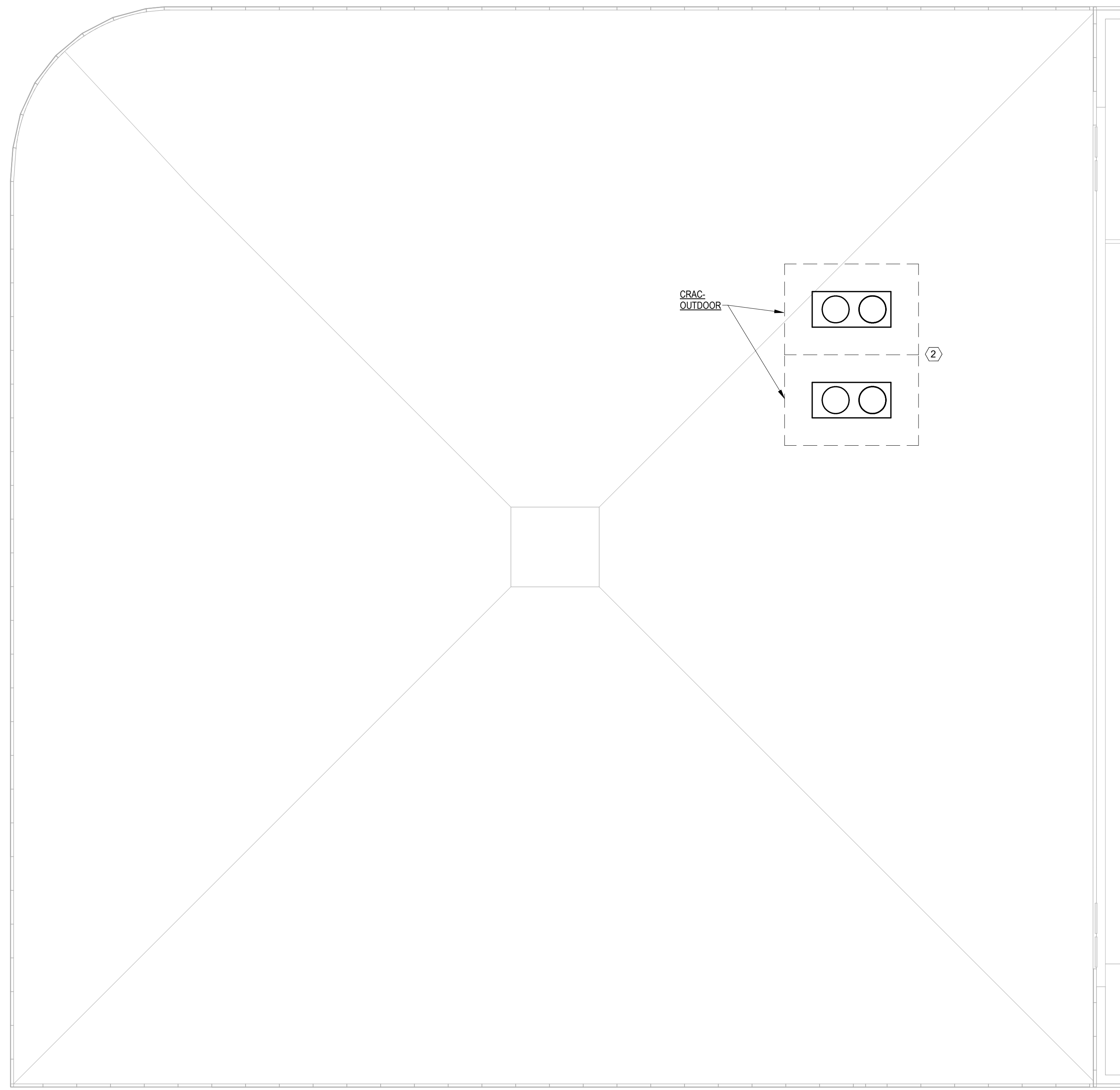
05-27-2022
CRODNEY D. FANNING
Lic. No. 034958
PROFESSIONAL ENGINEER

PROJECT: ROANOKE CITY PUBLIC SCHOOLS
ADMINISTRATION BUILDING ON CAMPBELL (AOC)
PHASE ONE (DATA CENTER)
201 Campbell Ave SW
Roanoke, VA 24011

DRAWING: SECOND FLOOR - PLUMBING / FIRE SUPPRESSION

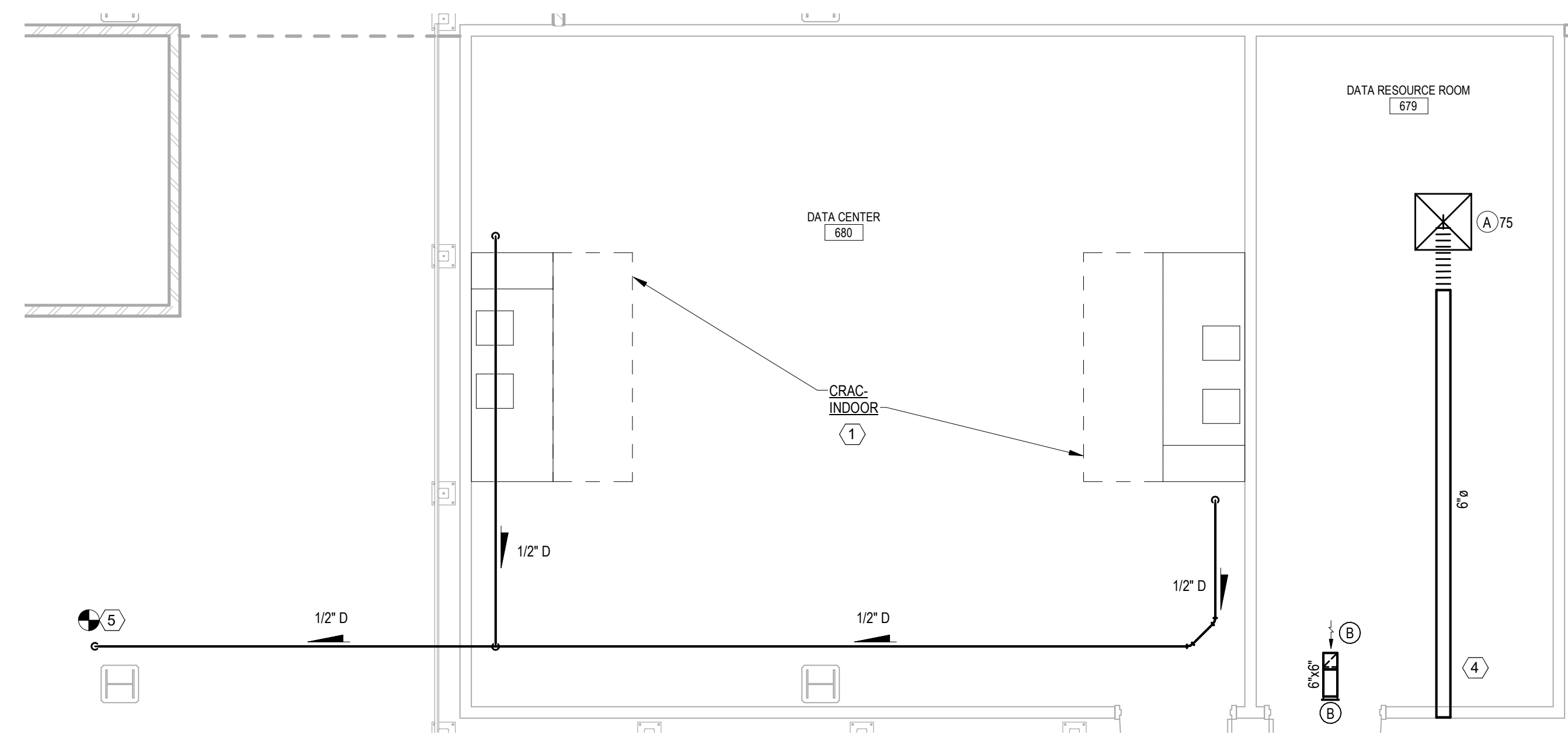
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NEW WORK ROOF PLAN - DATA CENTER - HVAC

SCALE: 1/8" = 1'-0"



NEW WORK SECOND FLOOR PLAN - DATA CENTER - HVAC

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

PLAN NOTES:

- COMPUTER ROOM AIR CONDITIONING UNIT WITH TOP DISCHARGE PLENUM TYPICAL OF 2.
- CONDENSING UNITS MOUNTED ON ROOF. CENTER BETWEEN EXISTING JOISTS. COORDINATE WITH STRUCTURAL TYPICAL OF 2.
- ROUTE AND SIZE REFRIGERANT PIPING TO CONDENSING UNIT ON ROOF PER MANUFACTURER'S RECOMMENDATIONS.
- SUPPLY DUCT TO BE CONNECTED TO NEW WAREHOUSE DUCTWORK IN FUTURE PHASE. COVER OPEN DUCT WITH TEMPORARY PROTECTION.
- CONDENSATE TO EXISTING ROOF DRAIN. SEE PLUMBING.

GENERAL NOTES:

- DUE TO THE DRAWINGS BEING DIAGRAMMATICAL IN NATURE, THE DRAWINGS DO NOT SHOW ALL RISES AND DROPS THAT MAY BE REQUIRED. THE CONTRACTOR SHALL INCLUDE THESE IN THE BID, WHERE POSSIBLE, ALL RISES AND DROPS SHALL BE CONSTRUCTED USING 45 DEGREE OR LONG RADIUS ELBOW.
- PROVIDE ALL DUCTWORK TRANSITIONS AND PIPING INCREASERS/REDUCERS AS REQUIRED FOR EQUIPMENT CONNECTIONS. CONSULT MANUFACTURER'S DATA FOR ACTUAL DUCTWORK AND PIPING CONNECTION SIZES, INCLUDING, BUT NOT LIMITED TO, THOSE SHOWN.
- ALL FINISHES AND SURFACES WHICH ARE DAMAGED DURING CONSTRUCTION WORK SHALL BE REPAIRED OR REPLACED TO THE SATISFACTION OF THE OWNER AT NO ADDITIONAL COST TO THE OWNER.
- CONTRACTOR SHALL SEAL AND FLASH ALL WALL, ROOF, AND FLOOR PENETRATIONS AIR TIGHT AND WATER TIGHT AT PIPE, DUCTWORK, AND CONDUIT PENETRATIONS.
- IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PERFORM ALL WORK NECESSARY TO PREPARE THE STRUCTURE FOR THE INSTALLATION WORK OF THE MECHANICAL SYSTEMS. ALL HOLES, OPENINGS AND ANY DAMAGED MATERIALS OR SURFACES SHALL BE REPAIRED AND FINISHED TO MATCH EXISTING.
- FIELD VERIFY TO ELECTRICAL, PLUMBING, ARCHITECTURAL AND STRUCTURAL FOR COORDINATION WITH THESE DRAWINGS.
- DO NOT BLOCK TUBE PULL OR SERVICE SPACE ON EQUIPMENT WITH PIPING, DUCTWORK, ETC. (FLANGED OR REMOVABLE SECTIONS MAY BE USED IN SOME INSTANCES WHERE TIGHT CLEARANCES EXIST).
- ALL DUCTS AND APPARATUS CASINGS ARE TO BE THOROUGHLY CLEANED BEFORE COILS ARE OPERATED.
- SUPPLY DUCTS SHALL TRANSITION FROM UNIT CONNECTION SIZE TO THE SIZE INDICATED ON THE DRAWINGS.
- PIPING, DUCTWORK AND EQUIPMENT SHALL BE SUPPORTED FROM, OR ANCHORED TO, THE BUILDING STRUCTURE. CEILING CONSTRUCTION SHALL NOT BE USED FOR SUPPORT OR ANCHORING OF NEW WORK.
- DO NOT LOCATE CONDUIT, WIRING, PIPING OR PIPING SUPPORTS BELOW FAN COIL UNIT ACCESS PANELS.
- PRIOR TO FINAL ACCEPTANCE OF THE PROJECT BY OWNER, THE CONTRACTOR SHALL DEMONSTRATE ACCESS TO ALL EQUIPMENT FILTERS AND VALVES IN THE PRESENCE OF THE OWNER'S MAINTENANCE PERSONNEL. ALL FILTERS IN UNITS OPERATED DURING CONSTRUCTION SHALL BE CHANGED AT THAT TIME. SUBMIT IN WRITING THAT THIS TASK HAS BEEN ACCOMPLISHED TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE. PROVIDE ONE EXTRA SET OF FILTERS FOR EACH ROOF TOP UNIT.
- MAINTAIN CEILING HEIGHTS. INSTALL ITEMS AS TIGHT TO STRUCTURE AS POSSIBLE.
- ALL DUCTWORK AND PIPES SHALL BE COORDINATED WITH OTHER NEW DUCTS, PIPES, LIGHTS, STRUCTURAL SYSTEM, CEILING SUPPORTS AND FRAMING BEFORE INSTALLATION. MINOR DUCT AND PIPE OFFSETS AND MINOR DUCT TRANSITIONS SHALL BE PROVIDED AS REQUIRED. WHERE TRANSITIONS ARE REQUIRED, CROSS SECTIONAL AREA OF DUCT SHALL NOT BE REDUCED. MEASUREMENTS FOR VERTICAL CLEARANCES OF DUCTWORK SHALL BE TAKEN AT THE JOB SITE BEFORE FABRICATION OF ANY DUCTWORK.
- ANY AND ALL EXPOSED DUCTWORK OR HVAC PIPING SHALL BE PAINTED. COORDINATE COLOR OF PAINT WITH THE ARCHITECT.
- EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S PUBLISHED INSTRUCTIONS.
- MATERIALS AND INSTALLATION SHALL COMPLY WITH LOCAL CODES, APPLICABLE PROVISIONS OF LATEST EDITION OF NATIONAL FIRE PROTECTION ASSOCIATION, LOCAL UTILITY REGULATIONS AND GOVERNMENTAL DEPARTMENTS HAVING JURISDICTION.
- VERIFY ROOF AND WALL OPENINGS WITH STRUCTURE.
- VERIFY THE LOCATION OF ALL THERMOSTATS, TEMPERATURE SENSORS, PANELS AND CONTROL INSTRUMENTS WITH THE ARCHITECT AND OWNER PRIOR TO ROUGH-IN.
- REFER TO STRUCTURAL AND ELECTRICAL DRAWINGS TO COORDINATE THE EXACT LOCATIONS OF DIFFUSERS, REGISTERS, GRILLES, PIPING AND OTHER MECHANICAL EQUIPMENT WITH CEILING GRID, LIGHTS, BEAMS AND OTHER BUILDING COMPONENTS.
- CONTRACTOR SHALL PROVIDE ALL SUPPORTS REQUIRED TO MOUNT MECHANICAL EQUIPMENT, PIPING AND DUCTWORK.
- PROVIDE FLEXIBLE DUCT CONNECTIONS BETWEEN THE SUPPLY AND RETURN DUCTS AND THE AIR UNITS.
- EXPOSED PIPING RUNOUTS SHALL BE INSTALLED IN PRACTICAL ALIGNMENT WITH THE BUILDING AND SHALL BE ADEQUATELY SECURED TO THE BUILDING STRUCTURE.
- PROVIDE MANUAL BALANCING DAMPERS AS REQUIRED FOR BALANCING AIRFLOWS, EVEN IF NOT SHOWN ON DRAWINGS. COORDINATE WITH TAB CONTRACTORS.
- PROVIDE ACCESS DOORS OF SUFFICIENT SIZE IN WALLS AND CEILINGS FOR ALL CONCEALED CONTROLS, DAMPERS OR ANY ITEMS REQUIRING ACCESS.
- AIR DEFLECTORS SHALL BE PROVIDED IN ALL SQUARE ELBOWS OF SUPPLY DUCTWORK, EVEN WHEN NOT SHOWN ON THE DRAWINGS. DO NOT PROVIDE AIR DEFLECTORS IN RETURN AND EXHAUST DUCTWORK.
- DUCTWORK AND PIPING SHALL NOT BE INSTALLED ABOVE ELECTRICAL PANELS. COORDINATE INSTALLATION OF DUCTWORK AND PIPING WITH ELECTRICAL PANELS WHEN SHOWN NEAR PANELS OR OVER ELECTRICAL ROOMS.
- SYSTEMS SHALL OPERATE UNDER CONDITIONS OF LOAD WITHOUT UNUSUAL OR EXCESSIVE NOISE OR VIBRATION. UNUSUAL OR EXCESSIVE NOISE OR VIBRATION SHALL BE CORRECTED.
- EQUIPMENT, MATERIALS AND LABOR REQUIRED BY THESE CONTRACT DRAWINGS SHALL BE GUARANTEED TO BE FREE FROM DEFECTIVE MATERIALS OR WORKMANSHIP FOR ONE YEAR AFTER FINAL ACCEPTANCE OF THE PROJECT UNLESS SPECIFIED OTHERWISE. DEFECTIVE MATERIALS OR WORKMANSHIP OCCURRING DURING THIS PERIOD SHALL BE CORRECTED AT NO ADDITIONAL COST.
- CONTRACTOR SHALL TAKE ALL NECESSARY MEASURES TO PROTECT DUCTWORK AND EQUIPMENT DURING CONSTRUCTION, INCLUDING, BUT NOT LIMITED TO, SEALING AND COVERING DUCTWORK AND EQUIPMENT.
- CONTRACTOR SHALL PROVIDE NECESSARY CONTROLS AND EQUIPMENT IN ORDER TO ADEQUATELY EXPAND THE EXISTING GAS SYSTEM. THE PANELS SHOWN ARE NOT INTENDED TO BE INCLUSIVE OF ALL PANELS THAT MAY BE REQUIRED FOR PROPER CONTROL OF THE HVAC SYSTEMS. PROVIDE ALL PANELS THAT ARE REQUIRED FOR A FULLY FUNCTIONAL BUILDING AUTOMATION SYSTEM. COORDINATE EXACT LOCATION OF ANY NEW PANEL(S) WITH THE ARCHITECT AND THE OWNER.
- ANNULAR SPACE AROUND DUCT PENETRATING ONE FLOOR SHALL BE SEALED WITH NON-COMBUSTIBLE MATERIAL AND WILL NOT ALLOW FREE PASSAGE OF SMOKE PER VCC 77.
- ALL CEILING PENETRATIONS IN DATA CENTER SHALL BE FULLY SEALED.

HVAC LEGEND

CAPACITY	CAP	
CEILING DIFFUSER	CD	
CEILING GRILLE	CG	
CEILING REGISTER	CR	
CLEANOUT	CO	
COOLING COIL CONDENSATE DRAIN PIPE	CCCD	
CUBIC FEET PER MINUTE	CFM	
DEGREES FAHRENHEIT	°F	
DIAMETER	" DIA	
DIRECTION OF FLOW		
DIRECTION OF SLOPE DOWN		
DUCTWORK (NEW)		
RETURN & EXHAUST SUPPLY		
FLEXIBLE DUCT RUNOUT		
HORSEPOWER	HP	
HOUR	HR	
INCH	" IN	
KILOWATT	KW	
PIPING INDICATION WITH RESPECT TO FLOW		
BOTTOM TAKEOFF		
SIDE CONNECTION		
TOP TAKEOFF		
TURN DOWN OR FROM BELOW		
TURN UP OR FROM ABOVE		
POUNDS	LBS	
REFRIGERANT PIPING	R	
THERMOSTAT OR TEMPERATURE SENSOR	TSTAT	
THOUSAND BTU PER HOUR	MBH	

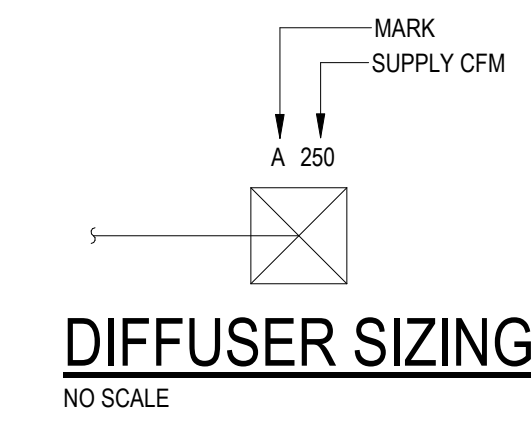
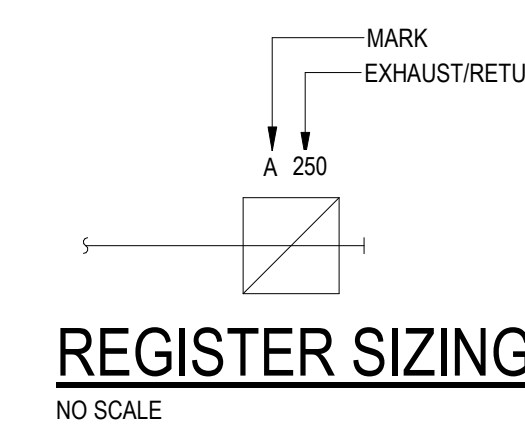
COMPUTER ROOM AIR CONDITIONERS: TRANE (OWNER PURCHASED, CONTRACTOR INSTALLED)

INDOOR EVAPORATING UNIT	
UNIT MARK	CRAC-INDOOR
CV OR VAV	VAV
SUPPLY AIR, CFM	10,000
MOTOR HP	4.2 (x2)
COOLING	
TOTAL CAPACITY, MBH	223.9
SENSIBLE CAPACITY, MBH	218.6
NO. OF COMPRESSORS	2
ELECTRICAL HEATING	
TOTAL CAPACITY, KW	18.0
STAGES OF HEATING	2
HUMIDIFICATION	
CAPACITY, LBS / HR	4 - 15
INPUT, KW	5.1
UNIT ELECTRICAL (V / Ph)	480 / 3
MCA, A	60.8
MOP, A	70
ESTIMATED UNIT WEIGHT, LBS	2,400
UNIT MODEL	TR-CFU-070
OUTDOOR CONDENSING UNIT	
UNIT MARK	CRAC-OUTDOOR
NUMBER OF FANS	2
UNIT ELECTRICAL (V / Ph)	480 / 3
MCA, A	9.3
MOP, A	15
ESTIMATED UNIT WEIGHT, LBS	600
UNIT MODEL	RT-SCS-312
REMARKS	
1. PROVIDE FACTORY MOUNTED DISCONNECT SWITCH AND FACTORY WIRED GFI OUTLET (CRAC-OUTDOOR).	
2. FURNISH INTEGRAL CONDENSATE PUMP.	
3. INCLUDE TWO ADDITIONAL STEAM HUMIDIFIER CANISTERS.	
4. INSTALL IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.	

GRILLES, REGISTERS AND DIFFUSERS: PRICE

MARK	SERVICE	TYPE	FACE SIZE, IN x IN.	NECK SIZE, IN x IN.	MAX AIR P.D., IN H2O	MAX N.C.	MODEL #	NOTES
A	SUPPLY	LAY-IN DIFFUSER	24"x24"	6"Ø	0.1	25	SCD	1, 2, 3
B	RETURN/EXHAUST	LAY-IN GRILLE	6"x6"	8"x8"	0.1	20	535	2

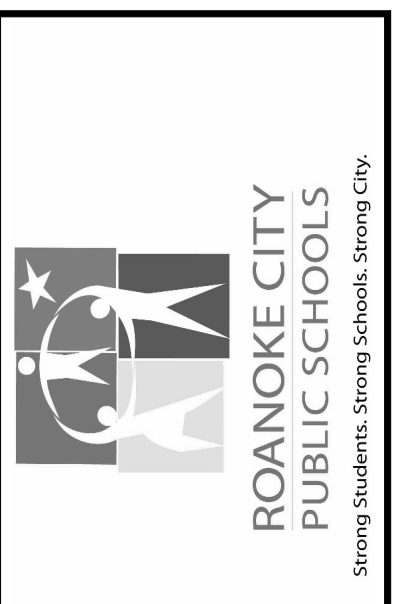
NOTES:
 1. DIFFUSER SHALL BE 4-WAY UNLESS OTHERWISE NOTED.
 2. COORDINATE WITH REFLECTED CEILING PLAN.
 3. FLEX DUCT CONNECTION SHALL EQUAL THE DIAMETER OF DIFFUSER CONNECTION.



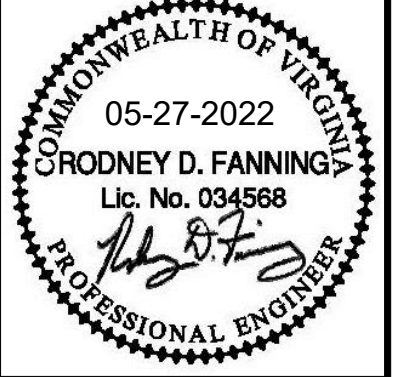
LAWRENCE PERRY & ASSOCIATES
Consulting Engineers

15 E Salem Avenue SE, Suite 101 Ph: (540) 342-1818
Roanoke, Virginia 24011 Fax: (540) 344-3410
Comm. No.: 21125
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DESCRIPTION	
BY	
MARK	
DATE	
REVISIONS	



DATE	05/27/2022	DESIGNED	RWR	CHECKED	RDF
PROJECT	18106-09	DRAWN	RWR		

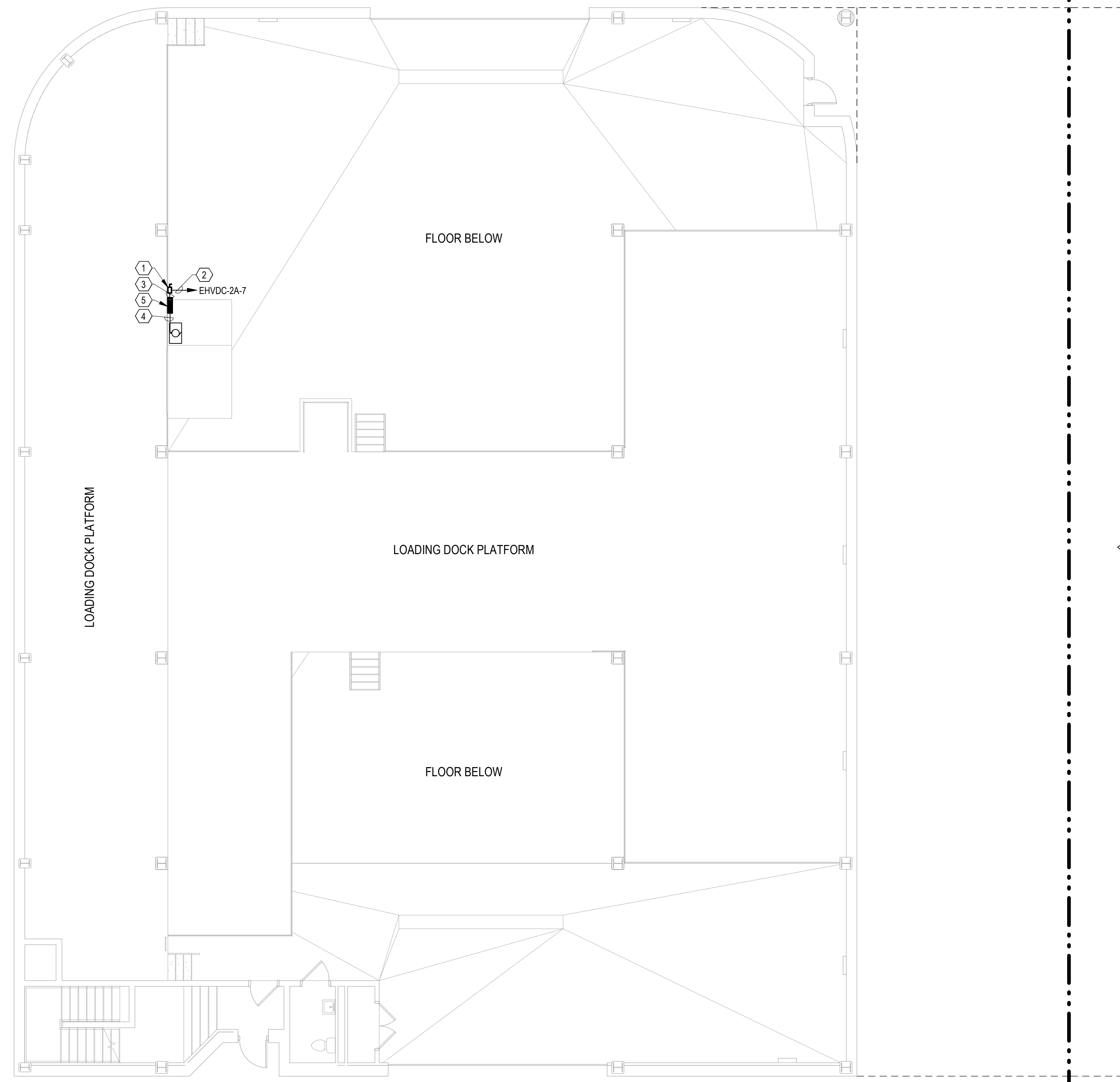


PROJECT: ROANOKE CITY PUBLIC SCHOOLS
ADMINISTRATION BUILDING ON CAMPBELL (AOC)
PHASE ONE (DATA CENTER)
201 Campbell Ave SW
Roanoke, VA 24011
DRAWING: SECOND FLOOR - HVAC

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EXISTING - BASEMENT POWER FLOOR PLAN - NORTH NEW DATA CENTER

SCALE: 1/8" = 1'-0"

GENERAL NOTES:

- A. CONTRACTOR IS RESPONSIBLE FOR REVIEWING THE ENTIRE CONTRACT DOCUMENTS TO HAVE A COMPLETE UNDERSTANDING OF THE PROJECT SCOPE OF WORK AND SHALL COORDINATE WITH ALL DISCIPLINES AND THE OWNER'S REPRESENTATIVE PRIOR TO ANY WORK.
- B. CONTRACTOR SHALL COORDINATE ALL REQUIRED SHUTDOWNS WITH THE PROJECT MANAGER/GC, OWNER'S REPRESENTATIVE AND THE UTILITY COMPANY IF REQUIRED.
- C. CONTRACTOR IS RESPONSIBLE FOR RELOCATING OR REWORKING ANY CEILING MOUNTED WAP, FIRE ALARM DEVICES, SPEAKERS, THE OWNER'S REPRESENTATIVE WILL HANDLE THE COORDINATION AND THE RELOCATION OR REINSTALLATION FOR THE SAME.
- D. CONTRACTOR SHALL LOCATE ALL RELAY AND POWER PACKS REQUIRED, SHOWN OR NOT SHOWN ON PLAN ABOVE A ACCESSIBLE CEILING SPACE.
- E. CONTRACTOR SHALL PROVIDE THE LOW VOLTAGE CABLING BETWEEN POWER PACK, RELAYS AND ASSOCIATED OCCUPANCY SENSORS AS REQUIRED. CONTRACTOR SHALL ADJUST SENSORS TO TURN LIGHTS OFF AFTER 20 MINUTES OF NO MOTION DETECTED. CONTRACTOR SHALL PROVIDE A 100% COVERAGE WITH OCCUPANCY SENSORS AND ADJUST TO NOT PICK UP MOTION FROM EXTERIOR, THROUGH DOORWAYS, WINDOWS AND GLASS WALLS OR OTHER DEFINED AREAS OUTSIDE OF THE SENSORS LOCATION.
- F. CONTRACTOR SHALL REFER TO LIGHTING SCHEDULE FOR DETAIL REQUIREMENT.

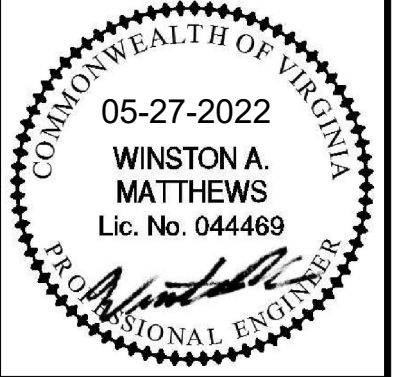
DRAWING KEY NOTES- NEW WORK:

- ① CONTRACTOR SHALL PROVIDE A SQUARE D OR EQUAL A HEAVY DUTY FUSED DISCONNECT SWITCH RATED FOR 30A, 3PHASE, 600V, NEMA 3R. CONTRACTOR SHALL PROVIDE BUSSMANN RK-1 LOW PEAK, DUAL ELEMENT, TIME DELAYED YELLOW FUSED SIZE PER THE MANUFACTURE'S RECOMMENDATIONS, WHICH MAYBE 12AMPS. CONTRACTOR SHALL COORDINATE FINAL MOUNTING LOCATION WITH INSTALLED 2 POLE HYDRAULIC LIFT SYSTEM. SWITCH SHALL NOT BE INSTALLED NO HIGHER THAN 6'-6" TO THE CENTER OF THE SWITCH.
- ② CONTRACTOR SHALL PROVIDE (3) #12 W/12 GROUND IN 75' CONDUIT ON THE LINE SIDE OF THE DISCONNECT SWITCH TO THE NEW I/LINE DISTRIBUTION PANEL EHVDC-2A, POSITION 7, WHICH IS A 20A, 3 POLE BREAKER, 4.5" MOUNTING SPACE. DISTRIBUTION PANEL IS LOCATED ON THE 2ND FLOOR LEVEL IN THE NEW DATA CENTER ROOM.
- ③ CONTRACTOR SHALL PROVIDE (3) #12 W/12 GROUND IN 75' CONDUIT FROM THE LOADSIDE OF THE FUSED DISCONNECT SWITCH TO THE PROVIDED LIFT MAIN CONTROL PANEL. CONTRACTOR SHALL PROVIDE A MINIMUM OF 3'-0" OF SEAL-TITE FLEXIBLE CONDUIT AT THE MAIN CONTROL PANEL'S CONNECTION POINT.
- ④ CONTRACTOR SHALL PROVIDE (3) #12 W/12 GROUND IN 75' SEAL-TITE FLEXIBLE CONDUIT TO THE LIFT S HYDRAULIC PUMP MOTOR'S POWER CONNECTION POINT.
- ⑤ LIFT'S MAIN CONTROL PANEL IS PROVIDED WITH A CONTROL TRANSFORMER. CONTRACTOR SHALL COORDINATE WITH INSTALLER FOR ANY REQUIRED CONTROL WIRING THAT IS THE RESPONSIBILITY OF THE ELECTRICAL CONTRACTOR. CONTRACTOR SHALL WIRE PER THE MANUFACTURE'S RECOMMENDATIONS. CONTRACTOR SHALL USE SEAL-TITE FLEXIBLE CONDUIT AT SELECTED POINT TO CONTROL NOISE TRANSFER.

	DESCRIPTION
	BY
	MARK DATE
	REVISIONS

ROANOKE CITY PUBLIC SCHOOLS	
<small>Sharing Students. Empowering Schools. Stronger City.</small>	
DATE	05/27/2022
PROJECT	18106-09
DESIGNED	MAR
DRAWN	MAR
CHECKED	WAM

RRMM
ARCHITECTS, PC
28 Church Ave SW
Roanoke, Virginia 24011
(540)344-1212



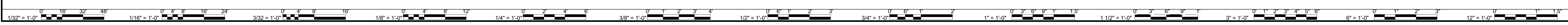
PROJECT
ROANOKE CITY PUBLIC SCHOOLS
ADMINISTRATION BUILDING ON CAMPBELL (AOC)
PHASE ONE (DATA CENTER)
201 Campbell Ave SW
Roanoke, VA 24011

DRAWING
EXISTING BASEMENT - POWER PLAN - NORTH

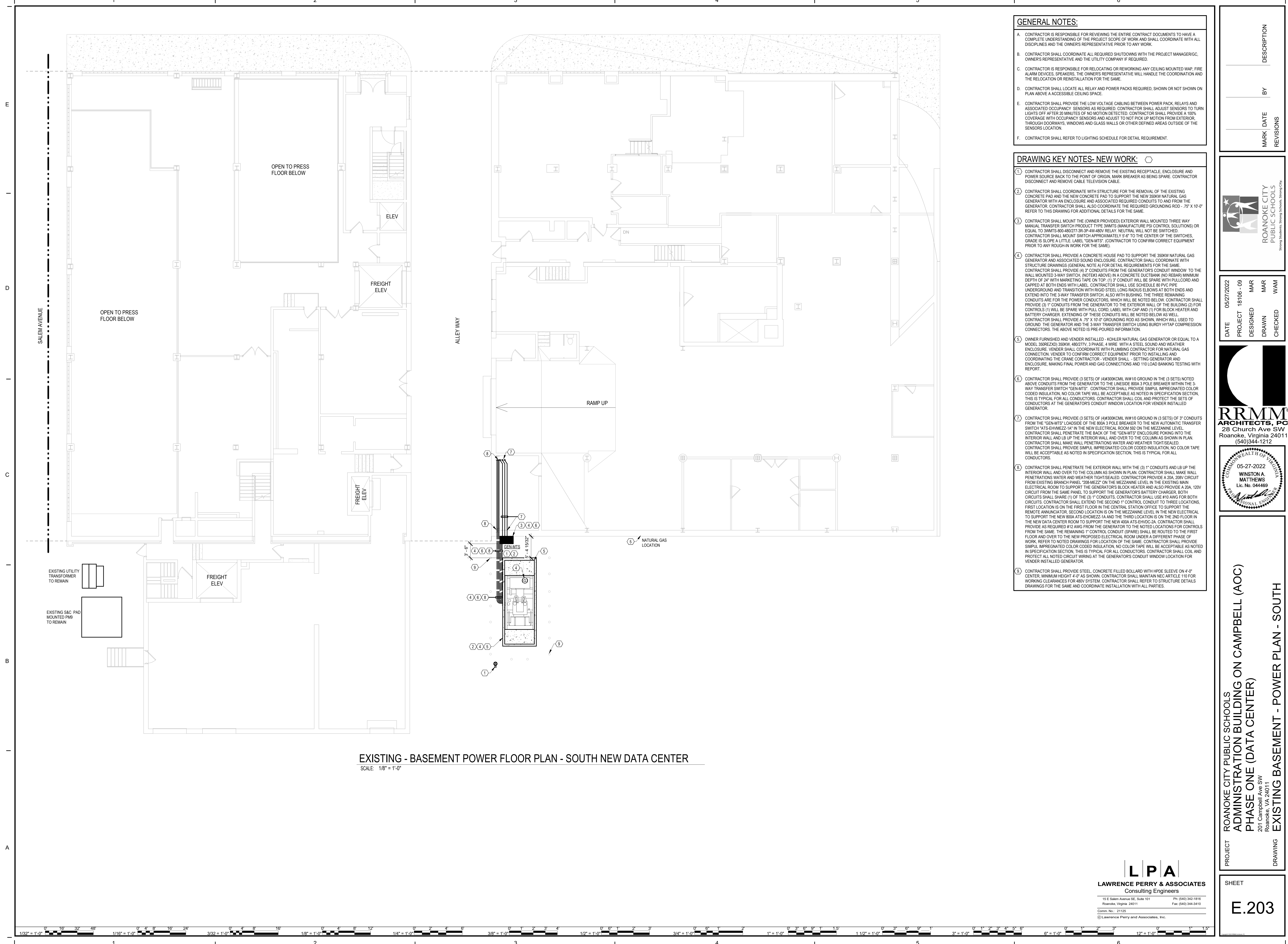
L P A
LAWRENCE PERRY & ASSOCIATES
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15 E Salem Avenue SE, Suite 101 Ph: (540) 342-1816
Roanoke, Virginia 24011 Fax: (540) 344-3410
Comm. No.: 21125
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EXISTING - BASEMENT POWER FLOOR PLAN - SOUTH NEW DATA CENTER
SCALE: 1/8" = 1'-0"

- GENERAL NOTES:**
- A. CONTRACTOR IS RESPONSIBLE FOR REVIEWING THE ENTIRE CONTRACT DOCUMENTS TO HAVE A COMPLETE UNDERSTANDING OF THE PROJECT SCOPE OF WORK AND SHALL COORDINATE WITH ALL DISCIPLINES AND THE OWNER'S REPRESENTATIVE PRIOR TO ANY WORK.
 - B. CONTRACTOR SHALL COORDINATE ALL REQUIRED SHUTDOWNS WITH THE PROJECT MANAGER/GC, OWNER'S REPRESENTATIVE AND THE UTILITY COMPANY IF REQUIRED.
 - C. CONTRACTOR IS RESPONSIBLE FOR RELOCATING OR REWORKING ANY CEILING MOUNTED WAF, FIRE ALARM DEVICES, SPEAKERS, THE OWNER'S REPRESENTATIVE WILL HANDLE THE COORDINATION AND THE RELOCATION OR REINSTALLATION FOR THE SAME.
 - D. CONTRACTOR SHALL LOCATE ALL RELAY AND POWER PACKS REQUIRED, SHOWN OR NOT SHOWN ON PLAN ABOVE A ACCESSIBLE CEILING SPACE.
 - E. CONTRACTOR SHALL PROVIDE THE LOW VOLTAGE CABLING BETWEEN POWER PACK, RELAYS AND ASSOCIATED OCCUPANCY SENSORS AS REQUIRED. CONTRACTOR SHALL ADJUST SENSORS TO TURN LIGHTS OFF AFTER 20 MINUTES OF NO MOTION DETECTED. CONTRACTOR SHALL PROVIDE A 100% COVERAGE WITH OCCUPANCY SENSORS AND ADJUST TO NOT PICK UP MOTION FROM EXTERIOR, THROUGH DOORWAYS, WINDOWS AND GLASS WALLS OR OTHER DEFINED AREAS OUTSIDE OF THE SENSORS LOCATION.
 - F. CONTRACTOR SHALL REFER TO LIGHTING SCHEDULE FOR DETAIL REQUIREMENT.

- DRAWING KEY NOTES- NEW WORK:**
- 1. CONTRACTOR SHALL DISCONNECT AND REMOVE THE EXISTING RECEPTACLE, ENCLOSURE AND POWER SOURCE BACK TO THE POINT OF ORIGIN, MARK BREAKER AS BEING SPARE. CONTRACTOR DISCONNECT AND REMOVE CABLE TELEVISION CABLE.
 - 2. CONTRACTOR SHALL COORDINATE WITH STRUCTURE FOR THE REMOVAL OF THE EXISTING CONCRETE PAD AND THE NEW CONCRETE PAD TO SUPPORT THE NEW 300KW NATURAL GAS GENERATOR WITH AN ENCLOSURE AND ASSOCIATED REQUIRED CONDUITS TO AND FROM THE GENERATOR. CONTRACTOR SHALL ALSO COORDINATE THE REQUIRED GROUNDING ROD - 75' X 10'-0" REFER TO THIS DRAWING FOR ADDITIONAL DETAILS FOR THE SAME.
 - 3. CONTRACTOR SHALL MOUNT THE (OWNER PROVIDED) EXTERIOR WALL MOUNTED THREE WAY MANUAL TRANSFER SWITCH PRODUCT TYPE SWMTS (MANUFACTURE PSC CONTROL SOLUTIONS) OR EQUAL TO SWMTS-800-480277-3P-4W-8BY RELAY. NEUTRAL WILL NOT BE SWITCHED. CONTRACTOR SHALL MOUNT SWITCH APPROXIMATELY 5'-6" TO THE CENTER OF THE SWITCHES. GRADE IS SLOPE A LITTLE. LABEL "GENMITS". (CONTRACTOR TO CONFIRM CORRECT EQUIPMENT PRIOR TO ANY ROUGH-IN WORK FOR THE SAME).
 - 4. CONTRACTOR SHALL PROVIDE A CONCRETE HOUSE PAD TO SUPPORT THE 300KW NATURAL GAS GENERATOR AND ASSOCIATED SOUND ENCLOSURE. CONTRACTOR SHALL COORDINATE WITH STRUCTURE DRAWINGS (GENERAL NOTE A) FOR DETAIL REQUIREMENTS FOR THE SAME. CONTRACTOR SHALL PROVIDE (4) 3" CONDUITS FROM THE GENERATORS CONDUIT WINDOW TO THE WALL MOUNTED 3-WAY SWITCH. (NOTES 3 ABOVE) IN A CONCRETE DUCTBANK (NO REBAR) MINIMUM DEPTH OF 24" WITH MARKING TAPE ON TOP. (1) 3" CONDUIT WILL BE SPARE WITH PULLCORD AND CAPPED AT BOTH ENDS WITH LABEL. CONTRACTOR SHALL USE SCHEDULE 80 PVC PIPE UNDERGROUND AND TRANSITION WITH RIGID STEEL LONG RADIUS ELBOWS AT BOTH ENDS AND EXTEND INTO THE 3-WAY TRANSFER SWITCH, ALSO WITH BUSHING. THE THREE REMAINING CONDUITS ARE FOR THE POWER CONDUCTORS, WHICH WILL BE NOTED BELOW. CONTRACTOR SHALL PROVIDE (8) 1" CONDUITS FROM THE GENERATOR TO THE EXTERIOR WALL OF THE BUILDING (2) FOR CONTROLS (1) WILL BE SPARE WITH PULL CORD, LABEL WITH CAP AND (1) FOR BLOCK HEATER AND BATTERY CHARGER. EXTENDING OF THESE CONDUITS WILL BE NOTED BELOW AS WELL. CONTRACTOR SHALL PROVIDE A 75' X 10'-0" GROUNDING ROD AS SHOWN, WHICH WILL USED TO GROUND. THE GENERATOR AND THE 3-WAY TRANSFER SWITCH USING SURDY W/TP COMPRESSION CONNECTORS. THE ABOVE NOTED IS PRE-POURED INFORMATION.
 - 5. OWNER FURNISHED AND VENDOR INSTALLED - KOHLER NATURAL GAS GENERATOR OR EQUAL TO A MODEL 359REXD) 350KW, 480/277V, 3 PHASE, 4 WIRE WITH A STEEL SOUND AND WEATHER ENCLOSURE. VENDOR SHALL COORDINATE WITH PLUMBING CONTRACTOR FOR NATURAL GAS CONNECTION. VENDOR TO COORDINATE CORRECT EQUIPMENT PRIOR TO INSTALLING AND COORDINATING THE CRANE CONTRACTOR - VENDOR SHALL - SETTING GENERATOR AND ENCLOSURE, MAKING FINAL POWER AND GAS CONNECTIONS AND 110 LOAD BANKING TESTING WITH REPORT.
 - 6. CONTRACTOR SHALL PROVIDE (3 SETS) OF (4#300KCMIL W/10 GROUND IN (3 SETS) NOTED ABOVE CONDUITS FROM THE GENERATOR TO THE LINESIDE 800A 3 POLE BREAKER WITHIN THE 3-WAY TRANSFER SWITCH "GENMITS". CONTRACTOR SHALL PROVIDE SIMPLIFIED IMPREGNATED COLOR CODED INSULATION, NO COLOR TAPE WILL BE ACCEPTABLE AS NOTED IN SPECIFICATION SECTION. THIS IS TYPICAL FOR ALL CONDUCTORS. CONTRACTOR SHALL COIL AND PROTECT THE SETS OF CONDUCTORS AT THE GENERATOR'S CONDUIT WINDOW LOCATION FOR VENDOR INSTALLED GENERATOR.
 - 7. CONTRACTOR SHALL PROVIDE (3 SETS) OF (4#300KCMIL W/10 GROUND IN (3 SETS) OF 3" CONDUITS FROM THE "GENMITS" LOADSIDE OF THE 800A 3 POLE BREAKER TO THE NEW AUTOMATIC TRANSFER SWITCH "ATS-EMZZ-1A" IN THE NEW ELECTRICAL ROOM 592 ON THE MEZZANINE LEVEL. CONTRACTOR SHALL PENETRATE THE BACK OF THE "GENMITS" ENCLOSURE POKING INTO THE INTERIOR WALL AND IS UP THE INTERIOR WALL AND OVER TO THE COLUMN AS SHOWN IN PLAN. CONTRACTOR SHALL MAKE WALL PENETRATIONS WATER AND WEATHER TIGHT/SEALED. CONTRACTOR SHALL PROVIDE SIMPLIFIED IMPREGNATED COLOR CODED INSULATION, NO COLOR TAPE WILL BE ACCEPTABLE AS NOTED IN SPECIFICATION SECTION. THIS IS TYPICAL FOR ALL CONDUCTORS.
 - 8. CONTRACTOR SHALL PENETRATE THE EXTERIOR WALL WITH THE (3) 1" CONDUITS AND IS UP THE INTERIOR WALL AND OVER TO THE COLUMN AS SHOWN IN PLAN. CONTRACTOR SHALL MAKE WALL PENETRATIONS WATER AND WEATHER TIGHT/SEALED. CONTRACTOR PROVIDE A 20A, 209V CIRCUIT FROM EXISTING BRANCH PANEL "208-MEZZ" ON THE MEZZANINE LEVEL IN THE EXISTING MAIN ELECTRICAL ROOM TO SUPPORT THE GENERATOR'S BLOCK HEATER AND ALSO PROVIDE A 20A, 120V CIRCUIT FROM THE SAME PANEL TO SUPPORT THE GENERATOR'S BATTERY CHARGER. BOTH CIRCUITS SHALL SHARE (1) OF THE (3) 1" CONDUITS. CONTRACTOR SHALL USE #10 AWG FOR BOTH CIRCUITS. CONTRACTOR SHALL EXTEND THE SECOND 1" CONTROL CONDUIT TO THREE LOCATIONS. FIRST LOCATION IS ON THE FIRST FLOOR IN THE CENTRAL STATION OFFICE TO SUPPORT THE REMOTE ANNUNCIATOR. SECOND LOCATION IS ON THE MEZZANINE LEVEL IN THE NEW ELECTRICAL TO SUPPORT THE NEW 800A ATS-EMZZ-1A AND THE THIRD LOCATION IS ON THE 2ND FLOOR IN THE NEW DATA CENTER ROOM TO SUPPORT THE NEW 400A ATS-EMDCC-2A. CONTRACTOR SHALL PROVIDE AS REQUIRED #12 AWG FROM THE GENERATOR TO THE NOTED LOCATIONS FOR CONTROLS FROM THE SAME. THE REMAINING 1" CONTROL CONDUIT (SPARE) SHALL BE ROUTED TO THE FIRST FLOOR AND OVER TO THE NEW PROPOSED ELECTRICAL ROOM UNDER A DIFFERENT PHASE OF WORK. REFER TO NOTED DRAWINGS FOR LOCATION OF THE SAME. CONTRACTOR SHALL PROVIDE SIMPLIFIED IMPREGNATED COLOR CODED INSULATION, NO COLOR TAPE WILL BE ACCEPTABLE AS NOTED IN SPECIFICATION SECTION. THIS IS TYPICAL FOR ALL CONDUCTORS. CONTRACTOR SHALL COIL AND PROTECT ALL NOTED CIRCUIT WIRING AT THE GENERATOR'S CONDUIT WINDOW LOCATION FOR VENDOR INSTALLED GENERATOR.
 - 9. CONTRACTOR SHALL PROVIDE STEEL CONCRETE FILLED BOLLARD WITH HPDE SLEEVE ON 4'-0" CENTER. MINIMUM HEIGHT 4'-0" AS SHOWN. CONTRACTOR SHALL MAINTAIN NEC ARTICLE 110 FOR WORKING CLEARANCES FOR 480V SYSTEM. CONTRACTOR SHALL REFER TO STRUCTURE DETAILS DRAWINGS FOR THE SAME AND COORDINATE INSTALLATION WITH ALL PARTIES.

	DESCRIPTION
BY	MARK DATE
REVISIONS	REVISIONS

 ROANOKE CITY PUBLIC SCHOOLS <small>Roanoke, Virginia 24011</small>	DATE: 05/27/2022 PROJECT: 18106-09 DESIGNED: MAR DRAWN: MAR CHECKED: WAM
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 RRMM ARCHITECTS, PC 28 Church Ave SW Roanoke, Virginia 24011 (540)344-1212
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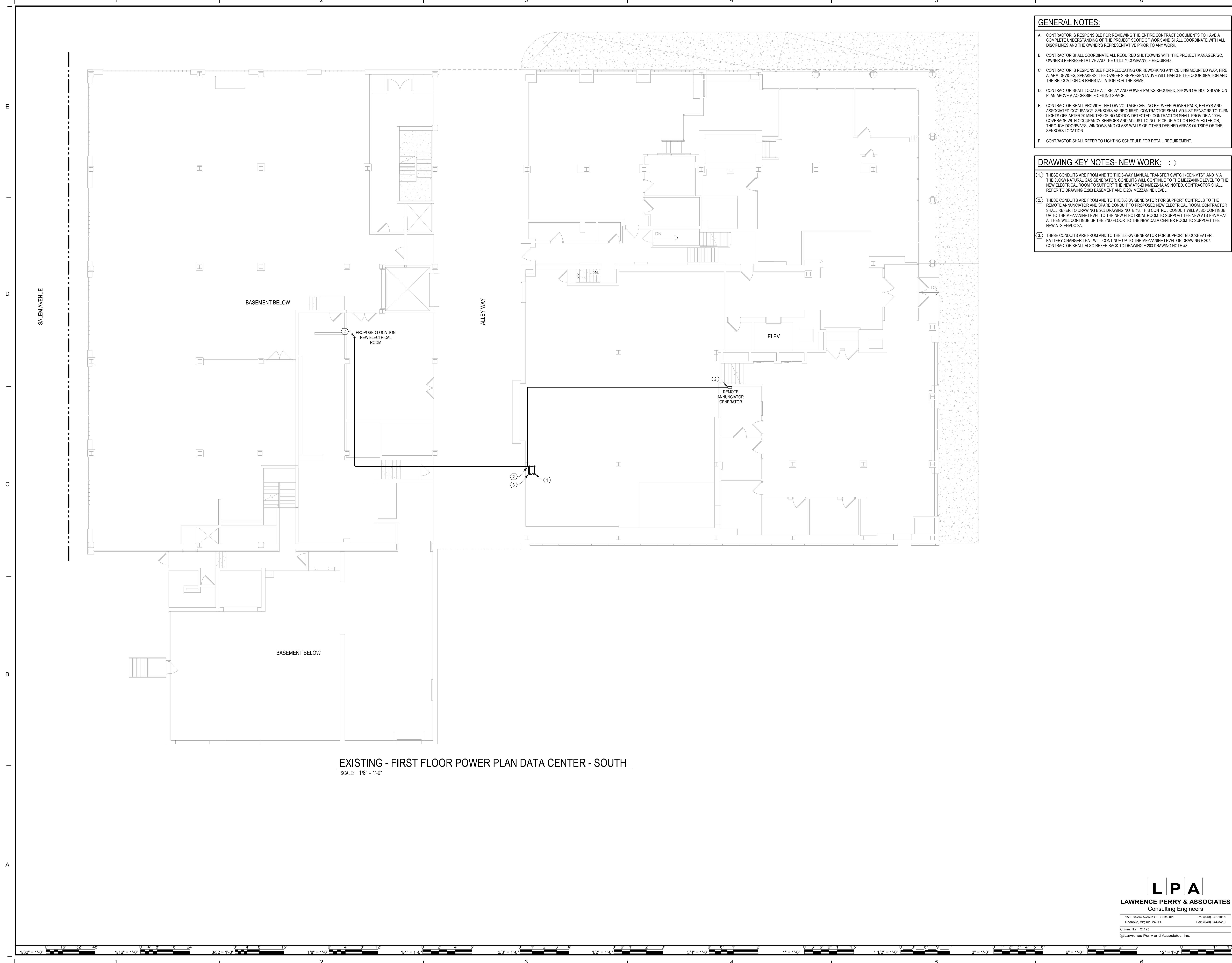
 05-27-2022 WINSTON A. MATTHEWS Lic. No. 044469
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PROJECT: ROANOKE CITY PUBLIC SCHOOLS ADMINISTRATION BUILDING ON CAMPBELL (AOC) PHASE ONE (DATA CENTER) <small>201 Campbell Ave SW Roanoke, VA 24011</small> DRAWING: EXISTING BASEMENT - POWER PLAN - SOUTH
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 LPA LAWRENCE PERRY & ASSOCIATES Consulting Engineers <small>15 E Salem Avenue SE, Suite 101 Ph: (540) 342-1818 Roanoke, Virginia 24011 Fax: (540) 344-3410 Comm. No.: 21125 ©Lawrence Perry and Associates, Inc.</small>

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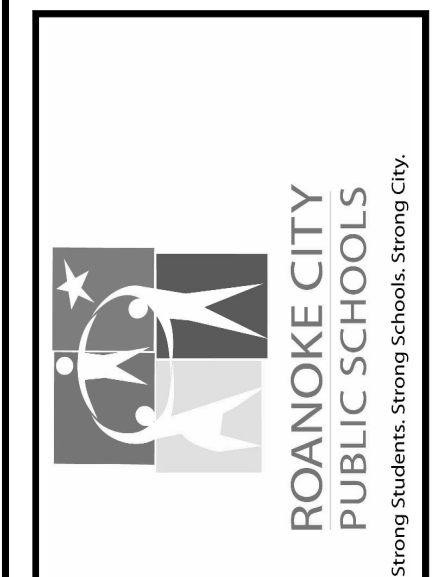
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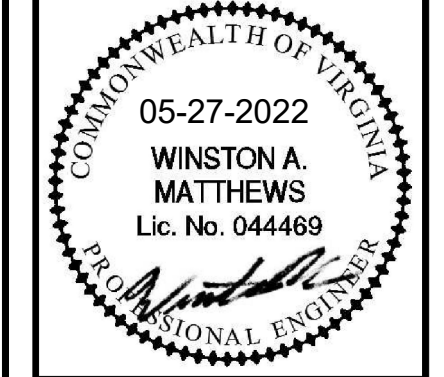
- GENERAL NOTES:**
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 - B. CONTRACTOR SHALL COORDINATE ALL REQUIRED SHUTDOWNS WITH THE PROJECT MANAGER/GC, OWNER'S REPRESENTATIVE AND THE UTILITY COMPANY IF REQUIRED.
 - C. CONTRACTOR IS RESPONSIBLE FOR RELOCATING OR REWORKING ANY CEILING MOUNTED WAF, FIRE ALARM DEVICES, SPEAKERS, THE OWNER'S REPRESENTATIVE WILL HANDLE THE COORDINATION AND THE RELOCATION OR REINSTALLATION FOR THE SAME.
 - D. CONTRACTOR SHALL LOCATE ALL RELAY AND POWER PACKS REQUIRED, SHOWN OR NOT SHOWN ON PLAN ABOVE A ACCESSIBLE CEILING SPACE.
 - E. CONTRACTOR SHALL PROVIDE THE LOW VOLTAGE CABLING BETWEEN POWER PACK, RELAYS AND ASSOCIATED OCCUPANCY SENSORS AS REQUIRED. CONTRACTOR SHALL ADJUST SENSORS TO TURN LIGHTS OFF AFTER 20 MINUTES OF NO MOTION DETECTED. CONTRACTOR SHALL PROVIDE A 100% COVERAGE WITH OCCUPANCY SENSORS AND ADJUST TO NOT PICK UP MOTION FROM EXTERIOR, THROUGH DOORWAYS, WINDOWS AND GLASS WALLS OR OTHER DEFINED AREAS OUTSIDE OF THE SENSORS LOCATION.
 - F. CONTRACTOR SHALL REFER TO LIGHTING SCHEDULE FOR DETAIL REQUIREMENT.

- DRAWING KEY NOTES- NEW WORK:**
- ① THESE CONDUITS ARE FROM AND TO THE 3-WAY MANUAL TRANSFER SWITCH (GEN-MTS) AND VIA THE 350KW NATURAL GAS GENERATOR. CONDUITS WILL CONTINUE TO THE MEZZANINE LEVEL TO THE NEW ELECTRICAL ROOM TO SUPPORT THE NEW ATS-EHMEZZ-1A AS NOTED. CONTRACTOR SHALL REFER TO DRAWING E.203 BASEMENT AND E.207 MEZZANINE LEVEL.
 - ② THESE CONDUITS ARE FROM AND TO THE 350KW GENERATOR FOR SUPPORT CONTROLS TO THE REMOTE ANNUNCIATOR AND SPARE CONDUIT TO PROPOSED NEW ELECTRICAL ROOM. CONTRACTOR SHALL REFER TO DRAWING E.203 DRAWING NOTE #8. THIS CONTROL CONDUIT WILL ALSO CONTINUE UP TO THE MEZZANINE LEVEL TO THE NEW ELECTRICAL ROOM TO SUPPORT THE NEW ATS-EHMEZZ-1A. THEN WILL CONTINUE UP THE 2ND FLOOR TO THE NEW DATA CENTER ROOM TO SUPPORT THE NEW ATS-EHVDCA-2A.
 - ③ THESE CONDUITS ARE FROM AND TO THE 350KW GENERATOR FOR SUPPORT BLOCK-HEATER, BATTERY CHARGER THAT WILL CONTINUE UP TO THE MEZZANINE LEVEL ON DRAWING E.207. CONTRACTOR SHALL ALSO REFER BACK TO DRAWING E.203 DRAWING NOTE #8.

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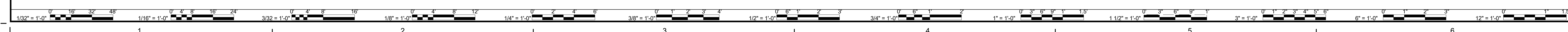
DATE	05/27/2022
PROJECT	18106-09
DESIGNED	MAR
DRAWN	MAR
CHECKED	WAM



PROJECT
ROANOKE CITY PUBLIC SCHOOLS
ADMINISTRATION BUILDING ON CAMPBELL (AOC)
PHASE ONE (DATA CENTER)
 201 Campbell Ave SW
 Roanoke, VA 24011

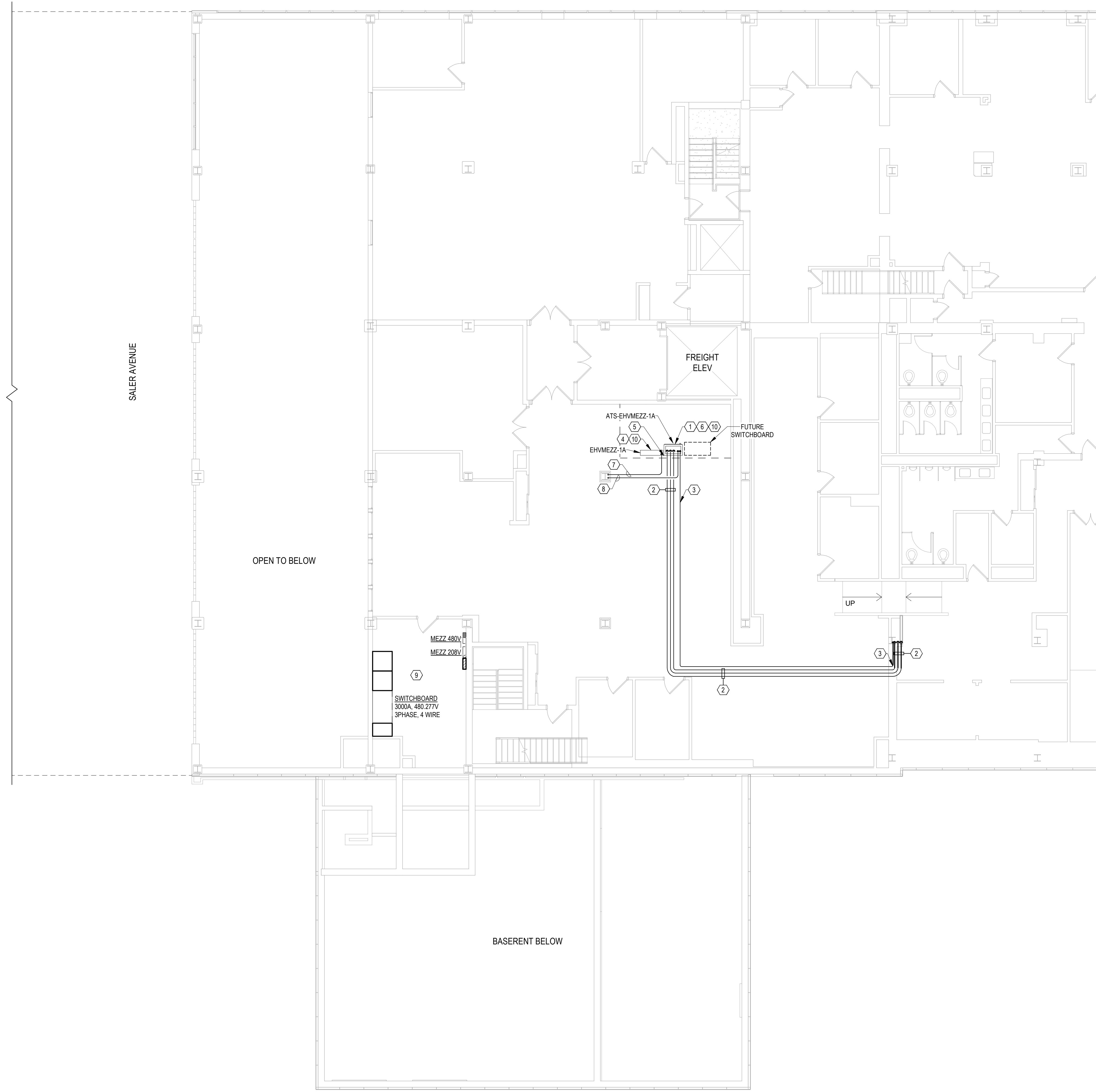
DRAWING
EXISTING FIRST FLOOR POWER PLAN - SOUTH

LPA
LAWRENCE PERRY & ASSOCIATES
 Consulting Engineers
 15 E Salem Avenue SE, Suite 101 Ph: (540) 342-1818
 Roanoke, Virginia 24011 Fax: (540) 344-3410
 Comm. No.: 21125
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EXISTING - MEZZANINE LEVEL POWER PLAN - SOUTH NEW DATA CENTER
 SCALE: 1/8" = 1'-0"

- GENERAL NOTES:**
- A. CONTRACTOR IS RESPONSIBLE FOR REVIEWING THE ENTIRE CONTRACT DOCUMENTS TO HAVE A COMPLETE UNDERSTANDING OF THE PROJECT SCOPE OF WORK AND SHALL COORDINATE WITH ALL DISCIPLINES AND THE OWNER'S REPRESENTATIVE PRIOR TO ANY WORK.
 - B. CONTRACTOR SHALL COORDINATE ALL REQUIRED SHUTDOWNS WITH THE PROJECT MANAGER/ GC, OWNER'S REPRESENTATIVE AND THE UTILITY COMPANY IF REQUIRED.
 - C. CONTRACTOR IS RESPONSIBLE FOR RELOCATING OR REWORKING ANY CEILING MOUNTED WAP, FIRE ALARM DEVICES, SPEAKERS, THE OWNER'S REPRESENTATIVE WILL HANDLE THE COORDINATION AND THE RELOCATION OR REINSTALLATION FOR THE SAME.
 - D. CONTRACTOR SHALL LOCATE ALL RELAY AND POWER PACKS REQUIRED, SHOWN OR NOT SHOWN ON PLAN ABOVE A ACCESSIBLE CEILING SPACE.
 - E. CONTRACTOR SHALL PROVIDE THE LOW VOLTAGE CABLING BETWEEN POWER PACK, RELAYS AND ASSOCIATED OCCUPANCY SENSORS AS REQUIRED. CONTRACTOR SHALL ADJUST SENSORS TO TURN LIGHTS OFF AFTER 20 MINUTES OF NO MOTION DETECTED. CONTRACTOR SHALL PROVIDE A 100% COVERAGE WITH OCCUPANCY SENSORS AND ADJUST TO NOT PICK UP MOTION FROM EXTERIOR, THROUGH DOORWAYS, WINDOWS AND GLASS WALLS OR OTHER DEFINED AREAS OUTSIDE OF THE SENSORS LOCATION.
 - F. CONTRACTOR SHALL REFER TO LIGHTING SCHEDULE FOR DETAIL REQUIREMENT.

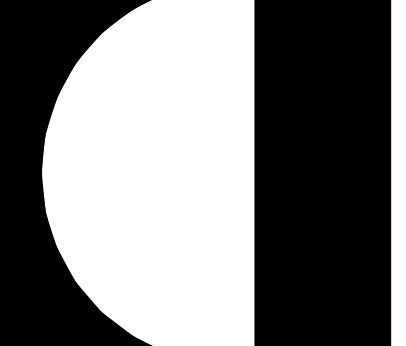
- DRAWING KEY NOTES- NEW WORK:**
1. CONTRACTOR SHALL INSTALL (OWNER PROVIDED) ASCO OR EQUAL TO A SERIES 7000 AUTOMATIC TRANSFER SWITCH (ATS) RATED FOR 800A - 480/277V (600V), 3 PHASE, 4 WIRE, 65ka, OPEN TRANSITION, SOLID NEUTRAL, COPPER CRIMPED LUGS FOR LONG BARREL CU CRIMP LUGS RATED FOR UP TO 60MM². ATS SHALL BE PROVIDED WITH USER CONTROLS AND CONTROLLER USER INTERFACE. CONTRACTOR SHALL REFER TO SPECIFICATION SECTION FOR FURTHER DETAIL REQUIREMENTS FOR THE SAME. CONTRACTOR SHALL PROVIDE PERMANENT LABEL "ATS-EHVMEZZ-1A" CONTRACTOR SHALL KEEP THE ATS TIGHT TO THE RIGHT (LOOKING FROM THE FRONT) TO THE NEW DISTRIBUTION PANEL "EHVMEZZ-1A" UNDER THIS PHASE. FUTURE SWITCHBOARD UNDER ANOTHER PHASE AS SHOWN WILL BE PLACED TO THE LEFT OF THE ATS-EHVMEZZ-1A. (CONTRACTOR TO CONFIRM CORRECT EQUIPMENT PRIOR TO ANY ROUGH-IN WORK FOR THE SAME).
 2. CONTRACTOR SHALL CONTINUE THE COLOR CODED (3 SETS) OF #430KCMIL W/ #10 GROUND IN (3 SETS) OF 3" CONDUITS FROM THE "GEN-ATS" LOUISIDE OF THE 800A 3-POLE BREAKER TO THE NEW AUTOMATIC TRANSFER SWITCH "ATS-EHVMEZZ-1A" IN THE NEW ELECTRICAL ROOM 592 ON THE MEZZANINE LEVEL. CONTRACTOR SHALL REFER TO DRAWING E.203 LEVEL BELOW AND E.203 BASEMENT DRAWING NOTE #7.
 3. CONTRACTOR SHALL CONTINUE THE 1" CONTROL CONDUIT AND ASSOCIATED WIRING TO THE NEW ATS-EHVMEZZ-1A" AS NOTED ON DRAWING E.203 DRAWING NOTE #8.
 4. CONTRACTOR SHALL PROVIDE A SQUARE D OR EQUAL TO A HCM DISTRIBUTION PANEL (EHVMEZZ-1A) RATED FOR 800A/LO 480/277V, 3 PHASE, 4 WIRE, 65ka, WITH 90 INCHES OF MOUNTING SPACES - EQUAL ON BOTH SIDES. UNIT SHALL BE PROVIDED WITH A 100% RATED 250A, 3PHASE BREAKER - THE REMAINING SPACES WILL BE PREPARED SPACES. CONTRACTOR SHALL REFER TO PANEL SCHEDULE.
 5. CONTRACTOR SHALL PROVIDE (3 SETS) OF (4) #300KCMIL W/ #10 GROUND IN (3 SETS) OF 3" CONDUIT FROM THE "ATS-EHVMEZZ-1A" TO THE NEW DISTRIBUTION PANEL "EHVMEZZ-1A".
 6. JUST TO NOTE, THE NEW "ATS-EHVMEZZ-1A" WILL NOT HAVE A NORMAL POWER SOURCE UNDER THIS PHASE OF WORK, ONLY EMERGENCY GENERATOR POWER SOURCE UNDER ANOTHER PHASE. THE NORMAL POWER SOURCE WILL BE COMING FOR THE FUTURE SWITCHBOARD WITHIN THIS SPACE.
 7. CONTRACTOR SHALL PROVIDE IMPREGNATED COLOR CODED #1/250KCMIL W/ #8 GROUND IN 3" CONDUIT FROM THE 100% RATED 250A, 3-POLE BREAKER IN THE NEW DISTRIBUTION PANEL "EHVMEZZ-1A" AND EXTEND UP TO THE 2ND FLOOR LEVEL TO THE NEW ATS-EHVDC-2A IN THE NEW DATA CENTER, APPROXIMATELY 250'-0". CONTRACTOR SHALL PROVIDE JUNCTION BOXES AS REQUIRED TO BE CODE COMPLIANT FOR THE AMOUNT OF 90 DEGREE BENDS. CONTRACTOR SHALL REFER TO THE ENLARGED POWER PLAN ON DRAWING E.208 FOR CONTINUATION OF THE SAME.
 8. CONTRACTOR SHALL EXTEND THE CONTROL WIRING AND ASSOCIATED CONDUIT FROM ATS-EHVMEZZ-1A" TO ATS-EHVDC-2A IN THE NEW DATA CENTER. CONTRACTOR SHALL REFER TO THE ENLARGED POWER PLAN ON DRAWING E.208 FOR CONTINUATION OF THE SAME.
 9. CONTRACTOR SHALL REFER TO DRAWING E.208 DRAWING KEY PLAN NOTES #2, 3 & 5 FOR SCOPE OF WORK WITHIN THIS MAIN ELECTRICAL ROOM.
 10. CONTRACTOR SHALL PROVIDE TEMPORARY MOUNTING FOR THE AUTOMATIC TRANSFER SWITCH "ATS-EHVMEZZ-1A" AND DISTRIBUTION PANEL "EHVMEZZ-1A". PROVIDE UNISTRUT FRAME WORK - SECURE TO THE CONCRETE FLOOR AND TO THE UNDERSIDE OF THE ABOVE DECK. CONTRACTOR SHALL CALL THE ELECTRICAL ENGINEERING PRIOR TO INSTALLING THE UNISTRUT FRAME WORK. THE GOAL IS TO SET THE PANEL AND THE ATS AS CLOSE AS POSSIBLE TO THEIR FINAL MOUNTING LOCATION, WHICH THE NEW ELECTRICAL ROOM WILL BE BUILT AROUND THESE PIECES OF EQUIPMENT.

	DESCRIPTION
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REVISIONS	

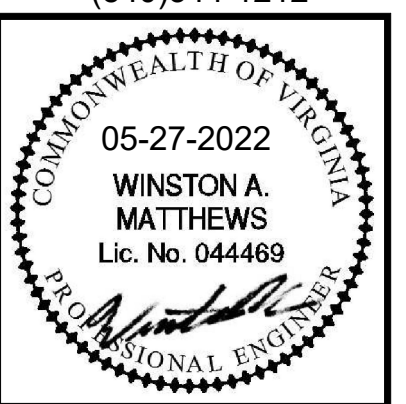


ROANOKE CITY PUBLIC SCHOOLS
Supporting Students. Empowering Schools. Inspiring Change.

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PROJECT	18106 - 09						




RRMM ARCHITECTS, P.C.
 28 Church Ave SW
 Roanoke, Virginia 24011
 (540)344-1212



05-27-2022
 WINSTON A. MATTHEWS
 Lic. No. 044469

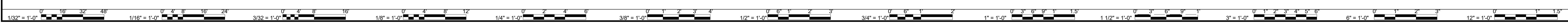
PROJECT	ROANOKE CITY PUBLIC SCHOOLS ADMINISTRATION BUILDING ON CAMPBELL (AOC) PHASE ONE (DATA CENTER) 201 Campbell Ave SW Roanoke, VA 24011	DRAWING	EXISTING - MEZZANINE POWER PLAN - SOUTH
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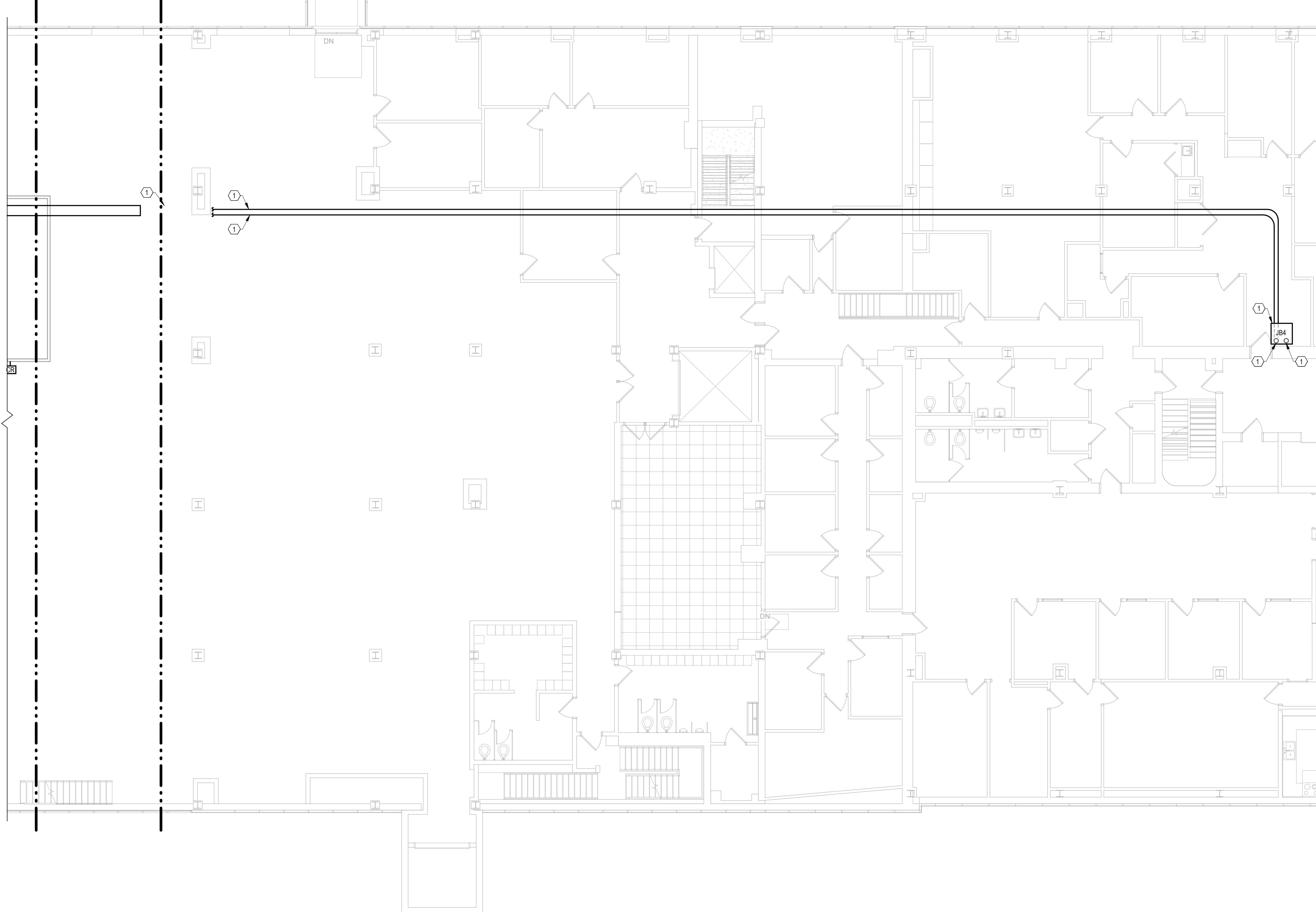
LPA
 LAWRENCE PERRY & ASSOCIATES
 Consulting Engineers

15 E Salem Avenue SE, Suite 101 Ph: (540) 342-1816
 Roanoke, Virginia 24011 Fax: (540) 344-3410
 Comm. No.: 21125
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MATCH LINE
SEE 1 / ED-208



EXISTING - SECOND FLOOR POWER PLAN NEW DATA CENTER - SOUTH
SCALE: 1/8" = 1'-0"

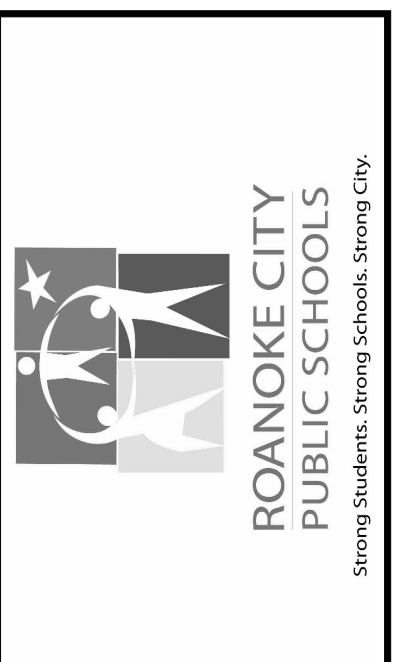
GENERAL NOTES:

- A. CONTRACTOR IS RESPONSIBLE FOR REVIEWING THE ENTIRE CONTRACT DOCUMENTS TO HAVE A COMPLETE UNDERSTANDING OF THE PROJECT SCOPE OF WORK AND SHALL COORDINATE WITH ALL DISCIPLINES AND THE OWNER'S REPRESENTATIVE PRIOR TO ANY WORK.
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- C. CONTRACTOR IS RESPONSIBLE FOR RELOCATING OR REWORKING ANY CEILING MOUNTED WAP, FIRE ALARM DEVICES, SPEAKERS, THE OWNER'S REPRESENTATIVE WILL HANDLE THE COORDINATION AND THE RELOCATION OR REINSTALLATION FOR THE SAME.
- D. CONTRACTOR SHALL LOCATE ALL RELAY AND POWER PACKS REQUIRED, SHOWN OR NOT SHOWN ON PLAN ABOVE A ACCESSIBLE CEILING SPACE.
- E. CONTRACTOR SHALL PROVIDE THE LOW VOLTAGE CABLING BETWEEN POWER PACK, RELAYS AND ASSOCIATED OCCUPANCY SENSORS AS REQUIRED. CONTRACTOR SHALL ADJUST SENSORS TO TURN LIGHTS OFF AFTER 20 MINUTES OF NO MOTION DETECTED. CONTRACTOR SHALL PROVIDE A 100% COVERAGE WITH OCCUPANCY SENSORS AND ADJUST TO NOT PICK UP MOTION FROM EXTERIOR, THROUGH DOORWAYS, WINDOWS AND GLASS WALLS OR OTHER DEFINED AREAS OUTSIDE OF THE SENSORS LOCATION.
- F. CONTRACTOR SHALL REFER TO LIGHTING SCHEDULE FOR DETAIL REQUIREMENT.

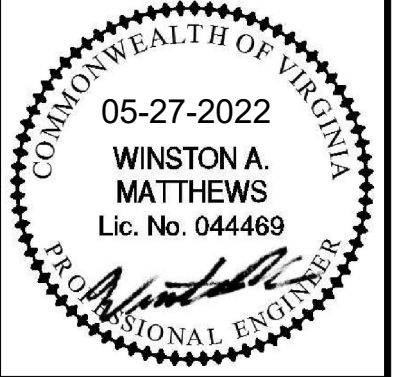
DRAWING KEY NOTES- NEW WORK:

- ① CONTINUATION OF THE (2) 4" EMT CONDUITS WITH (3) PULL CORDS IN EACH FROM THE EXISTING DATA ROOM - PENTHOUSE LEVEL TO THE NEW DATA CENTER ON THE 2ND FLOOR. CONDUITS SHALL DROP DOWN TO THE 2ND FLOOR LEVEL ALONG SIDE OF THE COLUMN, PAST DOWN TO THE UNDER SIDE OF THE 3RD FLOOR DECK TO A 30" X 30" X 12" JUNCTION/PULL BOX (TIGHT TO THE DECK). CONTRACTOR SHALL CONTINUE THE (2) 4" CONDUITS TO THE NORTH END AND STOP SHORT OF THE NEW P4W CABLE TRAY SYSTEM, WHICH STOP JUST SHORT OF THE EXISTING BUILDING WALL. CONTRACTOR SHALL PROVIDE RIDGE PLASTIC BUSHING ON THE ENDS, COIL THE PULL CORDS, LABEL THE BOTH CONDUITS - WITH THEIR STARTING POINT LOCATION "PENTHOUSE DATA ROOM". CONTRACTOR SHALL KEEP THE CONDUIT RACE TIGHT TO DECK AND DROP DOWN WITH LONG RADIUS ELBOWS TO THE CABLE TRAY SYSTEM. NO SHARP TURNS. TECHNOLOGY CABLES WILL BE PULLED FROM TO EACH DATA ROOMS. CONTRACTOR SHALL REFER TO DRAWING E.208 FOR CONTINUATION OF THE SAME.

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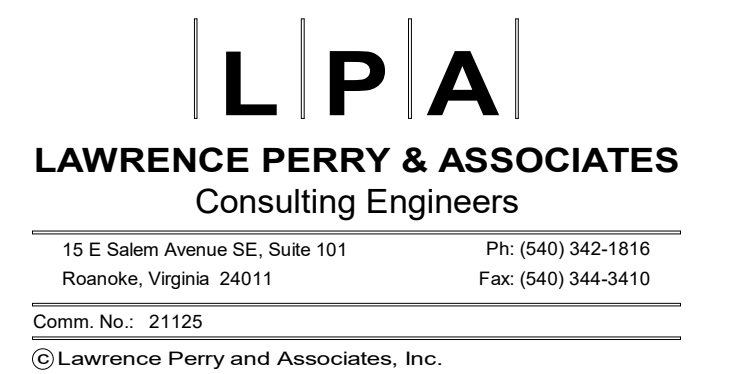


DATE	PROJECT	DESIGNED	DRAWN	CHECKED
05/27/2022	18106-09	MAR	MAR	WAM



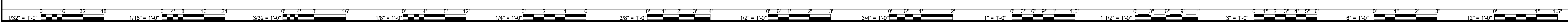
PROJECT
ROANOKE CITY PUBLIC SCHOOLS
ADMINISTRATION BUILDING ON CAMPBELL (AOC)
PHASE ONE (DATA CENTER)
 201 Campbell Ave SW
 Roanoke, VA 24011

DRAWING
EXISTING - SECOND FLOOR - SOUTH - ELECTRICAL

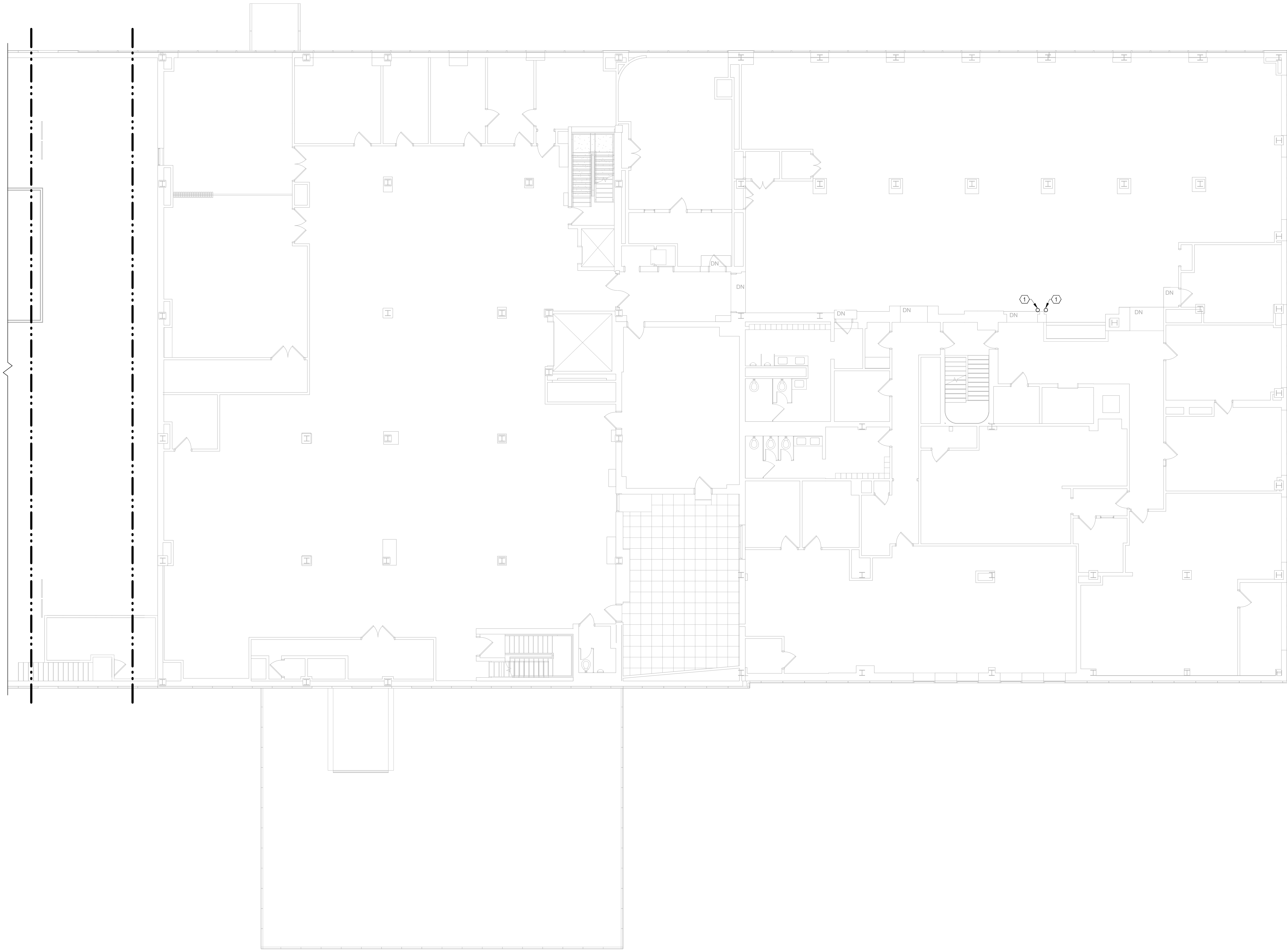


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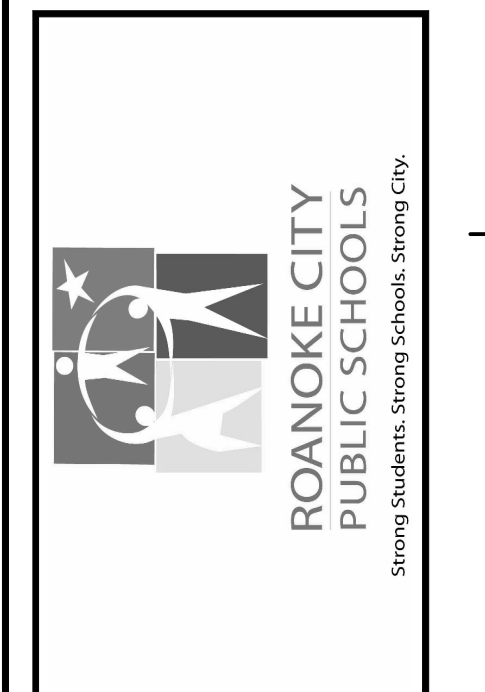


EXISTING - THIRD FLOOR POWER FLOOR PLAN - SOUTH NEW DATA CENTER
SCALE: 1/8" = 1'-0"

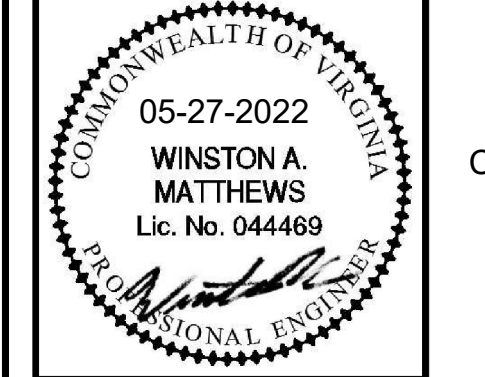
- GENERAL NOTES:**
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 - E. CONTRACTOR SHALL PROVIDE THE LOW VOLTAGE CABLING BETWEEN POWER PACK, RELAYS AND ASSOCIATED OCCUPANCY SENSORS AS REQUIRED. CONTRACTOR SHALL ADJUST SENSORS TO TURN LIGHTS OFF AFTER 20 MINUTES OF NO MOTION DETECTED. CONTRACTOR SHALL PROVIDE A 100% COVERAGE WITH OCCUPANCY SENSORS AND ADJUST TO NOT PICK UP MOTION FROM EXTERIOR, THROUGH DOORWAYS, WINDOWS AND GLASS WALLS OR OTHER DEFINED AREAS OUTSIDE OF THE SENSORS LOCATION.
 - F. CONTRACTOR SHALL REFER TO LIGHTING SCHEDULE FOR DETAIL REQUIREMENT.

- DRAWING KEY NOTES- NEW WORK:**
- 1 CONTINUATION OF THE (2) 4" EMT CONDUITS WITH (3) PULL CORDS IN EACH FROM THE EXISTING DATA ROOM - PENTHOUSE LEVEL TO THE NEW DATA CENTER ON THE 2ND FLOOR. CONDUITS SHALL DROP DOWN TO THE 2ND FLOOR LEVEL ALONG SIDE OF THE COLUMN, CONTRACTOR SHALL CORE DRILL AND SLEEVE - FIRE CALK THE 3RD FLOOR TO PASS DOWN TO THE UNDER SIDE OF THE DECK TO A 30" X 30" X 12" JUNCTION/PULL BOX (TIGHT TO THE DECK), CONTRACTOR SHALL REFER TO E.209 FOR CONTINUATION OF THE SAME.

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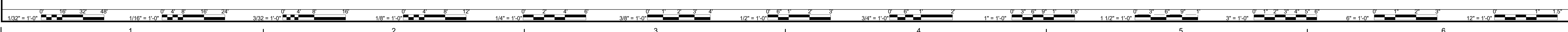
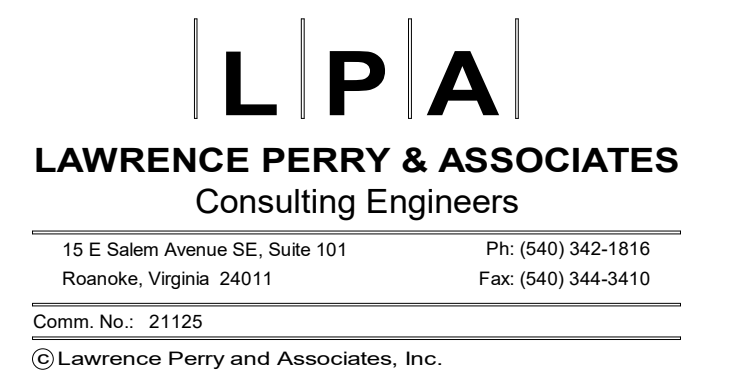


DATE	PROJECT	DESIGNED	DRAWN	CHECKED
05/27/2022	18106 - 09	MAR	MAR	WAM



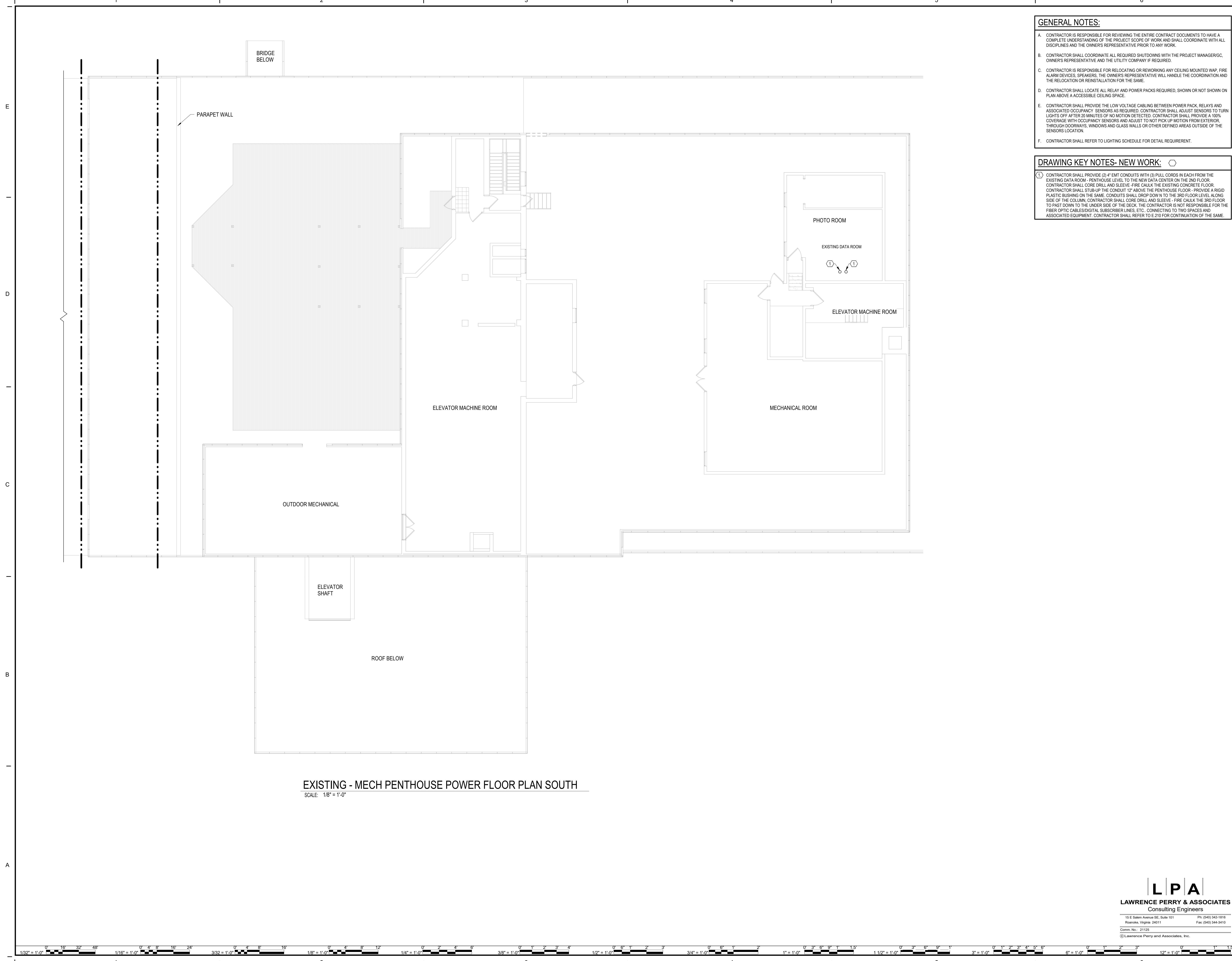
PROJECT
ROANOKE CITY PUBLIC SCHOOLS
ADMINISTRATION BUILDING ON CAMPBELL (AOC)
PHASE ONE (DATA CENTER)
 201 Campbell Ave SW
 Roanoke, VA 24011

DRAWING
EXISTING THIRD FLOOR - SOUTH - ELECTRICAL



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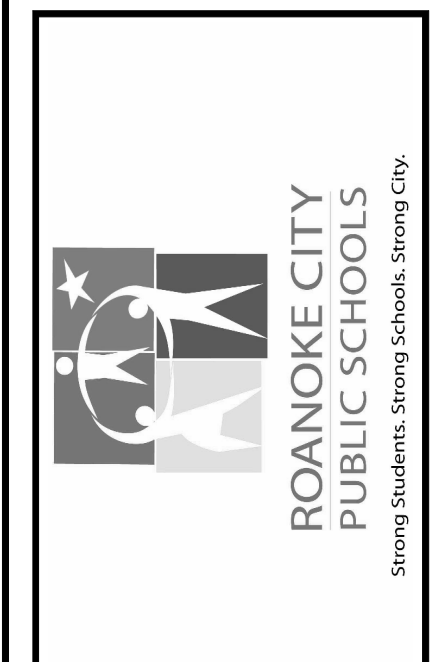


EXISTING - MECH PENTHOUSE POWER FLOOR PLAN SOUTH
SCALE: 1/8" = 1'-0"

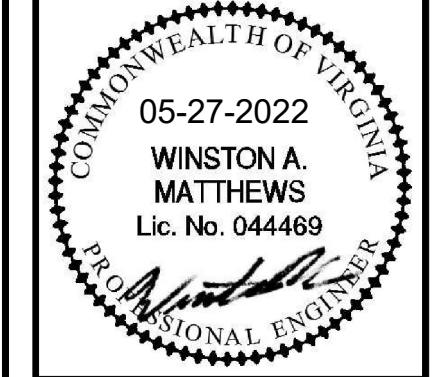
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 - F. CONTRACTOR SHALL REFER TO LIGHTING SCHEDULE FOR DETAIL REQUIREMENT.

- DRAWING KEY NOTES- NEW WORK:**
- ① CONTRACTOR SHALL PROVIDE (2) 4" EMT CONDUITS WITH (3) PULL CORDS IN EACH FROM THE EXISTING DATA ROOM - PENTHOUSE LEVEL TO THE NEW DATA CENTER ON THE 2ND FLOOR. CONTRACTOR SHALL CORE DRILL AND SLEEVE - FIRE CALK THE EXISTING CONCRETE FLOOR. CONTRACTOR SHALL STUB UP THE CONDUIT 12" ABOVE THE PENTHOUSE FLOOR. PROVIDE A RIGID PLASTIC BUSHING ON THE SAME. CONDUITS SHALL DROP DOWN TO THE 3RD FLOOR LEVEL ALONG SIDE OF THE COLUMN. CONTRACTOR SHALL CORE DRILL AND SLEEVE - FIRE CALK THE 3RD FLOOR TO PAST DOWN TO THE UNDER SIDE OF THE DECK. THE CONTRACTOR IS NOT RESPONSIBLE FOR THE FIBER OPTIC CABLES/DIGITAL SUBSCRIBER LINES, ETC. CONNECTING TO TWO SPACES AND ASSOCIATED EQUIPMENT. CONTRACTOR SHALL REFER TO E.210 FOR CONTINUATION OF THE SAME.

	DESCRIPTION
	BY
	MARK DATE
	REVISIONS



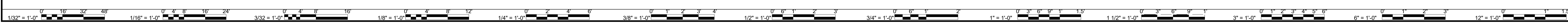
DATE	05/27/2022
PROJECT	18106-09
DESIGNED	MAR
DRAWN	MAR
CHECKED	WAM



PROJECT
**ROANOKE CITY PUBLIC SCHOOLS
 ADMINISTRATION BUILDING ON CAMPBELL (AOC)
 PHASE ONE (DATA CENTER)**
 201 Campbell Ave SW
 Roanoke, VA 24011

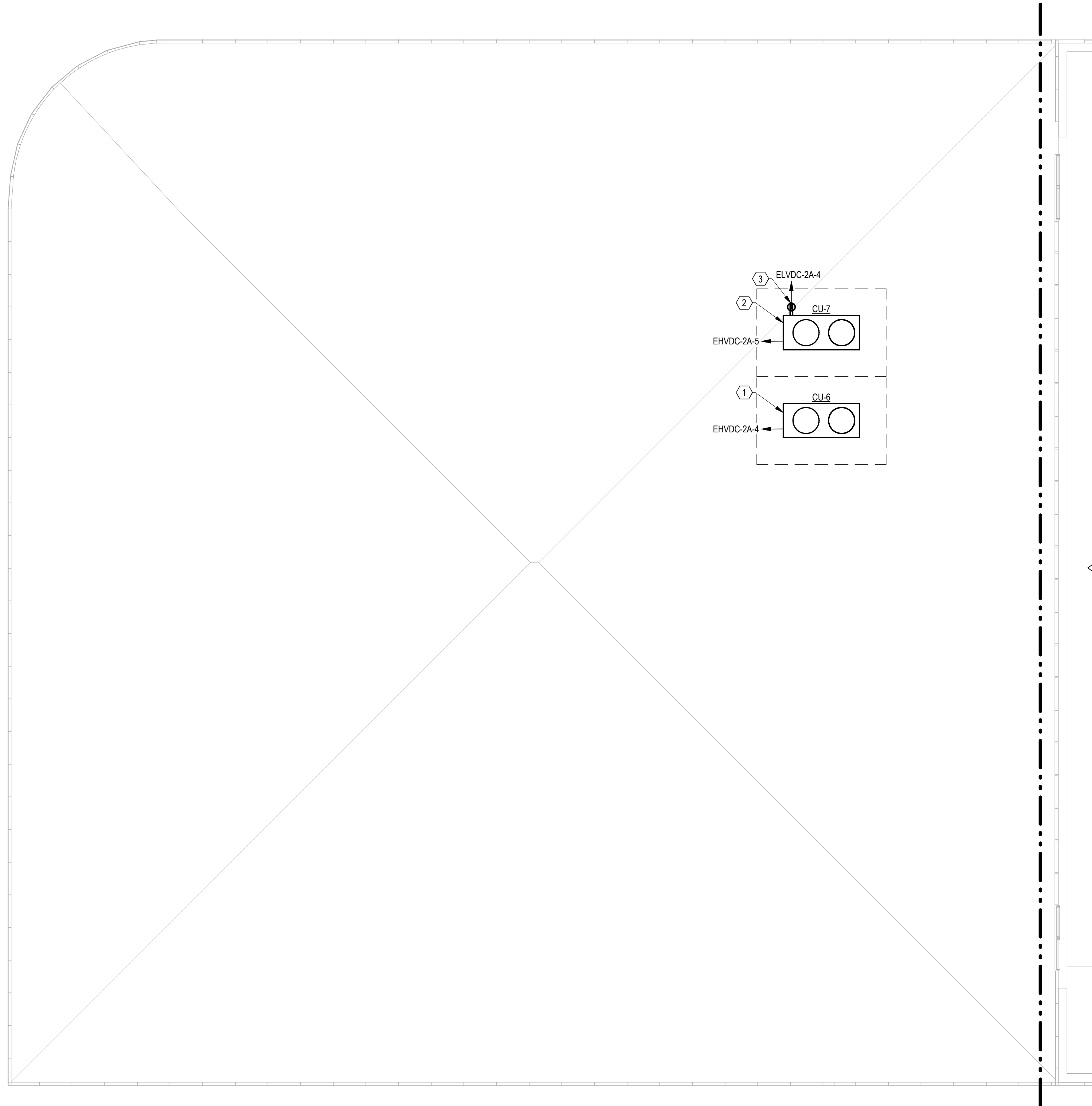
DRAWING
EXISTING MECHANICAL PENTHOUSE - ELECTRICAL

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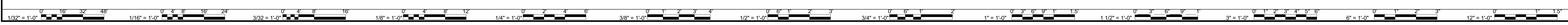
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EXISTING - ROOF POWER FLOOR PLAN - NORTH NEW DATA CENTER
SCALE: 1/8" = 1'-0"

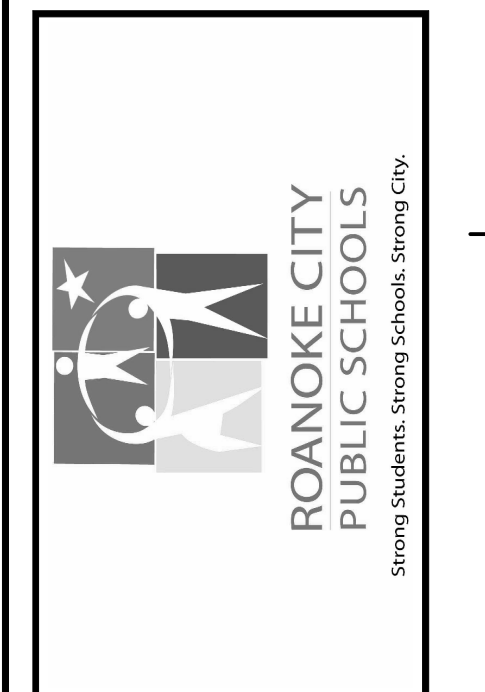
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 - F. CONTRACTOR SHALL REFER TO LIGHTING SCHEDULE FOR DETAIL REQUIREMENT.

- DRAWING KEY NOTES- NEW WORK:**
- ① CONTRACTOR SHALL PROVIDE A HACR TYPE - 15A 3 POLE BREAKER IN DISTRIBUTION PANEL EHVC-2 POSITION #4 (4.5' MOUNTING SPACE) TO SUPPORT CONDENSER - CU-6 UNIT ON ROOF. CONTRACTOR SHALL PROVIDE (3#12 W/12 GROUND IN 75' CONDUIT FROM BREAKER TO THE INSIDE OF THE PROVIDED MEANS OF DISCONNECTION WITHIN THE CU-1 UNIT. CONTRACTOR SHALL PROVIDE A MINIMUM OF 3'-0" OF SEAL-TITE FLEXIBLE CONDUIT AT THE CONNECTION POINT OF THE UNIT. CONTRACTOR WILL NOT USE THE CABLE TRAY CABLE. POWER SOURCE IS FROM THE NEW DISTRIBUTION PANEL IN THE NEW DATA CENTER. CONTRACTOR SHALL SEAL ALL CONDUITS PENETRATIONS OF THE NEW DATA CENTER'S FLOOR, WALLS, CEILING TILES, ETC. TO PREVENT ANY GAS LINKAGE OF THE FM-200 FIRE SUPPRESSION SYSTEM. CONTRACTOR SHALL WIRE PER THE MANUFACTURER'S RECOMMENDATIONS. CONTRACTOR SHALL REFER TO ROOF PLAN ON DRAWING E-208 FOR SUPPORTIVE CRAC UNIT IN THE NEW DATA CENTER.
 - ② CONTRACTOR SHALL PROVIDE A HACR TYPE - 15A 3 POLE BREAKER IN DISTRIBUTION PANEL EHVC-2 POSITION #5 (4.5' MOUNTING SPACE) TO SUPPORT CONDENSER - CU-7 UNIT ON ROOF. CONTRACTOR SHALL PROVIDE (3#12 W/12 GROUND IN 75' CONDUIT FROM BREAKER TO THE INSIDE OF THE PROVIDED MEANS OF DISCONNECTION WITHIN THE CU-1 UNIT. CONTRACTOR SHALL PROVIDE A MINIMUM OF 3'-0" OF SEAL-TITE FLEXIBLE CONDUIT AT THE CONNECTION POINT OF THE UNIT. CONTRACTOR WILL NOT USE THE CABLE TRAY CABLE. POWER SOURCE IS FROM THE NEW DISTRIBUTION PANEL IN THE NEW DATA CENTER. CONTRACTOR SHALL SEAL ALL CONDUITS PENETRATIONS OF THE NEW DATA CENTER'S FLOOR, WALLS, CEILING TILES, ETC. TO PREVENT ANY GAS LINKAGE OF THE FM-200 FIRE SUPPRESSION SYSTEM. CONTRACTOR SHALL WIRE PER THE MANUFACTURER'S RECOMMENDATIONS. CONTRACTOR SHALL REFER TO ROOF PLAN ON DRAWING E-208 FOR SUPPORTIVE CRAC UNIT IN THE NEW DATA CENTER.
 - ③ CONTRACTOR SHALL PROVIDE A GFCI RECEPTACLE IN A WEATHER PROOF ENCLOSURE AND MOUNT NEARBY CONDENSER'S FRAME WORK AS SHOWN. POWER SOURCE IS FROM THE NEW BRANCH PANEL IN THE NEW DATA CENTER. CONTRACTOR SHALL SEAL ALL CONDUITS PENETRATIONS OF THE NEW DATA CENTER'S FLOOR, WALLS, CEILING TILES, ETC. TO PREVENT ANY GAS LINKAGE OF THE FM-200 FIRE SUPPRESSION SYSTEM.

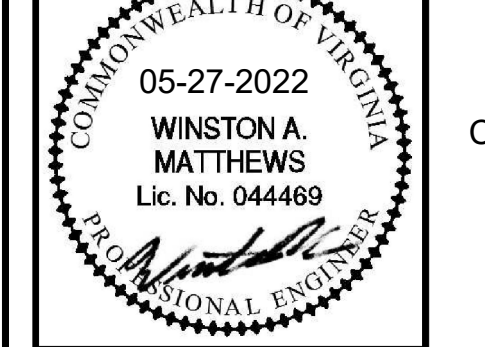


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	DESCRIPTION
	BY
	MARK DATE
	REVISIONS



DATE	05/27/2022
PROJECT	18106-09
DESIGNED	MAR
DRAWN	MAR
CHECKED	WAM



PROJECT
 ROANOKE CITY PUBLIC SCHOOLS
 ADMINISTRATION BUILDING ON CAMPBELL (AOC)
 PHASE ONE (DATA CENTER)
 201 Campbell Ave SW
 Roanoke, VA 24011

DRAWING
 EXISTING - ROOF PLAN - ELECTRICAL

SHEET
E.213



**ROANOKE CITY
PUBLIC SCHOOLS**

Strong Students. Strong Schools. Strong City.

PROJECT SPECIFICATIONS

ROANOKE CITY PUBLIC SCHOOLS ADMINISTRATION BUILDING ON CAMPBELL (AOC) PHASE ONE - (DATA CENTER)

201 CAMPBELL AVENUE
ROANOKE, VIRGINIA

RCPS IFB # 3092
RRMM PROJECT # 18106-09

PREPARED FOR

ROANOKE CITY PUBLIC SCHOOLS
DEPARTMENT OF PURCHASING
40 DOUGLAS AVENUE NW
ROANOKE, VA 24012

PREPARED BY

RRMM ARCHITECTS
28 CHURCH AVENUE SW
ROANOKE, VA 24011

May 27, 2022

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END OF SECTION 010100

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work performed by Owner.
4. Owner-furnished/Contractor-installed (OFCI) products.
5. Owner-furnished/Vendor-installed (OFVI) products.
6. Contractor's use of site and premises.
7. Coordination with occupants.
8. Work restrictions.
9. Specification and Drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 PROJECT INFORMATION

- A. Project Identification: Roanoke City Public Schools
Administration Building on Campbell Avenue –
Phase One (Data Center)

1. Project Location: 201 Campbell Avenue, SW, Roanoke, VA 24011.

- B. Owner: Roanoke City Public Schools, 40 Douglas Avenue, NW, Roanoke, VA 24012.

1. Owner's Representative: Jeff Shawver.

- C. Architect: RRMM Architects.

1. Architect's Representative: Chris A Phillips, AIA.

- D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Structural Engineer: Prosim Engineering, LLC.
 - a. Allan J. Long, P.E.
 2. Fire-Protection, Plumbing Engineer: Lawrence Perry and Associates.
 - a. Rodney Fanning, P.E.
 3. Electrical Engineer: Lawrence Perry and Associates.
 - a. Winston Matthews
- E. Web-Based Project Software: Project software acceptable to the Owner/Architect will be used for purposes of managing communication and documents during the construction stage.
1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
1. This project includes the construction of a new data center including support spaces and related infrastructure as well as a new hydraulic materials lift within the existing Roanoke City Public School Administration Building and other Work indicated in the Contract Documents.
- B. Type of Contract:
1. Project will be constructed under a single prime contract.

1.5 WORK PERFORMED BY OWNER

- A. Cooperate fully with Owner, so work may be carried out smoothly, without interfering with or delaying Work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Preceding Work: Owner will perform the following construction operations at Project site.
1. Owner has completed hazardous materials testing on the building. Areas affected by this work have been shared with Testing Agency and ACM anticipated to be disturbed will be remediated prior to General Contractor beginning work if ACM is believed to have been encountered, cease work immediately and notify Owner and Architect. See Appendix D "Hazardous Materials Report" for additional information.

1.6 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFICI) PRODUCTS

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:
1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
 2. Provide for delivery of Owner-furnished products to Project site.
 3. Upon delivery, inspect, with Contractor present, delivered items.
 - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
 4. Obtain manufacturer's inspections, service, and warranties.
 5. Inform Contractor of earliest available delivery date for Owner-furnished products.
- B. Contractor's Responsibilities: The Work includes the following, as applicable:
1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
 2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
 3. Receive, unload, handle, store, protect, and install Owner-furnished products.
 4. Make building services connections for Owner-furnished products.
 5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
 6. Repair or replace Owner-furnished products damaged following receipt.
- C. Owner-Furnished/Contractor-Installed (OFICI) Products:
1. SEE APPENDIX A – OWNER FURNISHED ITEMS AND INSTALLATION RESPONSIBILITIES.

1.7 OWNER-FURNISHED/VENDOR-INSTALLED (OFVI) PRODUCTS

- A. The Owner will furnish and install products indicated.
- B. Owner-Furnished/Vendor-Installed (OFVI) Products:
1. SEE APPENDIX A – OWNER FURNISHED ITEMS AND INSTALLATION RESPONSIBILITIES.
 2. Contractor shall coordinate its efforts and schedule with Owner's Vendor's forces to avoid unnecessary delays.

1.8 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

- B. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.9 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.10 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 6:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 - 1. Weekend Hours: Coordinate request with Owner.
 - 2. Early Morning Hours: Coordinate request with Owner.
 - 3. Work in Existing Building: Coordinate request with Owner.
 - 4. Hours for Utility Shutdowns: Coordinate request with Owner.
 - 5. Hours for Core Drilling: Coordinate request with Owner.

6. And other noisy operations: Coordinate request with Owner.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.
- F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 1. Maintain list of approved screened personnel with Owner's representative.

1.11 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
 - 3. Quantity allowances.
 - 4. Contingency allowances.
 - 5. Testing and inspecting allowances.
- C. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.
- C. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 7: Contingency Allowance: Include a contingency allowance of \$50,000.00 for use according to Owner's written instructions.

END OF SECTION 012100

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as

- performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed unless otherwise indicated.
- C. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.

- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within fourteen (14) days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.

- d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.

- c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.
2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Change Orders (numbers) that affect value.
 - d. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 5. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
 6. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use Schedule of Values and Certificate for Payment Supplied by Owner. as form for Applications for Payment.

- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Submittal schedule (preliminary if not final).
 5. List of Contractor's staff assignments.
 6. Copies of building permits.
 7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 8. Initial progress report.
 9. Report of preconstruction conference.
 10. Certificates of insurance and insurance policies.
 11. Performance and payment bonds.
 12. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. Evidence that claims have been settled, if applicable.
 6. Final liquidated damages settlement statement, if applicable.
 7. Proof that taxes, fees, and similar obligations are paid.
 8. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

PAYMENT PROCEDURES

012900 - 4

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Web-based Project management software package.
 - 6. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 2. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and in web-based Project software directory. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.

2. Preparation of the schedule of values.

3. Installation and removal of temporary facilities and controls.

4. Delivery and processing of submittals.

5. Progress meetings.

6. Preinstallation conferences.

7. Project closeout activities.

8. Startup and adjustment of systems.

1.6 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Owner name.
 3. Owner's Project number.
 4. Name of Architect.
 5. Architect's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.

- d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 7 days of receipt of the RFI response.
 - E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Include the following:
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number, including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 - F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within five days if Contractor disagrees with response.
- 1.7 PROJECT MEETINGS
- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of five days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
 - B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 1. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other

- concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Critical work sequencing and long lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Use of web-based Project software.
 - g. Procedures for processing field decisions and Change Orders.
 - h. Procedures for RFIs.
 - i. Procedures for testing and inspecting.
 - j. Procedures for processing Applications for Payment.
 - k. Distribution of the Contract Documents.
 - l. Submittal procedures.
 - m. Preparation of Record Documents.
 - n. Use of the premises and existing building.
 - o. Work restrictions.
 - p. Working hours.
 - q. Owner's occupancy requirements.
 - r. Responsibility for temporary facilities and controls.
 - s. Procedures for moisture and mold control.
 - t. Procedures for disruptions and shutdowns.
 - u. Construction waste management and recycling.
 - v. Parking availability.
 - w. Office, work, and storage areas.
 - x. Equipment deliveries and priorities.
 - y. First aid.
 - z. Security.
 - aa. Progress cleaning.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 2. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 3. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

- D. Progress Meetings: Conduct progress meetings at intervals appropriate to the work..
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
4. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
5. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Contractor.
 5. Name of firm or entity that prepared submittal.
 6. Names of subcontractor, manufacturer, and supplier.
 7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 8. Category and type of submittal.
 9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 11. Drawing number and detail references, as appropriate.
 12. Indication of full or partial submittal.
 13. Location(s) where product is to be installed, as appropriate.
 14. Other necessary identification.
 15. Remarks.
 16. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations;

include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

- D. Submittals Utilizing Web-Based Project Software acceptable to the Architect: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

- 1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

- 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

- a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

- 1. Initial Review: Allow 10 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 7 days for review of each resubmittal.

- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

- 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.

3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.

- f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
- 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 - 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 - 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include

list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

E. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.

F. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.7 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

- B. Contractor's Approval: Indicate Contractor's approval for each submittal with indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 - 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.8 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
 - 1. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

- A. Mockup Shop Drawings:
 - 1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
 - 2. Indicate manufacturer and model number of individual components.
 - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- E. Reports: Prepare and submit certified written reports and documents as specified.
- F. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.
- B. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- C. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.

2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.

D. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

E. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- F. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.10 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Engage a qualified testing agency to perform quality-control services.

- a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency/special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections attached to this Section, and as follows:
 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected Work.
 7. .

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.
 1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014100 - SPECIAL INSPECTION SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Special Inspection services.
- B. Certain structural components of the Project will be subject to the requirements for Special Inspections. Special Inspections will be applicable to the following specification sections:
 - 1. Section 032000 Concrete Reinforcing
 - 2. Section 033000 Building Cast-In-Place Concrete
 - 3. Section 051200 Structural Steel Framing
 - 4. Section 053100 Steel Decking
 - 5. Section 312000 Earth Moving
- C. The Owner will procure and bear all costs of the Special Inspector and the Independent Testing Laboratory, except as otherwise noted. The Special Inspector will be the manager of the Special Inspection process. The Special Inspector checks the certification of all other inspecting agents required by Special Inspections and coordinates their activities. The Special Inspector carries the responsibility for coordinating Special Inspections. The Statement of Special Inspections will be required by the Building Official as a condition for building permit issuance.
- D. Requirements for Special Inspections are outlined in the Statement and Schedule of Special Inspections included at the end of this section.
 - 1. Specific quality-assurance and control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

- E. Special Inspections are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
- F. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Quality Control" specifies requirements for repair and restoration of construction disturbed by inspection and testing activities.

1.3 RESPONSIBILITIES

- A. Contractor Responsibilities: Contractor shall provide and include in the Contract Sum, inspections, tests, and other similar quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction except where they are specifically indicated to be the Owner's responsibility, or are provided by another identified entity.
 - 1. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Contractor's responsibility.
 - a. The Contractor shall correct deficiencies in work that inspections and laboratory test reports have indicated to be not in compliance with requirements.
 - b. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.
 - 2. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - a. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
 - a. Provide access to the Work.
 - b. Furnish incidental labor and facilities necessary to facilitate inspections and tests.

- c. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
 - d. Provide and maintain for the sole use of the Special Inspector or Inspectors adequate facilities for safe storage and proper curing of test samples on the Project Site.
 - e. Provide the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
 - f. Provide security and protection of samples and test equipment at the Project Site.
 - g. The Contractor shall designate a representative (the superintendent or an assistant to the superintendent) who shall be the direct point-of-contact with the Special Inspector during each phase of the work. Discrepancies noted during the progress of the work will be reported to the Contractor's representative for corrective action. Communications given by the Special Inspector to the Contractor's representative shall be as binding as if given to the Contractor.
4. Provide an anticipated schedule of work for Special Inspector use, update monthly.
 5. Advance notice of visits for the Special Inspector shall be negotiated by the Contractor with the Special Inspector prior to the start of work.
 6. Contactor shall provide the Special Inspector with a copy of approved shop drawings relevant to pending inspections.

B. Special Inspector Responsibilities:

1. The Special Inspector shall coordinate and/or conduct and interpret tests, state in each report whether test specimens comply with requirements, specifically state any deviations therefrom, and record work required and performed to correct deficiencies.
2. The Special Inspector will keep records of all inspection and tests which will be furnished to the Building Official, the Architect, and the Structural Engineer of Record.
3. The Special Inspector shall notify the Architect, Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services. All discrepancies will be brought to the immediate attention of the Contractor for correction. If discrepancies are not corrected, the discrepancies will be brought to the attention of the Owner, Building Official, Architect and the Structural Engineer of Record.
4. A final report documenting completion of all required special inspections and corrections of any discrepancies noted will be submitted to the Building Official by the Special Inspector prior to, and as a condition of, issuance of the *Certificate of Use and Occupancy*.
5. The Special Inspector shall not perform any duties of the Contractor.
6. The Special Inspector shall not release, revoke, alter, decrease or increase the Contract Document requirements.
7. The Special Inspector shall provide a list of inspectors that will be on site, with discipline and a copy of qualifications for each.
8. Provide the Contractor with a list of contacts (primary and secondary) and preferred method of contact in order to coordinate site visits.

- C. Independent Testing Laboratory Responsibilities: The Independent Testing Laboratory engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Architect and the Contractor in performance of the Laboratory's duties. The Laboratory shall provide qualified personnel to perform required inspections and tests.
1. Notify Architect, Construction Manager, Structural Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Shall not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
- D. Coordination: The Contractor and each agency engaged to perform inspection, tests and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition the Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

1.4 SUBMITTALS

- A. Within 48 hours of each inspection or test, the Special Inspector and the Independent Testing Laboratory shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Architect and Structural Engineer.
1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
 2. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:
 - a. Date of issue.
 - b. Project title and number.
 - c. Name, address, and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making the inspection or test.
 - f. Designation of the Work and test method.
 - g. Identification of product and Specification Section.
 - h. Complete inspection or test data.
 - i. Test results and an interpretation of test results.
 - j. Ambient conditions at the time of sample taking and testing.

- k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
- l. Name and signature of laboratory inspector.
- m. Recommendations on retesting.
- n. Digital photos (12 megapixel sensor size, 3200 image resolution) must be taken of every inspection observed. Key photos and photos of deficiencies are to be contained within report, other photos are to be maintained by Special Inspector sorted by date of inspection, inspection report number and location of inspection. Photos are to be available immediately to team upon request. At closure of project, provide copy of digital photos to Owner.

1.5 QUALITY ASSURANCE

- A. Qualification for Special Inspector: The Special Inspector shall be a Registered Professional Engineer, licensed in the Commonwealth of Virginia, experienced in performing special inspections and shall be approved by the Building Official and the Architect. The credentials of all Inspectors and testing technicians shall be provided if requested.
- B. Qualifications for Independent Testing Laboratory: Engage independent inspection and testing laboratories, that are prequalified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.
 - 1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.
 - 2. Each independent Inspection and Testing Agency engaged on the Project shall demonstrate that it has the experience and capability to conduct the required field and laboratory testing without delaying the progress of the work. The minimum requirements shall be as follows:
 - a. Reinforced Concrete testing
 - 1) *ACI-CFTT Concrete Field Testing Technician – Grade 1*
 - 2) *ACI-LTT Laboratory Testing Technician – Grade 1 or 2 and Strength Testing Technician*
 - 3) *NICET-CT – Concrete Technician – Level II*
 - b. Reinforced Concrete Inspection
 - 1) *ACI-CCI Concrete Construction Inspector*
 - 2) *ICC-RCSI Reinforced Concrete Special Inspector*
 - c. Structural Steel
 - 1) *AWS-CWI Certified Welding Inspector*
 - 2) *AWS/AISC-CSI Certified Steel Inspector*
 - 3) *ICC-SWSI Structural Steel and Welding Inspector*
 - d. Non-Destructive Testing – American Society of Non-Destructive.

- e. Soils Testing
 - 1) NICET-ST- *Soils Technician Level III*
 - 2) NICET-GET – *Geotechnical Engineering Technician Level III*

- B. Pre-Construction Conference – Prior to the start of project construction, the Special Inspector and/or Owner’s Project Manager shall conduct a Pre-Construction Conference to discuss the requirements for Special Inspections as well as the Administrative Procedures to be followed during the course of the project. Protocols for notification, documentation, and individual responsibilities shall be reviewed. Attendees shall include, but are not limited to:
 - 1. Owner
 - 2. Owner’s Project Manager
 - 3. Owner’s Project Inspector
 - 4. Owner’s Independent Testing Agency
 - 5. Architect
 - 6. Structural Engineer
 - 7. Contractor’s Project Manager
 - 8. Contractor’s Superintendent

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.
- C. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 014100



Statement of Special Inspections

Permit #

Date 05-26-2022

Tax Map # 1010905

The current code in effect is the

2015 Virginia Uniform Statewide Building Code

This **Statement of Special Inspections** is submitted as a condition for permit issuance in accordance with the 2015 Edition of the Virginia Uniform Statewide Building Code, Section 111.2 and Chapter 17 of the 2015 Edition of the International Building Code. It includes a :

- 1. Complete list of all materials and work requiring special inspections, and;**
- 2. Complete list of all the inspections to be performed and whether they are required to be periodic or continuous inspections, and;**
- 3. Complete list of the individuals, approved agencies or firms intended to be retained for conducting such inspections.**

The Registered Design Professional in Responsible Charge (RDPRC) shall keep records of all inspections and shall furnish **Periodic Reports of Special Inspections** to the Building Commissioner each month on the date shown below until the **Final Report of Special Inspections** is submitted. **Periodic Reports of Special Inspections** will include a summary of all activities requiring special inspections for the period along with a log of discrepancies noted. During the course of the project, discrepancies and deviations from the approved plans and specification and code violations observed during the conduct of special inspections services shall be brought to the immediate attention of the contractor for correction. **If such discrepancies are not corrected, the discrepancies shall be brought to the immediate attention of the Building Commissioner.** The special inspection program does not relieve the Contractor of his or her responsibilities.

Special Inspections are in addition to the regular inspections by Building Inspections personnel specified in Section 113.3 of the Virginia Uniform Statewide Building Code.

Special Inspectors are not authorized to inspect work for Building Inspections personnel!

A **Final Report of Special Inspections** documenting completion of all required special inspections and correction of any discrepancies noted in the inspections shall be submitted prior to issuance of a Final Inspection and/or a Certificate of Occupancy.

Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Project Information:

Project Name Administration Building of Campbell Ave.

Property Address 201 Campbell Ave SW, Roanoke VA 24011

Owner Name Roanoke City Public Schools

Contractor Name (To be determined)

Form Prepared By:

Registered Design Professional in Responsible Charge Allan Long, P.E.

Company Name Prosim Engineering, LLC

Company Address 108 S. Iron St., Marion VA 24354

Phone # (276) 783-3977

Cell # (276) 698-1966

Email Address along@prosimeng.com

Planning Building & Development 215 Church Ave., SW, Room 170 Roanoke, VA 24011

Phone: (540) 853-1090 www.roanokeva.gov permitcenter@roanokeva.gov

Instructions For Completing This Form:

1. The Registered Design Professional (Architect/Engineer) in responsible charge of the Project shall complete this form and submit it with the Building Permit Application for review and approval by the Building Department prior to the issuance of the Building Permit for the Project. This Statement of Special Inspections (SSI) form will be issued to the job site at the time of issuance of the Building Permit.
2. Information detailing the qualifications including copies of all current certifications and accreditations of each Special Inspector, Special Inspection Agency, and Fabricator Shop, to be used for the Project shall be submitted by the Registered Design Professional (Architect/Engineer) in responsible charge with this completed form (Sections 1703 and 1704.2.1 of VUSBC-2015). Information shall also be provided outlining the qualifications of any Testing Labs (soils, concrete, masonry, steel, and others) being used for the project. This includes information about the Accreditation of the Testing Lab, names and qualifications of each.
3. Included in this document are the "**QUALIFICATION STANDARDS FOR SPECIAL INSPECTIONS**". Each party involved with the Project shall meet these minimum qualifications standards. (Sections 1701, 1702, 1703, and 1704 of VUSBC-2015)
4. This form is intended for buildings of structures that are assigned to Seismic Design Category A or B. The Registered Design Professional shall provide a modified Statement of Special Inspection for buildings or structures assigned to Seismic Design Category higher than B.

Special Inspection Categories (1701.1, 1702, 1704 & 1705):

Special inspections are required for materials, installation, fabrication, erection or placement of components and connections requiring special expertise to insure compliance with approved construction documents and applicable reference standards. Section 1705 of VUSBC-2015 lists a total of 15 different categories of special inspections and testing (Categories A through O) as listed below). Please check the appropriate boxes below that apply to your project and enter the name of each individual responsible for the Special Inspection you have checked in the space provided to the right of each category. Please provide the appropriate documents that verify the qualifications of each individual or firm listed.

Time of Month for Delivery of Periodic Report of Special Inspections:

Periodic reports of special inspections must be submitted on the date listed above, if the reports are not submitted within 10 days of the date above, the permit maybe suspended until reports are submitted.

Prepared By (RDPRC):

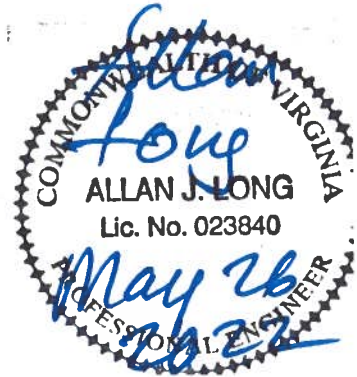
Print Name

Allan Long

Signature

Allan Long

Digitally signed by Allan Long
DN: C=US, E=along@prosimeng.com, O="Prosim Engineering, LLC", OU="Prosim Engineering
LLC", CN=Allan Long
Date: 2022.05.26 10:17:14 -04'00'



Owner's Authorization:

Signature

Jeffrey S. Shawver

Digitally signed by Jeffrey S. Shawver
Date: 2022.05.26 17:34:10 -04'00'

Date

Building Commissioner's Acceptance:

Signature Field

Date

A.

Inspection of Fabricators (1704.2.5):
Where fabrication of structural load-bearing members and assemblies is being performed on the premises of a fabricator's shop, special inspection of the fabricated items shall be required by Section 1704.2.5 and as required elsewhere in USBC-2015.
See Category A1 or A2 below for each Fabricator as appropriate:

A.1. Fabrication & Implementation Procedures (1704.2.5) for Fabricators Not Registered & Not Approved:

Check Box Below if Required	Indicate below all structural load-bearing members & assemblies that are being assembled on the premises of a fabricator's shop that is not registered and not approved (Section 1704.2.5)	Indicate below the name of the fabricator shop that is not registered and not approved (Section 1704.2.5)	Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below
<input type="checkbox"/>	1. Structural Steel		
<input type="checkbox"/>	2. Steel Joists & Girders		
<input type="checkbox"/>	3. Pre-cast Concrete		
<input type="checkbox"/>	4. Prestressed Concrete		
<input type="checkbox"/>	5. Wood Construction (Section 1705.5) - Prefabricated Structural Elements Covering:		
<input type="checkbox"/>	5.1. Manufactured Wood Trusses		
<input type="checkbox"/>	5.2. Walls		
<input type="checkbox"/>	5.3. Floors		
<input type="checkbox"/>	5.4. Roof Assemblies		
<input type="checkbox"/>	6. Cold Formed Steel Trusses		

A. 2. Fabricator Approval (1704.2.5.1) for Fabricators Registered & Approved:

Check Box Below if Required	Indicate below all structural load-bearing members & assemblies that are being assembled on the premises of a fabricator's shop that is not registered and not approved (Section 1704.2.5.1)	Indicate below the name of the fabricator shop that is not registered and not approved (Section 1704.2.5.1)	Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below
<input type="checkbox"/>	1. Structural Steel		<p>Required tasks to complying with the requirements of Category A-2:</p> <p>1. Prior to issuance of the Building Permit, provide the Building Department with a copy of the selected fabricator's current shop accreditation/certification.</p> <p>2. At the completion of fabrication, the Special Inspector and/or Special Inspection Agency shall obtain from each registered and approved fabricator and submit to the Building Department a Certificate of Compliance stating that the work was performed in accordance with the approved construction documents.</p>
<input type="checkbox"/>	2. Steel Joists & Girders		
<input type="checkbox"/>	3. Pre-cast Concrete		
<input type="checkbox"/>	4. Prestressed Concrete		
<input type="checkbox"/>	5. Wood Construction (Section 1705.5) - Prefabricated Structural Elements Covering:		
<input type="checkbox"/>	5.1. Manufactured Wood Trusses		
<input type="checkbox"/>	5.2. Walls		
<input type="checkbox"/>	5.3. Floors		
<input type="checkbox"/>	5.4. Roof Assemblies		
<input type="checkbox"/>	6. Cold Formed Steel Trusses		

B. Steel Construction (1705.2 & Table 1705.2.3):

Check Box Below if Required	Continual	Periodic	Required Verification and Inspections: Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below
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1. Material verification of high-strength bolts, nuts and washers:

<input checked="" type="checkbox"/>	-	X	1.1. Identification markings to conform to ASTM standards specified in the approved construction documents. Referenced Standard: AISC 360 and applicable ASTM material standards
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<input type="checkbox"/>	-	X	1.2. Manufacturer's certificate of compliance required.
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			2. Inspection of high-strength bolting: Referenced Standard: AISC 360
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<input checked="" type="checkbox"/>	-	X	2.1. Snug-tight joints.
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<input type="checkbox"/>	-	X	2.2. Pretensioned and slip-critical joints using turn-of-nut with matchmarking, twist-off bolt or direct tension indicator methods of installation.
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<input type="checkbox"/>	X	-	2.3. Pretensioned and slip-critical joints using turn-of-nut without matchmaking or calibrated wrench methods of installation.
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			3. Material verification of structural steel and cold-formed steel deck:
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<input checked="" type="checkbox"/>	-	X	3.1. For structural steel, identification markings to conform to AISC 360. Referenced Standards: AISC 360.
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<input checked="" type="checkbox"/>	-	X	3.2. For other steel, identification markings to conform to ASTM standards specified in the approved construction documents. Referenced Standards: Applicable ASTM material standards
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<input type="checkbox"/>	-	X	3.3. Manufacturer's certified test reports.
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			4. Material verification of weld filler materials:
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<input checked="" type="checkbox"/>	-	X	4.1. Identification markings to conform to AWS specification in the approved construction documents. Referenced Standard: AISC 360 and applicable AWS documents
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B. (cont) **Steel Construction (1705.2 & Table 1705.2.3):**

Check Box Below if Required	Continual	Periodic	Required Verification and Inspections:	Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below
<input type="checkbox"/>	-	X	4.2. Manufacturer's Certificate of Compliance required.	
<input checked="" type="checkbox"/>			5. Inspection of welding:	
<input checked="" type="checkbox"/>	X	-	5.1. Structural Steel and cold-formed steel deck: Referenced Standards: AWS & USBC-2015: 1705.2.2	
<input checked="" type="checkbox"/>	X	-	5.1.1. Complete and partial penetration groove welds.	
<input checked="" type="checkbox"/>	X	-	5.1.2. Multipass fillet welds.	
<input type="checkbox"/>	X	-	5.1.3. Single-pass fillet welds greater than 5/16".	
<input type="checkbox"/>	X	-	5.1.4. Plug and slot welds.	
<input checked="" type="checkbox"/>	-	X	5.1.5. Single-pass fillet welds less than or equal to 5/16".	
<input checked="" type="checkbox"/>	-	X	5.1.6. Floor and roof deck welds. Referenced Standards: AWS	
			5.2. Reinforcing steel: Referenced Standards: AWS & ACI 318	
<input type="checkbox"/>	-	X	5.2.1. Verification of weldability of reinforcing steel other than ASTM A 706.	
<input type="checkbox"/>	X	-	5.2.2. Reinforcing steel resisting flexural and axial forces in intermediate and special moment frames, and boundary elements of special structural walls of concrete and shear reinforcement.	
<input type="checkbox"/>	X	-	5.2.3. Shear reinforcement.	

B. (cont)			Steel Construction (1705.2 & Table 1705.2.3):	
Check Box Below if Required	Continual	Periodic	Required Verification and Inspections:	
<input type="checkbox"/>	-	X	5.2.4. Other reinforcing steel.	
			6. Inspection of steel frame joint details for compliance:	
<input type="checkbox"/>	-	X	6.1. Details such as bracing and stiffening.	
<input type="checkbox"/>	-	X	6.2. Member locations.	
<input type="checkbox"/>	-	X	6.3. Applications of joint details at each connection.	
<input type="checkbox"/>	-	X	7. Cold-formed steel trusses spanning 60 feet or greater (1705.2.4): Verify that the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.	
C. Concrete Construction (1705.3 & Table 1705.3):				
Check Box Below if Required	Continual	Periodic	Required Verification and Inspections: Reference Standard ACI 318 per any VUSBC 2015 section 1905 modification	
<input checked="" type="checkbox"/>	-	X	1. Inspection of reinforcing steel, including prestressing tendon, and placement. Referenced Standards: ACI 318 & VUSBC-2015: 1908.4	
<input type="checkbox"/>			2. Inspection of reinforcing steel welding in accordance with 1705.3.1, or 1705.3.2. Referenced Standards: AWS D1.4 & ACI 318	
<input type="checkbox"/>	X	-	3. Inspection of bolts to be installed in concrete prior to and during placement of concrete where allowable loads have been increased or where strength design is used. Referenced Standards: ACI 318 & VUSBC-2015: 1901.3, 1905	
			Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below	

C. (cont') **Concrete Construction (1705.3 & Table 1705.3):**

Check Box Below if Required

Continual

Periodic

Required Verification and Inspections:

Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below

<input checked="" type="checkbox"/>	-	X	4. Inspection of anchors installed in hardened concrete. Referenced Standards: ACI 318 & VUSBC-2015: 1901.3, 1905
<input checked="" type="checkbox"/>	-	X	5. Verifying use of required design mix. Referenced Standards: ACI 318 & VUSBC-2015: 1904, 1908.2, 1908.3
<input checked="" type="checkbox"/>	X	-	6. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete. Referenced Standards: ASTM C 172, ASTM C 31 & ACI 318 & VUSBC-2015: 1908.10
<input type="checkbox"/>	X	-	7. Inspection of concrete and shotcrete placement for proper application techniques. Referenced Standards: ACI 318 & VUSBC-2015: 1908.6, 1908.7, 1908.8
<input checked="" type="checkbox"/>	-	X	8. Inspection for maintenance of specified curing temperature and techniques. Referenced Standards: ACI 318 & VUSBC-1015: 1908.9
<input type="checkbox"/>			9. Inspection of prestressed concrete:
<input type="checkbox"/>	X	-	9.1. Application of prestressing force. Referenced Standards: ACI 318
<input type="checkbox"/>	X	-	9.2. Grouting of bonded prestressing tendons in the seismic-force-resisting system. Referenced Standard: ACI 318
<input type="checkbox"/>	-	X	10. Erection of precast concrete members. Referenced Standards: ACI 318
<input type="checkbox"/>	-	X	11. Verification of in-situ concrete strength, prior to stressing of tendons in posttensioned concrete and prior to the removal of shores and forms from beams and structural slabs. Referenced Standards: ACI 318
<input type="checkbox"/>	-	X	12. Inspect formwork for shape, location and dimensions of the concrete members being formed. Referenced Standards: ACI 318

D.

Masonry Construction (1705.4):

Masonry construction shall be inspected and verified in accordance with the requirements of Sections 1705.4 through 1705.4.2, depending on the classification of the building or structure or nature of the occupancy. Please check the applicable categories of D.1 or Category D.2. Exception: Special Inspections are not required for masonry construction that meets one of the three exceptions listed in Section 1705.4.

<input type="checkbox"/>	D.1.	Special Inspection (1705.4.1) for Empirical Designed Masonry, Glass Unit Masonry and Masonry Veneer in Occupancy Category IV (Essential Facilities):	Special Inspections and tests for empirically designed masonry, glass unit masonry or masonry veneer designed in accordance with Section 2109, 2110 or Chapter 14, respectively, where they are part of a structure classified as Risk Category IV shall be performed in accordance with TMS 402/ACI 530/ASCE 5, Level B Quality Assurance.
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<input type="checkbox"/>	D.1.	Special Inspection (1705.4.1) for Engineered Masonry in Occupancy Category I, II, or III (Nonessential Facilities):	The minimum Special Inspection Program for masonry designed per Section 2107 or 2108 or per Chapters other than Chapters 5, 6, or 7 of TMS 402/ACI 530/ASCE 5 in structures classified as Occupancy Category I, II, or III, in accordance with Section 1604.5.
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Check Box Below if Required	Continual	Periodic	Required Verification and Inspections:	Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below
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<input type="checkbox"/>	-	X	1. Compliance with required inspection provisions of the construction documents and the approved submittals shall be verified. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6
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<input type="checkbox"/>	-	X	2. Verification of f'_{m} and f'_{ac} prior to construction except where specifically exempted by code. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6
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<input type="checkbox"/>	X	-	3. Verification of slump flow and VSI as delivered to the site for self-consolidating grout. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6
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			4. As masonry construction begins, the following shall be verified to ensure compliance:
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<input type="checkbox"/>	-	X	4.1. Proportions of site-prepared mortar. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6
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<input type="checkbox"/>	-	X	4.2. Construction of mortar joints. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6
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<input type="checkbox"/>	-	X	4.3. Location of reinforcement, connectors, prestressing tendons and anchorages. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6
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<input type="checkbox"/>	-	X	4.4. Prestressing technique. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6
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<input type="checkbox"/>	-	X	4.5. Grade and size of prestressing tendons and anchorages. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6
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D.1.
(con't)

Level #1 Special Inspection (1705.4.1):

Required Verification and Inspections:

Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below

Check Box Below if Required

Continual

Periodic

5. During construction the inspection program shall verify:

- **X**

5.1. Size and location of structural elements.
Reference for Criteria: TMS 602/ACI 530.1/ASCE 6

- **X**

5.2. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other construction.
Reference for Criteria: TMS 402/ACI 530/ASCE 5

- **X**

5.3. Specified size, grade and type of reinforcement, anchor bolts, prestressing tendons and anchorages.
Reference for Criteria: TMS 402/ACI 530/ASCE 5 & TMS 602/ACI 530.1/ASCE 6

X

5.4. Welding of reinforcing bars.
Reference for Criteria: TMS 402/ACI 530/ASCE 5

- **X**

5.5. Protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F).
Reference for Criteria: TMS 602/ACI 530/ASCE 6

X

5.6 Application and measurement of prestressing steel.
Reference for Criteria: TMS 602/ACI 530.1/ASCE 6

The following shall be verified to insure compliance:

- **X**

6.1. Grout space is clean.
Reference for Criteria: TMS 602/ACI 530.1/ASCE 6

- **X**

6.2. Placement of reinforcement, connectors and prestressing tendons and anchorages.
Reference for Criteria: TMS 402/ACI 530/ASCE 5 & TMS 602/ASCE 6

- **X**

6.3. Proportion of site-prepared grout and prestressing grout for bonded tendons.
Reference for Criteria: TMS 602/ACI 530.1/ASCE 6

**D.1.
(con't)**

Special Inspection (1705.4.1):

Required Verification and Inspections:

Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below

Check Box Below if Required	Continual	Periodic	Required Verification and Inspections:
<input type="checkbox"/>	X	-	6.4. Verification of proportions of materials in premixed or preblended mortar and grout as delivered to the site. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6: Art. 1.5B
<input type="checkbox"/>	-	X	6.5. Construction of mortar joints. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6
<input type="checkbox"/>	X	-	7. Grout placement shall be verified to ensure compliance with code and construction document provisions. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6
<input type="checkbox"/>	X	-	7.1. Grout space prior to grouting. Reference for Criteria: TMS 602/ACI 530.1/ACSCCE 6: Art. 3.2D
<input type="checkbox"/>	-	X	7.2. Placement of prestressing grout: Reference for Criteria: TMS 602/ACI 530.1/ASCE 6: Art. 3.6C
<input type="checkbox"/>	-	X	7.3. Grouting of prestressing bonded tendons. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6
<input type="checkbox"/>	-	X	8. Size and location of structural elements. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6: Art. 3.3F
<input type="checkbox"/>	X	-	8.1. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other construction. Reference for Criteria: TMS 402/ACI 530/ASCE 5: Sec. 1.2.2(e), 1.16.1
<input type="checkbox"/>	-	X	8.2. Specified size, grade and type of reinforcement, anchor bolts, prestressing tendons and anchorages. Reference for Criteria: TMS 402/ACI 530/ASCE 5: Sec. 1.15 & TMS 602/ACI 530.1/ASCE 6: Art. 2.4, 3.4
<input type="checkbox"/>	X	-	8.3. Welding of reinforcing bars. Reference for Criteria: TMS 402/ACI 530/ASCE 5: Sec. 2.1.9.7.2, 3.3.3.4(b)

D.1. (cont)	Special Inspection (1705.4.1):		Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below	
Check Box Below if Required	Continual	Periodic	Required Verification and Inspections:	
<input type="checkbox"/>	X	-		8.4. Application and measurement of prestressing force. Reference for Criteria: TMS 602/ACI 530.1/ASCE 6: Art. 3.6B
<input type="checkbox"/>	X	-		9. Preparation of any required grout specimens, mortar specimens and/or prisms shall be observed. Reference for Criteria: VUSBC-2015: Sec. 2105.1 & TMS 602/ACI 530.1/ASCE 6
E. Structural Wood Construction (1705.5): 1. Special Inspections of the fabrication process of prefabricated wood structural elements and assemblies (covering: walls, floors, or roof assemblies along with manufactured roof trusses) shall be in accordance with Section 1704.2.5 (see Category A above). 2. Special Inspections of site-built assemblies shall be in accordance with Section 1705.5 as indicated below.				
Check Box Below if Required	Required Verification and Inspections:		Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below	
<input type="checkbox"/>	1. Fabrication of high-load diaphragms designed in accordance with Section 2306.2 shall be installed with Special Inspections as indicated in Sections 1704.2:			
<input type="checkbox"/>	1.1. Inspect the wood structural panel sheathing to ascertain that it is of the grade and thickness shown on the approved plans.			
<input type="checkbox"/>	1.2. Verify the nominal size of the framing members at adjoining panel edges, the nail or staple diameter and length, the number of fastener lines and that the spacing between fasteners in each line and at edge margins agrees with the approved plans.			
<input type="checkbox"/>	2. Metal-plate-connected wood trusses spanning 60 feet or greater (1705.5.2): Verify that the temporary restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.			
<input type="checkbox"/>	3. Prefabricated wood shear panels covering:			
<input type="checkbox"/>	3.1. Holdown anchor size and placement, including embedment length, spacing and edge distance.			
<input type="checkbox"/>	3.2. The connection of the structure to the shear panels.			

Soils (1705.6 & Table 1705.6):

F. 1. Perform Special Inspections of existing site soil conditions; fill placement and load-bearing requirements as required by Section 1705.6 and Table 1705.6.
 2. Determine compliance using the approved geotechnical report (Section 1803), and the construction documents prepared by the Registered Design Professional.
 3. Determine that proper materials and procedures are used during fill placement and in accordance with the provisions of the approved geotechnical report.
 Exception: Where Section 1803 does not require reporting of materials and procedures for fill placement, the special inspector shall verify that the in-place dry density of the compacted fill is not less than 90% of the maximum dry density at optimum moisture content determined in accordance with ASTM D 1557.

Check Box Below if Required	Continual	Periodic	Required Verification and Inspections:	Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below
<input checked="" type="checkbox"/>	-	X	1. Verify materials below shallow footings are adequate to achieve the design bearing capacity.	
<input checked="" type="checkbox"/>	-	X	2. Verify excavations are extended to proper depth and have reached proper material.	
<input checked="" type="checkbox"/>	-	X	3. Perform classification and testing of compacted fill materials.	
<input checked="" type="checkbox"/>	X	-	4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill.	
<input checked="" type="checkbox"/>	-	X	5. Prior to placement of compacted fill, observe subgrade and verify that site has been prepared properly.	

Check Box Below if Required	Continual	Periodic	Required Verification and Inspections:	Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below
<input checked="" type="checkbox"/>	-	X	1. Verify elements materials, size and lengths comply with the requirements.	
<input checked="" type="checkbox"/>	X	-	2. Determine capacities of test elements and conduct additional load tests, as required.	
<input checked="" type="checkbox"/>	X	-	3. Inspect driving operation and maintain complete accurate records for each element.	
<input checked="" type="checkbox"/>	X	-	4. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element.	

G. Driven Deep Foundations (1705.7 & Table 1705.7):

1. Perform Special Inspections during installation and testing of driven deep foundation elements as required by Table 1705.7
 2. Determine compliance using the approved geotechnical report (section 1803), and the construction documents prepared by the Registered Design Professional.

Check Box Below if Required	Continual	Periodic	Required Verification and Inspections:	Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below
<input type="checkbox"/>	X	-	1. Verify elements materials, size and lengths comply with the requirements.	
<input type="checkbox"/>	X	-	2. Determine capacities of test elements and conduct additional load tests, as required.	
<input type="checkbox"/>	X	-	3. Inspect driving operation and maintain complete accurate records for each element.	
<input type="checkbox"/>	X	-	4. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element.	

G. (cont)			Driven Deep Foundations (1705.7 & Table 1705.7:	
Check Box Below if Required	Continual	Periodic	Required Verification and Inspections:	
<input type="checkbox"/>			5. For steel elements, perform additional inspections in accordance with 1705.2 (see Category B above).	
<input type="checkbox"/>			6. For concrete elements and concrete-filled elements, perform additional inspections in accordance with Section 1705.3 & Table 1705.3 (see Category C above).	
<input type="checkbox"/>			7. For specialty elements, perform additional inspections as determined by the Registered Design Professional in Responsible Charge.	
H. Cast-In-Place Deep Foundations (1705.8 & Table 1705.8):				
1. Perform Special Inspections during installation and testing of cast-in-place deep foundation elements as required by Table 1705.8. 2. Determine compliance using the approved geotechnical report (Section 1803), and the construction documents prepared by the Registered Design Professional.				
Check Box Below if Required	Continual	Periodic	Required Verification and Inspections:	
<input type="checkbox"/>	X	-	1. Observe drilling operations and maintain complete and accurate records for each element.	
<input type="checkbox"/>	X	-	2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes.	
<input type="checkbox"/>			3. For concrete elements, perform additional inspections in accordance with Section 1705.3 & Table 1705.3 (see Category C above).	
			Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below	

I. Helical Pile Foundations (1705.9):			Required Verification and Inspections:	Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below
Check Box Below if Required	Continual	Periodic		
<input type="checkbox"/>	X	-	<p>1. Perform Special Inspections continuously during installation of helical pile foundations.</p> <p>2. Record information for each helical pile that includes installation equipment used, pile dimensions, tip elevations, final depth, final installation torque and other pertinent installation data as required by the Registered Design Professional in Responsible Charge.</p> <p>3. Use the approved geotechnical report (Section 1803) and the approved construction documents prepared by the Registered Design Professional to determine compliance.</p>	
<input type="checkbox"/>	X	-		
<input type="checkbox"/>	X	-		
K. Spray-Applied Fire-Resistant Materials (SFRM) (1705.14):				
1. Special Inspections for sprayed fire-resistant materials (SFRM) applied to floor, roof and wall assemblies and structural members shall be in accordance with Sections 1705.14 through 1705.14.6.3 2. Special Inspections shall be based on the fire-resistance design as designated in the approved construction documents. 3. <i>The tests set forth in Section 1705.14.1 shall be based on samplings from specific floor, roof and wall assemblies and structural members.</i> 4. Special Inspections shall be performed after the rough installation of electrical, automatic sprinkler, mechanical and plumbing systems and suspension systems for ceilings, where applicable.				
Check Box Below if Required	Required Verification and Inspections:			<p>Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below</p>
<input type="checkbox"/>	Physical and Visual Tests (1705.14.1): Perform Special Inspections for SFRM to include the following test and observations to demonstrate compliance with listing and fire-resistance rating covering condition of substrate, thickness of application, density in pounds per cubic foot, bond strength adhesion/cohesion and condition of finished application (see below for requirements).			
<input type="checkbox"/>	Structural Member Surface Conditions (1705.14.2): 1. Prepared the surfaces in accordance with the approved fire-resistance design and the written instructions of approved manufacturers. 2. Inspect the prepared surface of structural members to be sprayed before the application of the SFRM.			
<input type="checkbox"/>	Application (1705.14.3): 1. Verify that the substrate has a minimum ambient temperature before and after application as specified in the written instructions of approved manufacturers. 2. Verify that the area for application is ventilated during and after application as required by the written instructions of approved manufacturers.			

K.
(cont)

Spray-Applied Fire-Resistant Materials (SFRM) (1705.14):

Check
Box
Below if
Required

Required Verification and Inspections:

Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below

Thickness (1705.14.4):

No more than 10% of the thickness measurements of the SFRM applied to floor, roof and wall assemblies and structural members shall be less than the thickness required by the approved fire-resistance design, but in no case less than the minimum allowable thickness required by Section 1705.14.4.1.

- 1. Minimum allowable individual thickness (1705.14.4.1):
 - 1.1. For design thicknesses 1 inch or greater. It shall be the design thickness minus 1/4 inch.
 - 1.2. For design thicknesses less than 1 inch, it shall be the design thickness minus 25%.
 - 1.3. Thickness shall be determined in accordance with ASTM E 605.
- 1.4. Samples of the SFRM shall be selected in accordance with Section 1705.14.4.2 and 1705.14.4.3 (see below).
- 2. Floor, roof and wall assemblies (1705.14.4.2):

Determine the thickness of the applied SFRM in accordance with ASTM E 605, making not less than 4 measurements for each 1,000 square feet of the sprayed area in each story or portion thereof:
- 3. Cellular decks (1705.14.4.3): Select the thickness measurements from a square area, 12" by 12" in size. Make a minimum of 4 measurements that are located symmetrically within the square area.
- 4. Fluted decks (1705.14.4.4): Select the thickness measurements from a square area, 12" by 12" in size. Make a minimum of 4 measurements that are located symmetrically within the square area, including one each of the following: valley, crest and sides. Report the average of the measurements.
- 5. Structural members (1705.14.4.5): Determine the thickness of the applied SFRM in accordance with ASTM E 605. Perform thickness testing on not less than 25% of the structural members on each floor:
- 6. Beams and girders (1705.14.4.6): Make thickness measurements at 9 locations around the beams or girder at each end of a 12-inch length.
- 7. Joists and trusses (1705.14.4.7): Make thickness measurements at 7 locations around the joist or truss at each end of a 12-inch length.
- 8. Wide-flanged columns (1705.14.4.8): Make thickness measurements at 12 locations around the column at each end of a 12-inch length.
- 9. Hollow structural section and pipe (1705.14.4.9): Make thickness measurements at 4 locations around the column at each end of a 12-inch length.



<p>K. (cont)</p>	<p>Spray-Applied Fire-Resistant Materials (SFRM) (1705.14):</p>	<p>Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below</p>
<p>Check Box Below if Required</p>	<p>Required Verification and Inspections:</p> <p>Density (1705.14.5): The density of the SFRM shall not be less than the density specified in the approved fire-resistance design. Determine the density of the SFRM in accordance with ASTM E 605. Select the test samples to determine the density of the SFRM as follows: <ol style="list-style-type: none"> 1. From each floor, roof and wall assemblies at the rate of not less than 1 sample for every 2,500 square feet or portion thereof of the sprayed area in each story. 2. From beams, girders, trusses and columns at a rate of not less than 1 sample for each type of structural member for each 2,500 square feet of floor area or portion thereof in each story. </p> <p>Bond Strength (1705.14.6): Verify that the cohesive/adhesive bond strength of the cured SFRM applied to floor, roof and wall assemblies and structural members shall not be less than 150 pound per square foot. Determine the cohesive/adhesive bond strength in accordance with the field test specified in ASTM E 736 by testing in-place samples of SFRM selected in accordance with Sections 1704.12.6.1 through 1704.12.6.3 (see below): <ol style="list-style-type: none"> 1. <u>Floor, roof and wall assemblies (1705.14.6.1):</u> Select the test samples for determining the cohesive/adhesive bond strength of the SFRM from floor, roof and wall assembly at a rate of not less than 1 sample for every 2,500 square feet of the sprayed area in each story or portion thereof. 2. <u>Structural members (1705.14.6.2):</u> Select the test samples for determining the cohesive/adhesive bond strength of the SFRM from beams, girders, trusses, columns and other structural members at a rate of not less than 1 sample for every 2,500 square feet of floor area or portion thereof in each story. 3. <u>Primer, paint and encapsulated bond tests (1705.14.6.3):</u> Conduct bond tests to qualify a primer, paint or encapsulate when the SFRM is applied to a primed, painted or encapsulated surface for which acceptable bond-strength performance between these coatings and fire-resistant material has not been determined. Verify that a bonding agent approved by the SFRM manufacturer is applied to a primed, painted or encapsulated surface where the bond strengths are found to be less than required values. </p>	
<p>L.</p>	<p>Mastic & Intumescent Fire-Resistant Coatings (1705.15):</p>	<p>Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below</p>
<p>Check Box Below if Required</p>	<p>Required Verification and Inspections:</p> <p>Special Inspections for mastic and intumescent fire-resistant coatings applied to structural elements and decks shall be in accordance with AWCI 12-B and shall be based on the fire-resistance design as designated in the approved construction documents.</p>	

<p>M.</p>	<p>Exterior Insulation and Finish Systems (EIFS) (1705.16):</p>	<p>Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below</p>
<p>Check Box Below if Required</p>	<p>Required Verification and Inspections:</p>	
<p><input type="checkbox"/></p>	<p>Special Inspections are required for all EIFS applications unless one of the following exceptions applies. Exception #1: EIFS applications installed over a water-resistive barrier with a means of draining moisture to the exterior (unless the Special Inspection is required by the ICC Report of Approval for the selected EIFS). Exception #2: EIFS applications installed over masonry or concrete walls. Note: The Registered Design Professional shall indicate on the space to the right and on the plans the ICC Report of Approval number for the selected EIFS.</p>	
<p>O.</p>	<p>Special Inspections for Smoke Control (1705.18): Smoke control systems shall be tested by a Special Inspector.</p>	<p>Please provide the name and phone number of the special inspection agency and individual performing this special inspection service in the space below</p>
<p>Check Box Below if Required</p>	<p>Required Verification and Inspections:</p>	
<p><input type="checkbox"/></p>	<p>Testing Scope (1705.18.1): The test scope shall be as follows: 1. During erection of ductwork and prior to concealment for the purpose of leakage testing and recording of device location. 2. Prior to occupancy and after sufficient completion for the purposes of pressure difference testing, flow measurements and detection and control verification.</p>	

Qualification Standards for Special Inspections

Special Inspectors, Laboratory Technicians, Special Inspection Agencies, Testing Labs and Fabricator Shops

General Notes:

Note #1: Basis for formulating City of Roanoke's Building Safety Department Special Inspection Program (SIP):

These requirements were based on the "Model Program for Special Inspection (Based on the 2015 IBC Chapter 17)" published by the International Code Council (ICC) and the International Accreditation Services (IAS) and reflect the following:

1. Applicable provisions of Chapter 17 of VUSBC-2015;
2. Applicable portions of the following IAS Accreditation Criteria:
 - 2.1. AC89 - Accreditation Criteria for Testing Laboratories;
 - 2.2. AC98 - Accreditation Criteria for Inspection Agencies;
 - 2.3. AC157 - Accreditation Criteria for Fabrication Inspection Programs for Reinforced Concrete;
 - 2.4. AC172 - Accreditation Criteria for Fabrication Inspection Programs for Structural Steel;
 - 2.5. AC196 - Accreditation Criteria for Fabrication Inspection Programs for Wood Wall Panels;
 - 2.6. AC204 - Accreditation Criteria for Calibration Laboratories;
 - 2.7. AC291 - Accreditation Criteria for Special Inspection Agencies;
 - 2.8. AC370 - Accreditation Criteria for Product Certification Agencies;
 - 2.9. AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems; and/or
3. Applicable portions of the following Standards by International Organization for Standardization/International Electrotechnical Commission (ISO/IEC):
 - 3.1. ISO/IEC 17011: 2004(E), Conformity Assessment - General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies;
 - 3.2. ISO/IEC 17020: 1998(E), General Criteria for the Operation of Various Types of Bodies Performing Inspection;
 - 3.3. ISO/IEC 17024: 2003, Conformity Assessment - General Requirements for Bodies Performing Inspection;
 - 3.4. ISO/IEC 17025: 2005(E), General Requirements for the Competence of Testing and Calibration Laboratories;
 - 3.5. ISO/IEC 17025: 2005/Cor.1:2006(E), General Requirements for the Competence of Testing and Calibration Laboratories;
 - 3.6. ISO/IEC Guide 6.5: General Requirements for Bodies Operating Product Certification Systems.

Note #2: Guideline to Determine Compliance and Competence of Designated Special Inspector and Special Inspections Agency:

This information will be used as a guideline by the Building Safety Department to verify compliance with applicable provisions of Sections 1703 and 1704 of VUSBC-2015 in determining the competence of each designated Special Inspector, Laboratory Technician, Special Inspection Agency, Testing Laboratories and/or Fabricator Shop listed in the Statement of Special Inspections.

Note #3: Minimum Qualifications for Special Inspectors:

The minimum qualifications for Special Inspectors listed below are from the International Accreditation Service's "Accreditation Criteria for the IBC Special Inspection Agencies" AC 291.

Note #4: Required Information/Documentation and How it Will be Used:

This information shall be used by the Registered Design Professional in Responsible Charge of the project and/or the Responsible Professional Engineer representing the Special Inspection Agency and/or Testing Laboratory to measure the qualifications of each designated Special Inspector, Laboratory Technician, Special Inspection Agency, Testing Laboratory and Fabricator Shop that are listed in the Statement of Special Inspections. The Building Safety Department will consider equivalent criteria for the qualifications of any designated party, if submitted by the Registered Design Professional and/or Responsible Professional Engineer. The Registered Design Professional and/or Responsible Professional Engineer shall provide the Building Safety Department with sufficient documentation to substantiate the equivalency request.

General Notes (Cont):

Note #5: Special Inspection Agency Qualification Standards:

Each designated Special Inspection Agency shall be:

1. An agency that maintains IAS current accreditation with the scope of accreditation covering the disciplines for which the agency is designated; OR
2. An agency that meets the requirements of Section 1700 of VUSBC-2015. The Registered Design Professional and/or Responsible Professional Engineer of the agency shall provide all documentation as necessary for the Building Safety Department to determine if the Agency meets the applicable code requirements; OR
3. An agency that has been accredited by an approved Inspection Agency in accordance with ISO/IEC 17020.

Note #6: Special Inspector Qualification Standards:

Each designated Special Inspector and Laboratory Technician shall meet the "Minimum Qualifications for Special Inspectors" and related criteria as listed below.

Note #7: Special Inspector in Training (SIIT):

1. The intent of this provision is to provide practical opportunities for a Special Inspector in Training (SIIT) to gain the needed experience to qualify as a Special Inspector.
2. An Inspector who does not meet the qualifications for a Special Inspector may be allowed to perform a "Special Inspection" at the discretion of the Special Inspection Agency's Registered Design Professional, provided one or more of the following conditions are met:
 - 2.1. The individual is working under the direct and continuous supervision of a Special Inspector fully qualified for the type of work involved.
 - 2.2. The individual is working under the indirect or periodic supervision of a Special Inspector, and the scope of work is minor and/or routine and within the capabilities of the individual.

Note #8: Testing Labs Qualification Standards:

Each designated Testing Lab shall be accredited by one the following major acceptable accreditation authorities:

1. IAS Accreditation with the scope of accreditation covering the discipline's for which the Testing Lab is designated.
2. AASHTO Accreditation Program per either AASHTO R18 or ISO/IES 17250.
3. American Association of Laboratory Accreditation.
4. National Voluntary Laboratory Accreditation Program.
5. Other Accreditation Authority Program. The Testing Lab shall be accredited by a third party and shall meet the requirements of Section 1703 of VUSBC-12.

Note #9: Laboratory Technician Qualification Standards:

Each Laboratory Technician shall have certification in the appropriate category and one year minimum experience.

Note #10: Experience:

1. For experience to count toward qualifications, it shall be based on verifiable work directly related to the category or type of inspection involved.
2. An engineering degree (BS) plus appropriate in-house training may be substituted for not more than one year of experience. An engineering technology degree plus appropriate in-house training may be substituted for not more than six months experience. (Degree experience may not be substituted for more than half of the experience requirements in any category.)
3. Five or more years experience as a qualified Special Inspector in one or more categories of work may fulfill up to half the experience requirements in any category, at the discretion of the Special Inspection Agency's designated Responsible Professional Engineer.

Note #11: Certification:

Certification, when specified, is intended to mean the successful completion of:

1. AN ICC examination appropriate to the category of work involved; and/or
2. Having other specific certification obtained from a Nationally recognized certifying organization that is appropriate to the category of work involved and is acceptable to the Building Department.

Note: The Building Safety Department will consider equivalent certifications from Nationally recognized organization obtained by written examination when sufficient documentation to substantiate the equivalency is provided by the Special Inspection Agency's designated Responsible Professional Engineer.

Minimum Qualifications for Special Inspectors

Based on IAS AC291 Accreditation Criteria for Special Inspection Agencies

A. - Inspections of Fabricators (1704.2.5):

A.1. - Fabrication and Implementation (1704.2.5) for Fabricators not Registered and not Approved:

1. The designated Special Inspector and/or Special Inspection Agency shall perform in-plant periodic visits and reviews of all listed fabricator shops that are not registered and not approved per Section 1704.2.5 (see Category A.2. below). The duties include:
 - 1.1. Verify that the fabricator maintains detailed fabrication and quality control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards, and
 - 1.2. Review the procedures for completeness and adequacy relative to the code requirements for the fabricator's scope of work.
2. The designated Special Inspector and/or Special Inspection Agency inspecting a fabricator shop for compliance with Section 1704.2.1 shall be pre-approved by the Building Department for the specified category of construction prior to Building Permit issuance. See the specific category below for minimum qualification criteria:
 - 2.1. For Structural Steel Construction: See Category B below.
 - 2.2. For Precast/Prestressed Concrete: See Category C below.
 - 2.3. For Wood Construction: See Category E below.

A.2. - Fabricator Approval (1704.2.5.1) for Fabricators Registered and Approved:

1. Special Inspections required by Section 1704 are not required where the work is done on the premises of a Fabricator registered and approved to perform such work without Special Inspection. Approval shall be based upon review of the fabricator's written procedural and quality control manuals and periodic auditing of fabrication practices by an approved Special Inspection Agency (a third-party that is recognized by the Building Safety Department).
 2. Special Inspections are not required for work done on the premises of a registered and approved Fabricator that has a current accreditation from the International Accreditation Service (IAS), a current certification from a Nationally recognized organization (see item #4 below), or an equivalent certification (see Note below).
 3. An IAS-accredited fabricator that is listed on that IAS web site (www.iasonline.org). The IAS Accreditation is based on the IAS Fabrication Accreditation Standards (IAS Fabricator Accreditation Program currently offers accreditation services for reinforced concrete, precast concrete, structural steel and wood panel assemblies)
 4. A Nationally recognized organization/body that includes a third-party oversight of the fabricators facility (including processes and final products) as defined by the VUSBC. This option is subject to the review and acceptance by the Building Safety Department. The following National Fabricator Certifying Organizations are recognized and acceptable by City of Roanoke's Building Safety Department:
 - 4.1. American Institute of Steel Construction (AISC) for Fabricators of Structural Steel.
 - 4.2. American Steel Joist Institute (SJI) for Fabricators of Steel Joists.
 - 4.3. Precast/Prestressed Concrete Institute for Fabricators of Precast and Prestressed Concrete.
 - 4.4. Truss Plate Institute (TPI) for Fabricators of Wood Trusses.
- Note:** Equivalencies are subject to review and acceptance by the Building Department and shall be performed by an approved Special Inspection Agency in accordance with applicable provisions of Sections 1704.2.5 and 1703 of VUSBC-2015.

B. - Steel Construction:

B.1. - High Strength Bolting:

1. Current ICC certification as a Structural Steel and Bolting Special Inspector and a minimum one year of experience; OR
 2. Virginia Professional Engineer and a minimum one year of direct experience in structural steel and bolting construction (Inspector shall be qualified under Item #1).
 3. American Welding Society (AWS) Certified Welding Inspector (CWI) and has a minimum of one year of experience (Inspector shall be qualified under Item #B.1.1).
- Note:** ICC certifications for Structural Steel and Welding Special Inspectors are valid for the Bolting Special Inspector until the date of expiration.

B. - Steel Construction (con't):

B.2. - Welding:

1. American Welding Society (SAWS) Certified Welding Inspector (CWI); OR
2. Current ICC Certification as a Structural Steel and Welding Special Inspector and has a minimum one year of experience; OR
3. American Welding Society (AWS) Certified Associate Welding Inspector (CAWI) working under the direct on-site supervision of a Certified Welding Inspector (CWI) and a minimum one year of experience (Inspector shall be qualified under either Item #B.2.1 or Item #B.2.2).

B.3. - Nondestructive Testing (NDT):

1. Personnel qualified in accordance with nationally-recognized NDT personnel qualification practice or standard, such as ANSI/ANST-CP-189 or SNT-TC-1A; OR
2. American Society of Nondestructive Testing (ASNT) Level II and a minimum of 120 hours of direct testing experience or training as determined and approved by an ASNT Level III.

C. - Concrete Construction:

C.1. - Reinforced Concrete:

1. Current ICC Certification in Reinforced Concrete Special Inspection and one year of experience; OR
2. *Virginia* Professional Engineer and minimum one year of direct experience in reinforced concrete construction (Inspector shall be qualified under Item #C.1.1); OR
3. Bachelor's degree in Civil or Structural Engineering from an accredited institution and a minimum two years of experience (Inspector shall be qualified under Item #C.1.1); OR
4. ACI Concrete Construction Special Inspector or ACI Concrete Field Testing Technician Grade 1 and a minimum one year of experience (Inspector shall be qualified under Item #C.1.1).

C.2. - Pre-stressed/Pre-cast/Cast-in-Place/Poured-in-Place Concrete:

1. Current ICC Certification in Prestressed Concrete Inspection and one year of experience; OR
2. *Virginia* Professional Engineer and minimum one year of direct experience in prestressed concrete construction (Inspector shall be qualified under Item #C.2.1 above); OR
3. Bachelor's degree in Civil or Structural Engineering from an accredited institution and a minimum one year of experience (Inspector shall be qualified under Item #C.2.1 above); OR
4. ACI Concrete Construction Special Inspector or ACI Concrete Field Testing Technician Grade 1 and a minimum two years of experience (Inspector shall be qualified under Item #C.2.1 above).

C.3. - Post-installed Structural Anchor in Concrete:

1. Current ICC Certification in Reinforced Concrete Special Inspection; OR
2. Current ICC Certification as a Residential or Commercial Building Inspector, as applicable, and a minimum two years of experience related to the activity being inspected; OR
3. *Virginia* Professional Engineer and minimum one year of experience related to the activity being inspected (Inspector shall be qualified under Item #C.3.1 above); OR
4. Bachelor's degree in Civil or Structural Engineering from an accredited institution and a minimum two years of experience related to the activity being inspected (Inspector shall be qualified under Item #C.3.1 above).

D. - Masonry Construction:

1. Current ICC Certification in masonry and a minimum one year experience; OR
2. *Virginia* Professional Engineer and minimum one year of relevant experience (Inspector shall be qualified under Item #D.1 above); OR
3. Bachelor's degree in Civil or Structural Engineering from an accredited institution and a minimum two years of experience (Inspector shall be qualified under Item #D.1 above).

E. - Masonry Construction:

1. Virginia Professional Engineer and minimum one year of relevant experience related to the activity being inspected; OR
2. Bachelor's degree in Civil or Structural Engineering from an accredited institution and a minimum two years of experience related to the activity being inspected; OR
3. Current ICC Certification as a Commercial or Residential Building Inspector, as applicable, AND
 - 3.1. A minimum two years of related experience in engineered wood products.

F. - Soils:

1. NICET Level II Geotechnical Engineering Technology Certification, or ICC Soils Special Inspector Certification, and a Minimum two years of experience; OR
2. Technician with a minimum three years of documented experience directly related to soils testing and inspection under a licensed Virginia Professional Engineer (Inspector shall be qualified under Item #F.1 above); OR
3. Bachelor's degree in Civil or Structural Engineering/Geotech/Geologist from an accredited institution and a minimum of one year of experience (Inspector shall be qualified under Item #F.1 above); OR
4. Virginia Professional Engineer and a minimum one year of experience (Inspector shall be qualified under Item #F.1 above); OR
5. Professional Engineer in Geotechnical Engineering.

G. - Driven Deep Foundations:

1. Current ICC Certification in Concrete Special Inspection in addition to having one of the following (Virginia Professional Engineer, NICET III or IV, NICET CT Certified Engineering Technologist or Bachelors Degree in Civil or Structural Engineering); OR
2. Virginia Professional Engineer and minimum one year of relevant experience. In addition, Inspector shall obtain ICC Certification in Concrete Special Inspection; OR
3. NICET III or IV (geotechnical/construction or construction material testing/soils) and a minimum of five years experience. In addition, Inspector shall obtain ICC Certification in Concrete Special Inspection; OR
4. NICET CT Certified Engineering Technologist and a minimum of five years of experience. In addition, Inspector shall obtain ICC Certification in Concrete Special Inspection; OR
3. Bachelor's degree in Civil or Structural Engineering from an accredited institution and a minimum three years of experience. In addition, Inspector shall obtain ICC Certification in Concrete Special Inspection).

H. - Cast-in-Place Deep Foundations:

Same as **Category G** (see above).

I. - Helical Pile Foundations:

Same as **Category G** (see above).

J. - Vertical Masonry Foundation Elements:

Same as **Category D** (see above).

K. - Spray-Applied Fire-Resistant Materials (SFRM):

1. Current ICC Certification as a Spray-applied Fireproofing Special Inspector and a minimum one year experience; OR
2. Virginia Professional Engineer and minimum one year of experience in fireproofing applications (Inspector shall be qualified under Item #K.1 above); OR
3. Bachelor's degree in Civil or Structural Engineering from an accredited institution and a minimum two years of experience in fireproofing applications (Inspector shall be qualified under Item #K.1 above); OR
4. American Concrete Institute Concrete Field Testing Technician Grade 1 or American Welding Society Certified Welding Inspector and a minimum of one year experience in fireproofing applications (Inspector shall be qualified under Item #K.1 above).

L. - Mastic and Intumescent Fire-Resistant Coatings:

Same as **Category K** (see above).

M. - Exterior Insulation and Finish Systems (EIFS):

1. Current ICC Certification as a Reinforced Concrete Special Inspector; OR
2. Current ICC Certification as a Commercial or Residential Building Inspector, and a minimum two years of experience related to the activity being inspected; OR
3. Virginia Professional Engineer and minimum one year of experience related to the activity being inspected (Inspector shall be qualified under Item #M.1 above); OR
4. Bachelor's degree in Civil or Structural Engineering from an accredited institution and a minimum two years of experience related to the activity being inspected (Inspector shall be qualified under Item #M.1 above); OR
5. NICET CT Certified Engineering Technologist and a minimum five years of experience related to the activity being inspected (Inspector shall be qualified under Item #M.1 above); OR
6. Virginia Licensed Architect and a minimum one year of experience related to the activity being inspected (Inspector shall be qualified under Item #M.1 above).

N. - Special Cases As Determined by the Building Safety Department:

1. Current ICC Certification as a Special Inspector and a minimum two years of experience related to the activity being inspected; OR
 2. Virginia Professional Engineer and minimum one year of experience related to the activity being inspected (Inspector shall be qualified under Item #N.1 above); OR
 3. Bachelor's degree in Civil or Structural Engineering from an accredited institution and a minimum two years of experience related to the activity being inspected (Inspector shall be qualified under Item #N.1 above).
- Exception:** Individuals who have proven expertise in a field of specialty, either through education or field experiences of not less than five years, may be considered as meeting criteria to conduct one or more classes of Specialty Inspections.

O. - Special Inspections for Smoke Control:

1. Special Inspection Agencies for smoke control shall have expertise in fire protection engineering, mechanical engineering and certification as air balancers (Documentation of qualifications shall be submitted to the Building Safety Department for review and approval); OR
2. Virginia Professional Engineer, Air Balancer Certification, and on year of relevant experience; OR
3. Bachelor's degree in Engineering, Air Balancer Certification and three years of relevant experience; OR
4. NEDD Certification, National Air Balancer Certification and three years of relevant experience, including installation and operation skills for smoke control systems.



Special Inspection and Testing Agreement

Permit #

Date

05-26-2022

Tax Map #

1010905

The current code in effect is the
2015 Virginia Uniform Statewide Building Code

Project Information:

Project Name Administration Building on Campbell Ave.

Property Address 201 Campbell Ave SW, Roanoke VA 24011

Before a Permit Can be Issued:

The Owner and the Registered Design Professional in Responsible Charge, acting as the Owner's Agent, shall complete this agreement and the City of Roanoke Statement of Special Inspections.

Approval of Special Inspection Agencies, Special Inspectors and/or Testing Labs:

Special Inspection Agencies, Special Inspectors and Testing Labs shall disclose any possible conflicts of interest. The Registered Design Professional in Responsible Charge shall pre-qualify the designated Special Inspection Agencies, Special Inspectors, Testing Labs and Fabricator Shops, and submit their qualifications as part of the Statement of Special Inspections. The City of Roanoke Building Safety Department shall approve the designated Special Inspection Agencies, Special Inspectors, Testing Labs and Fabricator Shops, Prior to any work being performed.

Special Inspections and Testing shall meet the minimum applicable requirements of Section 1703 through 1711 of the **VUSBC-2015** and the following conditions:

A. Owner Responsibilities:

1. Agree and sign the Special Inspection and Testing Agreement.
2. Employ and Fund the Special Inspections and Testing Services:

The project Owner, the Engineer/Architect or record, an Agent of the Owner is responsible for employing and funding the special inspection and testing services. The Special Inspection Agencies and Special Inspectors shall not be in the employ of the Contractor, a subcontractor or material supplier. In the case of an Owner who is also acting as the Contractor, Special Inspection Agencies and the Special Inspectors shall be employed as specified by the Building Official.

B. Registered Design Professional in Responsible Charge Responsibilities:

1. Agree and sign the Special Inspection and Testing Agreement:

The Engineer/Architect of record shall complete the Special Inspection and Testing Agreement and submit with the Building Permit Application.

2. Complete the City's Statement of Special Inspections:

The Engineer/Architect of record shall complete the Statement of Special Inspections and submit it with the Building Permit Application. The Completion of the Statement of Special Inspections includes the following:

- i. Check the construction items on the Statement of Special Inspections that require Special Inspections. This shall include identification of materials, systems, components and work required to have Special Inspection and Testing.
- ii. Identify the type and extent of each Special Inspection and the names of individuals and firms performing special inspections and/or testing.
- iii. Identify the type and extent of each test.
- iv. Coordinate with the project Owner on the selection of the Special Inspection Agencies, Special Inspectors, Testing Labs and Fabricator Shops.
- v. Pre-qualify Special Inspection Agencies, Special Inspectors, Testing Labs and Fabricator Shops for each applicable construction operation based on the City's "Qualification Standards for Special Inspections" that are listed in the City's Statement of Special Inspections.
- vi. Provide (list on the City's Statement of Special Inspections) the name and contact information of each designated Special Inspection Agency, Special Inspector, Testing Lab and Fabricator Shop. This includes providing the Building Safety Department with all documents required by the City's Statement of Special Inspections for each party involved in the Special Inspection Program.

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- vii. Coordinate with Building Permit Applicant, to insure that the completed Special Inspection and Testing Agreement and the completed Statement of Special Inspections are submitted to the Building Safety Department for review and acceptance at the time of Building Permit Application.

3. Respond to field discrepancies:

The Engineer/Architect of Record shall respond to Special Inspector reports of uncorrected, nonconforming items and shall provide remedial measures.

4. Review shop drawings and submit design changes:

The Engineer/Architect of Record shall acknowledge and accept shop drawings that detail structural information. Written approval of any verbally approved deviations from the approved plans shall be submitted to the Building Safety Department and to the Special Inspector/Special Inspection Agency. Revised plans shall be submitted for Building Safety Department review and approval.

C. Contractor Responsibilities:

1. Agree and sign the Special Inspection and Testing Agreement.

2. Notify the Special Inspection Agency/Special Inspector/Testing Lab:

The Contractor or the holder of the Building Permit (Applicant or duly authorized agent) is responsible for notifying the Special Inspector or Special Inspection and Testing Agency regarding individual Special Inspections and Testing items listed on the City's Statement of Special Inspections.

3. Provide access to approved plans:

The contractor is responsible for providing the Special Inspector with access to the approved plans and approved shop drawings.

4. Retain Special Inspection records at the job site:

The Contractor is responsible for retaining, at the job site, copies of all special inspection records completed by Special Inspectors and making them available to the City's Building Inspector upon request.

5. Obtain Building Safety Department approval prior to concealment:

The Contractor shall request Building Safety Department inspections and obtain approval prior to concealing any work requiring special inspections.

D. Special Inspection Agency, Special Inspector and Testing Lab Duties and Responsibilities:

1. Agree and sign the Special Inspection and Testing Agreement.

2. General requirements:

Special Inspectors shall review approved plans, specifications, and the referenced standards and approved shop drawings for Special Inspection requirements. Special Inspectors shall comply with the Special Inspection requirements of the VUSBC-2012 and the Statement of Special Inspections regarding work and materials.

3. Signify presence at job site:

The Special Inspector shall notify Contractor's personnel of their presence and responsibilities at the job site. A Special Inspection Log (copy attached) of each Special Inspector's presence on the job site shall be provided near the building inspection reports. This record shall include the following:

- i. Inspection type
- ii. Name of special inspection
- iii. Certification number
- iv. Date
- v. Any pertinent notes
- vi. Time of arrival and departure

4. Observe assigned work and comply with Statement of Special Inspections:

- i. Inspect categories listed on the approved Statement of Special Inspections that they are responsible for. Inspections shall indicate conformance with approved plans, specifications, referenced standards and applicable workmanship provisions of the **VUSBC-2015**.
- ii. Use the Architect/Engineer reviewed and accepted structural shop drawings as an aid in conducting the related special inspections.
- iii. Be on site at all times to observe construction operations that require continuous Special Inspections and Testing. Be on site to observe construction operations that require periodic inspections as required per Sections 1703, 1704 and 1705 of **VUSBC-2015**.

5. Report nonconforming items:

The Special Inspectors shall bring all nonconforming items to the immediate attention of the Contractor and note all such items in the Special Inspector's daily report. If any item is not resolved in a timely manner or is about to be covered by construction, the Special Inspector shall immediately notify the Building Safety Department, the Engineer/Architect of record and post a discrepancy notice at the job site. The Special Inspector shall write a separate report to be posted at the jobsite regarding noted discrepancies. This report shall contain, as a minimum, the following about each nonconforming item:

- i. Description and exact location.
- ii. Reference to applicable details of approved plans/specifications.
- iii. Name and title of each individual notified and method of notification.
- iv. Corrective action taken to resolve noted discrepancy at the job site.

6. Provide Progress Reports:

The special Inspectors shall complete written inspection reports for each visit and leave a copy onsite for the Contractor and the Building Inspector to review. The Special Inspector/Special Inspection Agency shall provide copies of these reports weekly, or at the completion of a Special Inspection if Special Inspections take place more than a week apart, to the Building Safety Department's Building Inspector, Engineer/Architect of record and any others designated. These reports shall include:

- i. Date
- ii. Time of arrival and departure
- iii. Building permit number
- iv. Project name and address
- v. Type of inspection
- vi. Inspection frequency required - Continuous or Periodic
- vii. Inspections made including locations
- viii. Tests performed
- ix. Any nonconformance items (discrepancies) and how they were resolved
- x. Listing of unresolved items, parties notified, time and method of notification
- xi. Itemization of changes authorized by the Engineer/Architect of record
- xii. Inspector's signature
- xiii. Full name of inspector printed clearly
- xiv. Certification number

7. Submit final report:

The Special Inspection Agency shall submit a final report that is sealed, signed and dated by its responsible Engineer/Architect, to the City of Roanoke Building Safety Department's Building Inspector, stating that all items requiring Special Inspections and Testing were fulfilled and reported. This report shall also state that all items required Special Inspections and tested items were inspected and found to be in conformance with the approved plans, shop drawings, specifications, referenced standards, Statement of Special Inspections and applicable provisions of the **VUSBC-2015**. Items not in conformance, unresolved items, or any discrepancies in Special Inspection coverage (i.e., missed inspections, periodic inspections when continuous inspections were required, etc.) shall be specifically mentioned in this report.

E. Building Safety Department Responsibilities:

Specific duties and responsibilities of the Building Safety Department relating to Special Inspections include the following:

1. Review and approve of submittal documents for compliance with the Special Inspection Program Requirements:

The Building Safety Department is responsible for reviewing all submitted plans, specifications, forms related to the Special Inspection Program, and any other submitted documents for compliance with the Virginia Building Code. All items submitted must be reviewed and approved prior to issuance of the Building Permit. This includes the following:

- i. Check the qualification of each Special Inspector, Special Inspection Agency, Testing Lab and Fabricator Shop that is listed on the Statement of Special Inspections in accordance with the City's "Qualification Standards for Special Inspections".
- ii. Check that all parties involved in the Special Inspection Program have completed their portion of the Special Inspection and Testing Agreement.
- iii. Issue the Building Permit with the approved Statement of Special Inspections, Special Inspection and Testing Agreement and permit conditions attached to the approved plans that will be kept on the job site.
- iv. Determine if a pre-construction meeting is required to review the Special Inspection Program with all appropriate members of the construction team.

2. Monitor special inspections and testing activities:

The Building Inspectors will monitor work requiring Special Inspection and Testing activities at the job site to assure that the designated qualified Special Inspectors are performing their duties when work requiring Special Inspections is in progress.

3. Review special inspection reports:

The Building Inspector will check the special inspection reports left at the job site by the Special Inspector for any discrepancies or non-conforming items. Weekly special inspection reports received will be reviewed by the Building Inspector. The Building Inspector must review all special inspection reports and perform field inspections to verify conformance to the approved plans, shop drawings and specifications prior to concealing any work related to special inspections.

4. Perform final inspection:

The Building Safety Department will not perform a final inspection or approve the project until the final Special Inspection report has been received from a Special Inspection Agency and reviewed and approved by the Building Inspector.

ACKNOWLEDGEMENTS

I have read and agree to comply with my responsibilities as they are outlined in the Special Inspection and Testing Agreement

Owner:

Print Name: Jeffrey Shawver, Director of Physical Plant, Roanoke City Public Schools

Date: 2022-05-26

Signature: Jeffrey S. Shawver

Digitally signed by Jeffrey S. Shawver
Date: 2022.05.26 17:36:38 -04'00'

Registered Design Professional in Responsible Charge (Project Engineer/Architect of Record):

Print Name/Company: Allan Long, PE / Prosim Engineering, LLC

Date: May 26, 2022

Signature:

Allan Long

Digitally signed by Allan Long
DN: C=US, E=along@prosimeng.com, O="Prosim Engineering, LLC", OU="Prosim Engineering, LLC", CN=Allan Long
Date: 2022.05.26 10:11:38-04'00'

Contractor:

Print Name/Company: TBD

Date:

Signature:

Special Inspections and Testing Agencies and/or Testing Laboratories:

Print Name/Company: TBD

Date:

*Signature:

Print Name/Company:

Date:

*Signature:

*This signature must be that of the responsible professional Engineer within the Special Inspection Agency.

Independent Special Inspectors:

Print Name:

Date:

Signature:

Print Name:

Date:

Signature:

**Accepted by the City of Roanoke's
Building Safety Department**

Print Name:

Date:

Signature:

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- C. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery,

handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

- D. Dust- and HVAC-Control Plan: Submit narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.
- B. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches.

2.2 TEMPORARY FACILITIES

- A. Field Offices: Owner will provide interior space for field offices for duration of Project.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.2 TEMPORARY UTILITY INSTALLATION

- A. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- B. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.
- C. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- D. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- E. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
 1. Utilize designated area within existing building for temporary field offices.

- B. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- C. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- E. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- F. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
 - 1. Do not load elevators beyond their rated weight capacity.
 - 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work, so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- G. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

- E. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side.
 - 2. Provide walk-off mats at each entrance through temporary partition.

- F. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of Owner's permanent facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

- B. Maintenance: Maintain facilities in good operating condition throughout project.
 - 1. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
 - 2. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 3. Section 01770 "Closeout Procedures" for submitting warranties.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products. Architect will consider alternate manufacturer's if submittal data demonstrates they are equal to or better than Basis of Design product.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

C. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Resolution of Compatibility Disputes between Multiple Contractors:

- a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
- b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

- a. Name of product and manufacturer.
- b. Model and serial number.
- c. Capacity.
- d. Speed.
- e. Ratings.

1.5 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
 - 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
 - 2. Store products to allow for inspection and measurement of quantity or counting of units.
 - 3. Store materials in a manner that will not endanger Project structure.
 - 4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
 - 5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 7. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. **Manufacturer's Warranty:** Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - 2. **Special Warranty:** Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 - 6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.
- B. Product Selection Procedures:
 - 1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
 - 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with

requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

- a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
 5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 3. Evidence that proposed product provides specified warranty.
 4. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Installation of the Work.
 - 3. Cutting and patching.
 - 4. Coordination of Owner's portion of the Work.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for coordination of Owner-furnished products, Owner-performed work, Owner's separate contracts, and limits on use of Project site.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 PREINSTALLATION MEETINGS RELATED TO NEW WAREHOUSE LIFT

- A. Layout Conference: Conduct conference at Project site.
 - 1. Prior to establishing layout of new Warehouse Lift review location requirements. Inform Architect and Owner of scheduled meeting. Require representatives of each entity directly concerned with location and installation of warehouse lift to attend:
 - 2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
 - 3. Review manufacturer's shop drawings to ensure compatibility with information on drawings. Notify owner and architect if any discrepancies are found.
 - 4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- B. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to commencing work related to the new warehouse lift, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect and Owner of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend.
2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

- B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

3.4 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb, and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.5 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in schedule with the owner.
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.
1. Provide temporary facilities required for Owner-furnished, Contractor-installed and Owner-furnished, Vendor-installed products.
 2. Refer to Section 011000 "Summary" for other requirements for Owner-furnished, Contractor-installed and Owner-furnished, Vendor-installed products.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.
1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel and Owner's separate contractors at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Recycling nonhazardous demolition and construction waste.
 - 2. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:
 - a. Asphalt paving.
 - b. Concrete.
 - c. Concrete reinforcing steel.
 - d. Brick.
 - e. Concrete masonry units.
 - f. Wood studs.
 - g. Wood joists.
 - h. Plywood and oriented strand board.
 - i. Wood paneling.
 - j. Wood trim.
 - k. Structural and miscellaneous steel.
 - l. Rough hardware.
 - m. Roofing.
 - n. Insulation.
 - o. Doors and frames.
 - p. Door hardware.
 - q. Windows.
 - r. Glazing.
 - s. Metal studs.
 - t. Gypsum board.
 - u. Acoustical tile and panels.
 - v. Carpet.
 - w. Carpet pad.
 - x. Demountable partitions.
 - y. Equipment.
 - z. Cabinets.
 - aa. Plumbing fixtures.
 - bb. Piping.
 - cc. Supports and hangers.
 - dd. Valves.
 - ee. Sprinklers.
 - ff. Mechanical equipment.
 - gg. Refrigerants.
 - hh. Electrical conduit.
 - ii. Copper wiring.
 - jj. Lighting fixtures.
 - kk. Lamps.
 - ll. Ballasts.
 - mm. Electrical devices.
 - nn. Switchgear and panelboards.

- oo. Transformers.
- 2. Construction Waste:
 - a. Masonry and CMU.
 - b. Lumber.
 - c. Wood sheet materials.
 - d. Wood trim.
 - e. Metals.
 - f. Roofing.
 - g. Insulation.
 - h. Carpet and pad.
 - i. Gypsum board.
 - j. Piping.
 - k. Electrical conduit.
 - l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Wood pallets.
 - 8) Plastic pails.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 - 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

3.3 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
 - 2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.3 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.

- B. Certificate of Insurance: For continuing coverage.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.

- a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Complete startup and testing of systems and equipment.
3. Perform preventive maintenance on equipment used prior to Substantial Completion.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."

5. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 6. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 7. Complete final cleaning requirements.
 8. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
2. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
3. Submit list of incomplete items in the following format:
 - a. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list) or format as acceptable to Architect.

1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 1. Submit on digital media acceptable to Architect.
- D. Warranties in Paper Form:
 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive **8-1/2-by-11-inch (215-by-280-mm)** paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - d. Remove snow and ice to provide safe access to building.
 - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - f. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - g. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - h. Vacuum and mop concrete.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.

- l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - o. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - p. Clean strainers.
 - q. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:

1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
 1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Architect.
 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 - 1. Fire.
 - 2. Flood.
 - 3. Gas leak.
 - 4. Water leak.
 - 5. Power failure.
 - 6. Water outage.
 - 7. System, subsystem, or equipment failure.
 - 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.

- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- 1.10 PRODUCT MAINTENANCE MANUALS
- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:

- a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

1.5 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

3.1 DRAFTING OF RECORD DRAWINGS

- A. Using mark-ups provided by Contractor, Architect will draft changes to the drawings and have record drawings in PDF format to Owner.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.3 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.4 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.

- d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
 6. Troubleshooting: Include the following:

- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.5 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.6 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's tenants' on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

1.6 FIELD CONDITIONS

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

1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.8 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.

- c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of

hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

5. Maintain fire watch during and for at least 8 hours after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Work in Historic Areas: Selective demolition may be performed only in areas of Project
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site
1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Concealed blocking.
 2. Plywood panels.

1.2 DEFINITIONS

- A. Lumber grading agencies, and abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. SPIB: The Southern Pine Inspection Bureau.
 4. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 2. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.
 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 - 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content:
 - 1. Miscellaneous Lumber: 19 percent unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED LUMBER

- A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Treatment is not to promote corrosion of metal fasteners.
 - 2. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Concealed blocking.
 - 2. Wood nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
 - 3. Plywood panels.

2.3 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Furring.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:
 - 1. Hem-fir (north); NLGA.
 - 2. Mixed southern pine or southern pine; SPIB.
 - 3. Spruce-pine-fir; NLGA.
 - 4. Hem-fir; WCLIB or WWPA.
 - 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - 6. Northern species; NLGA.
 - 7. Eastern softwoods; NeLMA.
- C. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD PANELS

- A. Plywood Panels: DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.5 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.
- B. Nails, Brads, and Staples: ASTM F1667.

- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood panels by fastening to studs. Install fire-retardant-treated plywood panels with classification marking of testing agency exposed to view.
- D. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
- E. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- F. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 - 2. ICC-ES evaluation report for fastener.
- H. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

END OF SECTION 061000

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SECTION 072600 - VAPOR RETARDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Polyethylene vapor retarders.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D4397, 10-mil-thick sheet, with maximum permeance rating of 0.1 perm.

2.2 ACCESSORIES

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Place vapor retarders on side of construction indicated on Drawings.

- B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer.
- C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 PROTECTION

- A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 072600

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Listed System Designs: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.
 - 1) UL in its online directory "Product iQ."
 - 2) Intertek Group in its "Directory of Building Products."
 - 3) FM Approvals in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems are to be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. Everkem Diversified Products, Inc.
 - d. Grabber Construction Products, Inc.
 - e. Hilti, Inc.
 - f. Holdrite; a division of Reliance Worldwide Corporation.
 - g. International Fireproof Technology Inc.
 - h. NUCO Inc.
 - i. Passive Fire Protection Partners.
 - j. RectorSeal Firestop; a CSW Industrials Company.
 - k. Roxtec Inc.
 - l. Specified Technologies, Inc.

- m. Tremco Incorporated.
 - n. Unique Fire Stop Products.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479.
- 1. F-Rating: Not less than the fire-resistance rating of the wall penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479.
- 1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of the floor. The following floor penetrations do not require a T-rating:
 - a. Those within the cavity of a wall.
 - b. Floor, tub, or shower drains within a concealed space.
 - c. 4-inch or smaller metal conduit penetrating directly into metal-enclosed electrical switchgear.
- D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
- 1. Permanent forming/damming/backing materials.
 - 2. Substrate primers.
 - 3. Collars.
 - 4. Steel sleeves.

2.3 FILL MATERIALS (AS APPLICABLE)

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric strips for use around combustible penetrants.
- F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

- G. Pillows/Bags: Compressible, removable, and reusable intumescent pillows encased in fire-retardant polyester or glass-fiber cloth. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.
- J. Fire-Rated Cable Sleeve Kits: Complete kits designed for new or existing cable penetrations through walls to accept standard accessories.
- K. Thermal Wrap: Flexible protective wrap tested and listed for up to 2-hour fire ratings in accordance with ASTM E814/UL 1479 for membrane penetrations or ASTM E1725/UL 1724 for thermal barrier and circuit integrity protection.
- L. Fire-Rated Cable Pathways: Single or gangable device modules composed of a steel raceway with integral intumescent material and requiring no additional action in the form of plugs, twisting closure, putty, pillows, sealant, or otherwise to achieve fire and air-leakage ratings.
- M. Retrofit Device for Cable Bundles: Factory-made, intumescent, collar-like device for firestopping existing over-filled cable sleeves and capable of being installed around projecting sleeves and cable bundles.
- N. Wall-Opening Protective Materials: Intumescent, non-curing putty pads or self-adhesive inserts for protection of electrical switch and receptacle boxes.
- O. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestop gasket for use around rectangular steel HVAC ducts without fire dampers.
- P. Firestop Plugs: Flexible, re-enterable, intumescent, foam-rubber plug for use in blank round openings and cable sleeves.
- Q. Fire-Rated Cable Grommet: Molded two-piece grommet made of plenum-grade polymer and foam inner core for sealing small cable penetrations in gypsum walls up to 1/2 inch diameter.
- R. Endothermic Wrap: Flexible, insulating, fire-resistant, endothermic wrap for protecting membrane penetrations of utility boxes, critical electrical circuits, communications lines, and fuel lines.

2.4 MIXING

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION OF PENETRATION FIRESTOPPING SYSTEMS

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nonstaining silicone joint sealants.
 - 2. Mildew-resistant joint sealants.
 - 3. Polysulfide joint sealants.
 - 4. Latex joint sealants.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Joint sealants.
- B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports: Based on evaluation of comprehensive tests performed by a qualified testing agency indicating that sealants comply with requirements.
- B. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Manufacturers' special warranties.
- B. Installer's special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.6 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adfast.
 - b. Pecora Corporation.
 - c. Sika Corporation.
 - d. Tremco Incorporated.

2.3 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adfast.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. Pecora Corporation.
 - d. Soudal USA.
 - e. The Dow Chemical Company.
 - f. Tremco Incorporated.

2.4 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adfast.
 - b. Everkem Diversified Products, Inc.
 - c. Franklin International.
 - d. Pecora Corporation.
 - e. Sherwin-Williams Company (The).
 - f. Tremco Incorporated.

2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adfast.
 - b. Alcot Plastics Ltd.
 - c. Construction Foam Products; a division of Nomaco, Inc.
 - d. Master Builders Solutions.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer),

- old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.

6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Airtec Corporation.
 2. Apex Industries, Inc.
 3. Baron Metal Industries Inc.; an Assa Abloy Group company.
 4. Ceco Door; ASSA ABLOY.
 5. Concept Frames, Inc.
 6. Curries Company; ASSA ABLOY.
 7. Custom Metal Products.
 8. Daybar Industries, Ltd.
 9. DCI Hollow Metal.
 10. DE LA FONTAINE.
 11. Deansteel Manufacturing Company, Inc.

12. Deronde Products.
13. DKS Steel Door & Frame Systems, Inc.
14. Fleming Door Products Ltd.; Assa Abloy Group Company.
15. Gensteel Doors, Inc.
16. HMF Express, LLC.
17. Hollow Metal Xpress.
18. JR Metal Frames Manufacturing, Inc.
19. Karpen Steel Custom Doors & Frames.
20. L.I.F. Industries, Inc.
21. LaForce, Inc.
22. Megamet Industries, Inc.
23. Mesker Door Inc.
24. Metropolitan Door Industries Corp.
25. Michbi Doors Inc.
26. MPI Group, LLC (The).

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A..
 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
 - d. Edge Construction: Model 2, Seamless.
 - e. Edge Bevel: Bevel lock and hinge edges 1/8 inch in 2 inches.
 - f. Core: Manufacturer's standard Kraft-paper, honeycomb, Polystyrene, Polyurethane, Polyisocyanurate, or Vertical steel stiffener core.

- g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener or laminated mineral board core for fire-rated doors.

2. Frames:

- a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
- b. Construction: Full profile welded. For new walls and whenever feasible. Knocked down frames are acceptable if needed in newly created openings in existing walls.

2.4 FRAME ANCHORS

A. Jamb Anchors:

- 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
- 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.6 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.7 STEEL FINISHES

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

2.8 LOUVERS

- A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.
1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
- B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11 or NAAMM-HMMA 840 as requested by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
 - 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 4. Solidly pack mineral-fiber insulation inside frames.
 - 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
 - 2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.

3.3 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

- B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:
 - a. Swinging doors.
2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames".

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.

B. Keying Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.
2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - a. Flow of traffic and degree of security required.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Samples for Initial Selection: For each type of exposed finish.
- D. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.
 - h. List of related door devices specified in other Sections for each door and frame.
- E. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Architectural Hardware Consultant.
- B. Product Certificates: For each type of electrified door hardware.
1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

- D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware and keying schedule.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.

- b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
- a. Exit Devices: Two years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of door hardware from single manufacturer.
- 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
- B. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design".
- 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 - 2. Comply with the following maximum opening-force requirements:
 - a. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.

2.3 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. McKinney Products Company; an ASSA ABLOY Group company.

2.4 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch latchbolt throw.
 - 2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.
- D. Lock Trim:
 - 1. Description: As indicated on Drawings.
- E. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. SARGENT Manufacturing Company; ASSA ABLOY.
- F. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. SARGENT Manufacturing Company; ASSA ABLOY.

2.5 ELECTRIC STRIKES

- A. Electric Strikes: BHMA A156.31; Grade 1; with faceplate to suit lock and frame.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Hanchett Entry Systems (HES), Inc.; ASSA ABLOY Group.

2.6 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. SARGENT Manufacturing Company; ASSA ABLOY.

2.7 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from stainless steel.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Best Access Systems; Stanley Security Solutions, Inc.
- B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.
 - 1. Core Type: Interchangeable.
- C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.8 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.
 - 1. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."

2.9 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; stainless steel unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.10 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Norton Door Controls; an ASSA ABLOY Group company.

2.11 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Pemko; an ASSA ABLOY Group Company.
- B. Maximum Air Leakage: When tested in accordance with ASTM E283 with tested pressure differential of 0.3-inch wg, as follows:
 - 1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening.

2.12 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.13 AUXILIARY DOOR HARDWARE

- A. Auxiliary Hardware: BHMA A156.16.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.14 AUXILIARY ELECTRIFIED DOOR HARDWARE

- A. Auxiliary Electrified Door Hardware:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. ASSA ABLOY Electronic Security Hardware; Hanchett Entry Systems, Inc.; ASSA ABLOY Group.
 - b. SARGENT Manufacturing Company; ASSA ABLOY.

2.15 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.
 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 1. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames.
 - 2) Strike plates to frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Closers to doors and frames.

2.16 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations. All operable door hardware shall be ADA compliant.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
 - 2. Furnish permanent cores to Owner for installation.

- E. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.
- F. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
 - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.8 DOOR HARDWARE SCHEDULE

- A. Hardware Set 1: Each door to have the following:

Set: 1.0

Doors: 101

3 Hinge (heavy weight)	T4A3786	US26D	MK
1 Rim Exit Device, Storeroom	12 72 8804 ETL	US32D	SA
1 Core	7-PIN	626	BE
1 Electric Strike	9500	630	HS ⚡
1 SMART Pac Bridge Rectifier	2005M3		HS ⚡
1 Surface Closer	CPS8501	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Gasketing (Head/Jambs)	S773BL		PE
1 Sweep	315CN		PE
1 Card Reader	BY OWNER		
1 Door Position Switch	DPS-M/W-BK (TO SUIT)		SU ⚡
1 Motion Sensor	XMS		SU ⚡
1 Power Supply	AQLxx-R8E1 (TO SUIT)		SU ⚡
1 Wiring Diagram	Elevation and Point to Point as Specified		

Notes:

- Electronic Operation: Valid card releases electric strike or key retracts latchbolt. Request to exit shows authorized egress. Free egress at all times. In case of power loss, door remains locked and latched.
- Power supply shared with opening 102

Set: 2.0

Doors: 102

3 Hinge (heavy weight)	T4A3786	US26D	MK
1 Storeroom Lock	72 8204 LNL	US26D	SA
1 Core	7-PIN	626	BE
1 Electric Strike	1600	630	HS ⚡
1 SMART Pac Bridge Rectifier	2005M3		HS ⚡
1 Surface Closer	CPS8501	689	NO
1 Kick Plate	K1050 10" CSK	US32D	RO
1 Gasketing (Head/Jambs)	S773BL		PE
1 Card Reader	BY OWNER		
1 Door Position Switch	DPS-M/W-BK (TO SUIT)		SU ⚡
1 Motion Sensor	XMS		SU ⚡

1 Wiring Diagram

Elevation and Point to Point as Specified

Notes:

- Electronic Operation: Valid card releases electric strike or key retracts latchbolt. Request to exit shows authorized egress. Free egress at all times. In case of power loss, door remains locked and latched.
- Power supply specified in Set 1.0.

END OF SECTION 087100

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
- B. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C645 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated
 2. Protective Coating: Comply with ASTM C645; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
 - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- B. Studs and Track: ASTM C645.
1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
 2. Depth: As indicated on Drawings.
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Steel Thickness: 0.0269 inch.
- D. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.
 1. Depth: 1-1/2 inches.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- E. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
 1. Configuration: Asymmetrical or hat shaped.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
 1. Depth: As indicated on Drawings.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
 2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 1. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 2. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 3. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Carrying Channels (Main Runners): 48 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- D. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
2. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum wallboard.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. Certainteed; SAINT-GOBAIN.
 - c. Continental Building Products Inc.
 - d. Georgia-Pacific Gypsum LLC.
 - e. National Gypsum Company.
 - f. PABCO Gypsum.
 - g. Panel Rey.
 - h. USG Corporation.
 - 2. Thickness: 5/8 inch.
 - 3. Long Edges: Tapered.

2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (control) joint.

2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

2.5 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.

- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Fit gypsum panels around ducts, pipes, and conduits.
 - 2. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - 2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C840.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.

3.5 FINISHING OF GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 5: At all locations exposed to view.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch-square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.
 - 3. Clips: Full-size hold-down clips.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Size and location of initial access modules for acoustical panels.
 - 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.

- d. Sprinklers.
 - e. Access panels.
5. Perimeter moldings.
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- E. Field quality-control reports.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For finishes to include in maintenance manuals.
- 1.6 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- 1. Acoustical Ceiling Panels: Full-size panels of each type equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.
- 1.7 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS ACT1

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong No. 868 Clean Room VL or comparable product by one of the following:
1. Armstrong World Industries, Inc.
 2. CertainTeed Corp.
 3. Chicago Metallic Corporation.
 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with vinyl overlay on face.
 2. Pattern: E (lightly textured).

- C. Color: White.
- D. LR: Not less than 0.80.
- E. CAC: Not less than 40.
- F. Edge/Joint Detail: Square.
- G. Thickness: 5/8 inch.
- H. Modular Size: 24 by 24 inches.
- I. Anti-Mold/Mildew: Panels resist the growth of mold and mildew on the tile surface.

2.4 ACOUSTICAL PANELS ACT2

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong No. 1714 School Zone Fine Fissured or comparable product by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corp.
 - 3. Chicago Metallic Corporation.
 - 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
 - 2. Pattern: CE (perforated, small holes and lightly textured).
- C. Color: White.
- D. LR: Not less than 0.85.
- E. NRC: Not less than 0.70.
- F. CAC: Not less than 35.
- G. Edge/Joint Detail: Square.
- H. Thickness: 3/4 inch.
- I. Modular Size: 24 by 24 inches.
- J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
 - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.
- D. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.
- E. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.6 METAL SUSPENSION SYSTEM ACT1

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Clean Room 15/16 Inch Exposed Tee System or comparable product by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corp.
 - 3. Chicago Metallic Corporation.
 - 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Wide-Face, Capped, Double-Web, Fire-Rated, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 15/16-inch-wide metal caps on flanges.
 - 1. Structural Classification: Intermediate-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Hot-dipped galvanized, gasketed.
 - 5. Gasket System: Clean-room type.

2.7 METAL SUSPENSION SYSTEM ACT2

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Prelude XL 15/16 Inch Exposed Tee System or comparable product by one of the following:
1. Armstrong World Industries, Inc.
 2. CertainTeed Corp.
 3. Chicago Metallic Corporation.
 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Wide-Face, Capped, Double-Web, Fire-Rated, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 15/16-inch-wide metal caps on flanges.
1. Structural Classification: Intermediate-duty system.
 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 3. Face Design: Flat, flush.
 4. Cap Material: Steel cold-rolled sheet.

2.8 ACCESSORIES

- A. Hold-Down Clips: Manufacturer's standard hold-down.
- B. Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including manufacturer's standard antimicrobial gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 - 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - b. Install panels with pattern running in one direction parallel to long axis of space.
 - c. Install panels in a basket-weave pattern.
 - 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 - 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
 - 5. Install lean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
 - 6. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Compliance of seismic design.

- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
 - 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
 - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

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SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.
- C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
- D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F or more than 85 deg F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 WARRANTY

- A. Limited 2-year warranty for rubber base.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE (RB1)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AB; American Biltrite.
 - 2. Armstrong World Industries, Inc.
 - 3. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 - 4. Flexco.
 - 5. Johnsonite; A Tarkett Company.
 - 6. Mondo Rubber International, Inc.
 - 7. Roppe Corporation, USA.
 - 8. VPI, LLC, Floor Products Division.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
 - 1. Group: I (solid, homogeneous).
 - 2. Style and Location: Style B, Cove.
 - 3. Thickness: 0.125 inch.
 - 4. Height: 4 inches.
 - 5. Lengths: Coils in manufacturer's standard length.
 - 6. Outside Corners: Job formed.
 - 7. Inside Corners: Job formed.
 - 8. Colors: As indicated on Drawings.

2.2 RUBBER MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Roppe Corporation, USA.
 - 2. VPI Corporation.
 - 3. Johnsonite: A Tarkett Company.
- B. Description: Rubber reducer strip for resilient flooring transition strips.
 - 1. Profile and Dimensions: As indicated on Drawings.
 - 2. Locations: Provide rubber molding accessories in areas indicated.
 - 3. Colors and Patterns: As indicated on Drawings.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: To be provided and installed by Owner.
- E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

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SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resinous flooring systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

1.4 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- B. Material Certificates: For each resinous flooring component, from manufacturer.
- C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Flammability: Self-extinguishing according to ASTM D635.

2.2 MANUFACTURERS

- A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.3 RESINOUS FLOORING (EPX1, EPXB1)

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Duraflex, Inc.
 - b. Key Resin Company.
 - c. Sherwin-Williams Company, High Performance Flooring: Basis-of-Design – FasTop Deco Flake SL45

2. Heavy Duty Environment (Decorative Flake Broadcast): FasTop Deco Flake SL45 (Urethane/Epoxy).
 - a. Primer: Resuflor Aqua 3477
 - b. Slurry Installation: FasTop Multi Slurry Resin with FasTop SL45 Aggregate; broadcast 5310-8 dry silica sand to yield 1/8" slurry.
 - c. Bonding Coat, Broadcast: Resuflor 3746; 6750/6755 Flake Broadcast to excess.
 - d. Flake size: 1/4 inch.
 - e. Grout: Resuflor 3746.
 - f. Topcoat: Elladur 4850.

3. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to the test methods:
 - a. Compressive Strength: 6,926 psi per ASTM C 579.
 - b. Tensile Strength: 944 psi per ASTM C 307.
 - c. Flexural Strength: 1,909 psi per ASTM C 580.
 - d. Hardness: 83 per ASTM D 2240 / Shore D Durometer.
 - e. Impact Resistance: >160 in lbs. per ASTM D 4226..
 - f. Abrasion Resistance: 51 mgs max. weight loss per ASTM D 4060, Taber Abrader CS-17.
 - g. Flexural Modulus of Elasticity: 1.0×10^6 psi per ASTM C 580.
 - h. Flammability: Self-extinguishing per ASTM D 635 (Extent of burning 0.25" max.).
 - i. Water Absorption: 0.1% per ASTM C 413.
 - j. Cure Rate Allow: 8-12 hours for foot traffic, 24 for light traffic and normal operations.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with NACE No. 6/SSPC-SP13, with a Concrete Surface Profile (CSP) of 3 or greater in accordance with the International Concrete Repair Institute

(ICRI) Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
 1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- E. If moisture tests are higher than Manufacturer's recommended range, perform moisture mitigation system. Moisture mitigation system to be approved by Manufacturer and Architect.

3.2 INSTALLATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
 1. Integral Cove Base: 4 inches high.
 2. Provide metal trim cap (MT1) as indicated on Drawings.

- D. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system.
 - 1. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- E. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.
- F. Grout Coat: Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat.
- G. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

3.3 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may, at any time and any number of times during resinous flooring application, require material samples for testing for compliance with requirements.
 - 1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.4 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

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SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete
 - 2. Concrete masonry units (CMU).
 - 3. Steel.
 - 4. Galvanized metal.
 - 5. Gypsum board.
- B. Related Requirements:
 - 1. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.
 - 2. Section 099600 "High Performance Coatings" for high-performance and special-use coatings.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 - 3. VOC content.
- D. Coatings Inspection Report: Provide coatings inspection report as completed by authorized representative of selected coatings manufacturer. Report shall include photos of existing site conditions as well as product and surface preparation recommendations for all previously painted substrates.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gallon of each material and color applied.
- B. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.6 DELIVERY, STORAGE, AND HANDLING

- 1. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
- 2. Maintain containers in clean condition, free of foreign materials and residue.
- 3. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design:
 - 1. Sherwin-Williams Company (The). – Matt Smith, Architectural Account Executive; (804)774-1967, matthew.a.smith@sherwin.com.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Behr Process Corporation.
 - 2. Benjamin Moore & Co.
 - 3. McCormick Paints.
 - 4. PPG Architectural Finishes, Inc.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. Colors: As indicated in a color schedule.
 - 1. 20 percent of surface area will be painted with deep tones.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Concrete: 12 percent.
 2. Masonry (Clay and CMU): 12 percent.
 3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 1. Finish surfaces for verification of products, colors and sheens.
 2. Finish area designated by Architect.
 3. Provide samples that designate primer and finish coats.
 4. Do not proceed with remaining work until the Architect approves the mock-up.
- F. Adhesion Test: Apply a test area on all previously painted substrates, allowing paint to dry one week before testing adhesion. If adhesion is poor, additional abrasion of the surface and/or removal of the previous coating may be necessary.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Previously Painted Substrates: Apply a test area on all previously painted substrates, allowing a paint to dry one week before testing adhesion. If adhesion is poor, additional abrasion of the surface and/or removal of the previous coating may be necessary.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Traffic Surfaces:

- 1. Water-Based Clear Sealer System: MPI INT 3.2G.
 - a. First Coat: H&C CLARISHIELD Water Based Wet Look Sealer, 50.148154; MPI #99.
 - b. Top Coat: H&C CLARISHIELD Water Based Wet Look Sealer, 50.148154; MPI #99.

B. CMU Substrates:

- 1. Institutional Low-Odor/VOC Latex System: MPI INT 4.2E: New, unpainted low traffic wall surfaces.
 - a. Block Filler: PrepRite Block Filler, B25W25 MPI #4.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Semi-Gloss Topcoat: ProMar 200 HP Zero VOC Latex Semi-Gloss, B31-1950 Series, (Gloss Level 5), MPI #147.
- 2. Institutional Low-Odor/VOC Latex System: RIN 4.2L: Previously painted, low traffic wall surfaces.
 - a. Touch up and Spot Prime: LOXON Concrete & Masonry Primer, LX2W50; MPI #3.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Flat Topcoat: ProMar 200 Zero VOC Latex Flat, B30-12600 Series; (Gloss Level 1) MPI #143.
 - d. Eggshell Topcoat: ProMar 200 HP Zero VOC Latex Eg-Shel, B20-1950 Series; (Gloss Level 3), MPI #145.
 - e. Semi-Gloss Topcoat: ProMar 200 HP Zero VOC Latex Semi-Gloss, B31-1950 Series, (Gloss Level 5), MPI #147.
- 3. Epoxy-Modified Latex System: MPI INT 4.2J:
 - a. Block Filler: Pro Industrial Heavy Duty Block Filler, B42W150; MPI #4.
 - b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
 - c. Topcoat: Pro Industrial Water Based Catalyzed Epoxy B73-300, (Gloss Level 5), MPI #115.

C. Steel Substrates:

1. Water Based Dryfall System: MPI INT 5.1C: Exposed ceiling structure.
 - a. Primer: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series; MPI #107.
 - b. Topcoat: S-W Pro Industrial Waterborne Acrylic Dryfall, B42-80 Series; MPI #118.

 2. WB Light Industrial Coating System: MPI INT 5.1B:
 - a. Prime Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series; MPI #107.
 - b. Intermediate Coat: WB Light Industrial Coating, matching topcoat.
 - c. Topcoat: Pro Industrial Acrylic Coating Semi-Gloss, B66-651 (Gloss Level 5), MPI #153.
- D. Galvanized-Metal Substrates:
1. WB Light Industrial Coating System: MPI INT 5.3K.
 - a. Prime Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series, MPI #134.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Pro Industrial Acrylic Coating Semi-Gloss, B66-651 (Gloss Level 5), MPI #153.
- E. Gypsum Board Substrates:
1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M, RIN 9.2M:
 - a. Prime Coat: ProMar 200 Zero VOC Primer, B28W2600; MPI #149.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Eggshell Topcoat: ProMar 200 HP Zero VOC Latex Eg-Shel, B20-1950 Series; (Gloss Level 3), MPI #145.
 - d. Semi-Gloss Topcoat: ProMar 200 HP Zero VOC Latex Semi-Gloss, B31-1950 Series, (Gloss Level 5), MPI #147.

END OF SECTION 099123

SECTION 102600 - WALL PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Corner guards.

1.3 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For each type of wall protection showing locations and extent.

- 1. Include plans, elevations, sections, and attachment details.

- C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

- 1. Corner Guards: 12 inches long. Include example top caps.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of handrail.

- B. Material Certificates: For each type of exposed plastic material.

- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall protection product to include in maintenance manuals.

- 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include

precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 48-inch-long units.
 - 2. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store wall protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
 - 2. Keep plastic materials out of direct sunlight.
 - 3. Store plastic wall-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
 - a. Store corner-guard covers in a vertical position.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
 - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 CORNER GUARDS

- A. Surface-Mounted, Metal Corner Guards (CG1): Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Construction Specialties, Inc.
 - b. Inpro Corporation.
 - c. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - d. Pawling Corporation.
 - 2. Material: Stainless-steel sheet, Type 304.
 - a. Thickness: Minimum 16 gauge.
 - b. Finish: Directional satin, No. 4.
 - 3. Wing Size: Nominal 2 by 2 inches.
 - 4. Corner Radius: 1/8 inch and 3/4 inch.
 - 5. Length: 4 foot.
 - 6. Mounting: Tamper-resistant, countersunk screws through factory-drilled mounting holes and adhesive.

2.4 MATERIALS

- A. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- B. Adhesive: As recommended by protection product manufacturer.

2.5 FABRICATION

- A. Fabricate wall protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For wall protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
 - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
 - 2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.

3.4 CLEANING

- A. Immediately after completion of installation, clean corner guards with Manufacturer recommended cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

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SECTION 230000 - HEATING, VENTILATING AND AIR-CONDITIONING (HVAC)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section of the specifications shall be applicable to all phases of mechanical work covered by specifications and drawings issued for this project.
- B. The "General Conditions of the Contract", "Supplementary General Conditions", and all other similar general requirements issued for this project shall apply to all mechanical work and are hereby made a part of this section.
- C. The Contractor and/or his representatives shall be fully acquainted with the design and operation of the systems and equipment described in these specifications and on the drawings.
- D. Work included under this section shall include complete systems as shown on the plans and as specified. Provide supervision, labor, material, equipment, machinery, plant, and other items necessary to complete the mechanical systems. It is the intention of these specifications and drawings to call for finished work, tested, and ready for operation.
- E. Definitions:
 - 1. "Owner" and "Contractor" shall mean the respective parties to the prime contract governing the project. Only one contractor is recognized as a party to this contract. Where the terms "Mechanical Contractor" or "Subcontractor" are used, it is for convenience only.
 - 2. "Architect/Engineer" shall mean the firm and authorized representatives of the firm engaged by the Owner for architectural and engineering services related to this project.
 - 3. "Mechanical" shall mean all work related to air conditioning, heating, ventilation, plumbing, sprinkler systems, noise and vibration control, and similar work, including all related components, accessories, controls, and miscellaneous work required for a complete system.
 - 4. "Contract Documents" shall mean and include the agreement, the drawings and specifications and all modifications thereto authorized by the Owner in writing prior to final completion of the project.
 - a. The term "Agreement" shall mean the completed and signed contract form.
 - b. The term "Drawings" shall mean the drawings prepared by the Architect/Engineer for specific use in bidding and execution of the work.
 - c. The term "Specifications" shall include the legal and procedural documents, the general conditions, special conditions, and the technical specifications.

- d. The term "Technical Specifications" shall mean that part of the specifications which describes, outlines, and stipulates the kind and quality of the materials to be furnished, the quality of workmanship required, and the methods to be used in the construction under the contract. For convenience, the mechanical portions of the technical specifications are arranged into one general section and several detailed sections related to the various trades represented in the work. Such arrangement and references shall not operate to make the Architect/Engineer an arbiter in establishing the limits of any subcontract or trade.
5. "Work" of the Contractor shall mean labor or materials or both.
6. "As shown", "as indicated", "as detailed", or words of similar import shall mean reference to the drawings included in the contract documents, unless stated otherwise.
7. "As directed", "as required", "as permitted", "approved", or words of similar import shall mean that the direction, requirement, permission, approval, or acceptance of the Architect/Engineer is intended unless stated otherwise.
8. "As necessary" shall mean that which is necessary to achieve satisfactory completion of the work in order to provide the intended function and form of the project in compliance with the contract documents.
9. "Provide" shall mean "provide complete and in place", that is "furnish and install", ready for beneficial occupancy by the Owner. Except where stated otherwise, description of any work in the contract documents shall mean that the work shall be provided by the Contractor, even though the words "provide" or "furnish and install" do not accompany the description.
10. "Similar" shall be interpreted in a general sense and not as meaning identical, and all related details shall be worked out in respect to their location and their connection with other parts of the work.
11. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
12. Option or Optional: Contractor's choice of an alternate material or method.

1.2 INTENT OF CONTRACT DOCUMENTS

- A. The contract documents are complementary, and what is called for in one place shall be as binding as if called for in all places. Where variances occur between drawings and specifications or within either document itself, include in the contract price the item or arrangement of better quality, greater quantity, or higher cost. Agreement shall take precedence over the specifications and drawings. Figured dimensions shall be used in preference to scaling the drawings. In case of conflict between large and small scale drawings, the large scale drawings shall govern.
- B. The mechanical drawings show the general arrangement of all piping, equipment, and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The mechanical work shall conform to the requirements shown on all of the drawings. Architectural and structural drawings shall take precedence over

mechanical drawings. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves, boxes, offsets, transitions, and other accessories as may be required to meet such conditions.

1.3 CODES AND STANDARDS

- A. All materials and workmanship shall comply with all applicable codes, state and federal laws, local ordinances, industry standards, utility company regulations, and all other criteria which normally apply to work of this nature.
- B. In case of difference between building codes, state laws, federal laws, local ordinances, industry standards, utility company regulations, other criteria and the contract documents, the more stringent regulations will apply. The Contractor shall promptly notify the Architect/Engineer in writing of any such difference.
- C. If the Contractor performs any work that does not comply with these contract documents or the requirements of the applicable building codes, state laws, local ordinances, industry standards, utility company regulations, and other applicable criteria, he shall bear all costs arising in correcting the deficiencies.
- D. The standards referred to, except as modified in the specifications, shall have full force and effect as though printed in these specifications. The manufacturer and trades involved shall be familiar with the application of these standards.
- E. Applicable codes and standards shall include, but are not necessarily restricted to, the most recently recognized issues of the following:
 - 1. Building Codes:
 - a. Virginia Uniform Statewide Building Code
 - b. International Mechanical Code and accumulative supplements.
 - 2. Industry Standards, Codes, and Specifications:
 - a. AASHO - American Association of State Highway Officials
 - b. ADA - Americans with Disabilities Act
 - c. AGA - American Gas Association
 - d. ARI - Air Conditioning and Refrigeration Institute
 - e. AMCA- Air Moving and Conditioning Association
 - f. ANSI - American National Standards Institute
 - g. ASHRAE - American Society of Heating, Refrigeration, and Air Conditioning Engineers
 - h. ASME - American Society of Mechanical Engineers

i.	ASSE -	American Society of Sanitary Engineering
j.	ASTM -	American Society of Testing and Materials
k.	AWS -	American Welding Society
l.	CISPI -	Cast Iron Soil Pipe Institute
m.	CSA -	Canadian Standards Association
n.	AWWA-	American Water Works Association
o.	FIA -	Factory Insurance Association
p.	FM -	Factory Mutual
q.	FS -	Federal Specification
r.	IBR -	Institute of Boiler and Radiator Manufacturers
s.	IRI -	Industrial Risk Insurers
t.	ISO -	Insurance Services Office
u.	MSS -	Manufacturer's Standardization Society of the Valve and Fittings Industry, Inc.
v.	NBS -	National Bureau of Standards
w.	NEC -	National Electrical Code
x.	NFPA -	National Fire Protection Association
y.	NSF -	National Sanitation Foundation
z.	PDI -	Plumbing & Drainage Institute
aa.	UL -	Underwriters' Laboratories, Inc.
bb.	SMACNA -	Sheet Metal and Air Conditioning Contractors' National Association
cc.	UFAC -	Uniform Federal Accessibility Standards
dd.	SCAQMD -	South Coast Air Quality Management District
ee.	GS -	Green Seal Standard

1.4 GOVERNMENTAL FEES, PERMITS, AND INSPECTIONS

- A. Under each applicable section of the detailed mechanical specifications, the Contractor shall obtain and pay for all required licenses, permits, charges for connections to outside services, fees and inspections. Upon completion of the work under each section of the detailed mechanical specifications, the Contractor shall furnish a certificate of final inspection to the Architect/Engineer from the governmental inspection department having jurisdiction.

1.5 VISITING THE SITE

- A. Each Contractor shall be responsible for visiting the site before bidding the job to familiarize himself with all existing conditions to be met in the execution of the work under this contract. No additional compensation will be allowed for any changes which may be required to make because of site conditions.

1.6 QUALITY ASSURANCE

A. Product Criteria:

1. All materials shall be new and shall bear the manufacturer's name, trade name, and the UL label in every case where a standard has been established for this particular material. The equipment to be furnished shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design. All equipment shall bear a permanent and legible factory-applied nameplate to permit identification of manufacturer, model number and type of unit.
2. Equipment Service: Products shall be supported by a service organization which maintains an adequate inventory of repair parts and is located, in the opinion of the Architect/Engineer, reasonably close to the site.
3. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer to provide for uniform appearance, operation, and maintenance.
4. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.

B. Manufacturers' directions shall be followed in the delivery, storage, protection, and installation of all equipment and materials. The Contractor shall promptly notify the Architect/Engineer in writing of any conflict between any requirements of the contract documents and the written instructions before proceeding with the work. If the Contractor performs any work that does not comply with the manufacturers' directions or such written instructions from the Architect/Engineer, he shall bear all costs arising in correcting the deficiencies.

C. Factory Start-up by the manufacturer's Factory Certified Representative shall be provided for each Boiler, Chiller, Cooling Tower, Air Handling Unit (Packaged, Split, Central Station, Heat Pump, or ERV) and Variable Refrigerant System,. Letters signed by the Representative stating that their equipment has been started, tested, and is operating safely shall be submitted to the Owner as part of the bound Operations and Maintenance Instructions manual specified in section 2.10 CATALOG DATA FOR OWNER of this specification.

1.7 BIDDING INSTRUCTIONS

- A. Products are generally specified by a performance specification and/or by manufacturer's name and model number or trade name.
- B. When specified only by a performance specification, the Contractor may use any manufacturer who meets the performance specification and applicable codes. (The Contractor shall be subject to the requirements of 1.09 - SHOP DRAWINGS.)

- C. When several products/manufacturers are specified together, then the Contractor has the option of using any product/manufacturer listed. The Contractor shall be subject to the requirements of 1.09 - SHOP DRAWINGS. The Contractor's bid shall be compiled on the use of the listed products without exception. Substitutions will only be considered after the contract has been executed and shall be subject to the requirements of 1.08 - SUBSTITUTIONS.
- D. When several products/manufacturers are specified together and the system design is based on one of the listed products by specific model number(s) or catalog number(s), then the Contractor has the option of using the one specific product or any other product/manufacturer listed. In either case, the Contractor shall be subject to the requirements of 1.09 - SHOP DRAWINGS. However, when the other listed product/manufacturer is used, the Contractor shall be responsible for determining that the product(s) will be compatible with building design, electrical design, mechanical design, and the product(s) will not necessitate design modifications by the Architect/Engineer. The Contractor's bid shall be compiled on the use of the listed products without exception. Substitutions will only be considered after the Contract has been executed and shall be subject to the requirements of 1.8 - SUBSTITUTIONS. If the products/manufacturers are listed to be "only", then substitutions will not be considered.
- E. When only one manufacturer's name is listed, this shall be the basis of the bid. The Contractor's bid shall be compiled on the use of the listed product. Substitutions will only be considered after the Contract has been executed and shall be subject to the requirements of 1.8 - SUBSTITUTIONS.

1.8 SUBSTITUTIONS

- A. Substitutions will not be considered during the bid.
- B. After the Contract has been executed, the Architect/Engineer will consider a formal request for a review of substituted products in place of those specified, under the following conditions:
 - 1. Not later than 30 days from the Contract Date, the Contractor shall provide a list of products proposed as substitutions, including the name, manufacturer, and section of the specifications governing the product.
 - 2. The request shall be accompanied by accurate cost data on the proposed substitutions indicating whether or not a modification of the Contract Sum is to be considered.
- C. Substitutions are understood to mean that the installing Contractor:
 - 1. Has personally investigated the proposed substitute and has determined that it is equal or superior in all respects to the item specified;
 - 2. Will provide the same guarantee for the substitution that he would for the item or equipment specified;

3. Certifies that the cost data is complete and includes all related costs under this Contract, and waives all claims for additional cost related to the installation of the accepted substitute;
 4. Has coordinated the installation of the substitute, providing design modifications and changes as required for the work to be complete in all respects;
 5. Has coordinated the installation of the substitute with the General Contractor pertaining to changes required for the work to be complete with all trades and all changes shall be provided without additional cost to the Owner.
- D. The acceptance by the Architect/Engineer of any or all of those substitute items listed by the Contractor for review shall not constitute an approval of the substitute but shall mean that the Contractor may then submit detailed shop drawings for review. When a request for substitution is granted, shop drawings will be reviewed by the Architect/Engineer. Shop drawings not complete with proper review information will not be reviewed and will be returned unchecked. If after two submittals, the substitute equipment is not approved, the specified equipment shall be provided.

1.9 SHOP DRAWINGS

- A. Shop Drawings are required for all material and equipment that is specified by a manufacturer's name or as indicated in the technical specifications. Furnish the number of copies required by the General and Special Conditions of the Contract, but in no case less than six (6) copies. Submittal data for related equipment shall be submitted at one time.
- B. Substitutions will not be considered if:
1. They are indicated or implied on shop drawing submissions without information specified in 1.8 - SUBSTITUTIONS.
 2. They require a substantial revision of the Contract Documents in order to accommodate their use.
- C. Identify submittals with PROJECT NAME and NUMBER, CONTRACTOR'S NAME, SECTION NUMBER & NAME, and PARAGRAPH NUMBER of SPECIFICATION GOVERNING, MANUFACTURER, MODEL or STYLE, and CONTRACTOR'S REVIEW STAMP. Submittals shall be detailed, dimensioned drawings showing construction, size and arrangement, service clearances, performance characteristics, and capacity. Submittals not properly identified or containing information of a general nature will not be reviewed and will be returned unchecked.
- D. Acceptance of shop drawings shall not be considered as a guarantee of measurements or building conditions. Acceptance shall not relieve the Contractor from the responsibility or necessity of furnishing material or performing work required by the drawings and specifications. Submittal data on any one item shall not be reviewed more than three (3) times. If not accepted after the third review, the Contractor shall provide the equipment upon which the design was based.

- E. Failure to submit shop drawings in ample time for checking shall not entitle an extension of contract time, and no claim for extension by reason of such default will be allowed.
- F. No material or equipment, for which submittals are required, may be delivered to or installed at the job site until submittals have been accepted.
- G. Unless a specific finish is indicated in the contract documents, wherever a choice of finish is available for the specified item, submit accurate color chips or charts to the Architect for review and selection.

PART 2 - PRODUCTS

2.1 DRIVE GUARDS

- A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory fabricated unit casings.
- B. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.
- C. Access for Speed Measurement: One-inch diameter hole at each shaft center.
- D. Lubrication: Guards shall not interfere with lubrication of equipment.

2.2 PAINTING

- A. General - Paint mechanical and electrical equipment and material in Equipment Rooms and utility type areas and located outside of the building or on the roof. Painting of equipment and material in finished rooms or areas shall be accomplished as described in PAINTING Section of the Architectural Specifications. Painting in concealed spaces shall be limited to equipment and materials not otherwise protected from rusting such as hangers and supports. Paint shall be products of Sherwin-Williams, Pittsburgh, or Pratt-Lambert. All paints, finishes and coatings shall comply with Green Seal Standard GS-11, GS-03, and SCAQMD Rule #1113 VOC limits for paints and coatings
- B. Workmanship - The work shall be accomplished by workmen skilled in the painting trade after testing is complete and systems are ready for operation. Surfaces to be painted shall be completely dry before applying paint. Surfaces shall not be painted when the temperature is below 50 Deg. F or above 120 Deg. F, or when they are exposed to hot sun. Materials shall be evenly spread and smoothly flowed on without runs or sags. Each coat

shall be thoroughly dry before application of succeeding coat. The painters shall protect adjacent surfaces with drip covers during the process of painting. Upon completion, paint spots, if any, shall be removed from adjacent surfaces.

- C. Preparation of surface - Metal surfaces shall be cleaned with solvent before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be pretreated with a phosphoric acid cleaning solution and primed with Sherwin-Williams "Galvanized Iron Primer".
- D. Painting - After preparation as described above, each item shall be painted as follows, except color of paint for equipment and material located outside of the building or on the roof shall be as selected by the Architect.
 - 1. Painting is not required of equipment, equipment supports, and hangers with a factory-finish coat. Patch painting is required of any damaged areas to match factory-finish coat. Painting is required where equipment or equipment supports do not have factory-finish paint. Painting shall be as follows:
 - a. Uninsulated boiler surfaces and other similar hot surfaces shall be painted with two coats of silicone alkyd aluminum paint with a dry temperature resistance of 1000 Deg. F.
 - b. Other equipment and associated hangers and supports shall be primed with one coat of alkyd, zinc potassium chromate metal primer, except insulated surfaces shall be primed with one coat Sherwin-Williams "Wall Primer and Sealer." Finish with two coats of Sherwin-Williams Steel Gray Enamel. Exterior of belt guards and other protective guards shall be finished with two coats of machinery enamel in OSHA yellow color. Interior of items covered by belt guards and other protective guards shall be finished with two coats of machinery enamel in OSHA orange color. Nameplates on equipment shall not be painted.
 - 2. Ducts, pipes, and conduits - Interior duct behind grilles, registers, and diffusers shall have 1 finish coat of Sherwin-Williams Black Enamel. Exposed duct, pipes, conduits, and associated hangers exposed in equipment rooms and other unfinished areas such as storage areas shall have two finish coats of paint of the same color as adjacent walls or ceilings. Bare copper pipe shall not be painted. Canvas or paper jacket insulation of pipes or duct exposed in unfinished areas shall be primed and sealed before final two coats of paint. Hangers and supports in concealed areas not protected by factory-finish paint shall have one coat of metal primer.
- E. Identification of pipes and equipment
 - 1. Equipment - Each piece of equipment shall be identified by stenciled marking that will read the same as the identification shown on mechanical or electrical drawings. Stencil letters shall be 2 inches high upper case painted with white enamel.

2. Pipes shall be identified using pre-printed markers sized appropriately for the pipes being identified (shop drawings required). Markers shall be Seton "Setmark" type or equal. Pipe identification shall meet the most current edition of ANSI Specification A13.1. Markers shall be located close to valves or flanges and adjacent to changes in direction, branches and where pipes pass through walls or floors, and at intervals of 15 feet on straight runs. Provide a Color Code Chart, framed with glass front, indicating piping service and color code schedule. Post in Mechanical Room where directed by Engineer.
3. Pipes and conduit - Color bands shall be painted on each pipe or conduit where exposed or accessible. Bands shall be 1-1/2 inches wide and shall be placed every 15 feet along the pipe or conduit. Color bands shall be Sherwin-Williams "Kem Lustral" enamel as shown in the following color code schedule and chart. Provide color code chart, framed with glass front, sized appropriately for number of colors used. Post in mechanical room where directed by Engineer.
4. Color code schedule

COLOR BANDING CODE

Number	Color	Catalog Number
1.	Orange	No. F65 E 36
2.	Blue	No. F65 L 3
3.	Brown	No. F65 N 11
4.	Red	No. F65 R 1
5.	Black	No. F65 B 1
6.	Yellow	No. F65 Y 48
7.	Green	No. F65 G 40

5. Pipe shall be identified with flow arrows as described below.
 - a. Arrows shall be stencil type.
 - b. Arrows shall be readable from floor.
 - c. Arrows shall be installed every 15'-0".
 - d. Arrows shall be painted on pipes.
 6. Ducts shall have flow arrows as described below.
 - a. Arrow shall be stencil type, black only.
 - b. Arrow shall be placed at least every 10'-0" and between duct turns over 5'-0".
 - c. Arrows shall be painted on duct and shall be readable from floor.
- F. Identification of Valves: Properly mark service and control valves. Valve markers shall be metal tags with designations stamped thereon or laminated engraved plastic chained to their respective valves. Identification symbols or designations shall be the same as shown on the Contract Documents.

- G. Equipment locations above acoustic tile ceilings: Provide colored brass push-pins complete with a minimum 1/2" shank and 5/8" diameter head. Pin head color shall be blue or color as selected by Architect or Owner. Locate push-pins directly below all scheduled mechanical equipment.

2.3 MOTORS, CONTROL, AND ELECTRICAL WIRING

- A. Provide motors in accordance with NEMA Standards and suitably designed to match the starting and running characteristics of the driven equipment. Unless indicated otherwise, motors less than 1/2 horsepower shall be wound for 120 volt, single phase, 60 hertz. Motors 1/2 horsepower and above, unless indicated otherwise, shall be wound for three phase, 60 hertz, 200 volt, 230 volt, or 460 volt as required by the system voltage. Select motors coordinated with the utilization voltage and phase. Motors for equipment with VFD shall be matched to the VFD.
- B. All starters and safety switches, except for those specified to be furnished with the mechanical equipment, shall be furnished as part of the Electrical Work - Division 26.
- C. Starters and safety switches furnished with the mechanical equipment shall comply with the specifications of Sections 26 28 16 and 26 29 13.13. Starters furnished as an integral part of the mechanical equipment shall be complete with properly sized overload heaters. Integral 3-phase motor starters and VFD's shall be provided with phase loss protection.
- D. Temperature control wiring shall be furnished as part of the Mechanical Work, Section 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC. Temperature control wiring is any wiring, regardless of voltage, related to mechanical equipment that is not the equipment power circuit from the circuit breaker in the panelboard to the motor starter or safety disconnect switch and to the motor or equipment junction box. Temperature control wiring shall include, regardless of voltage, power for control panels, power for actuators, signal for input and outputs, interlocks, and line voltage as herein specified to provide the proper operation and sequence of control for all heating, ventilating, and air conditioning equipment. All wiring shall conform to applicable sections of Division 26, 27 and 28 of the specifications.
 - 1. Power for control panels shall be provided by Controls Contractor and shall be obtained from nearest receptacle or unswitched 120 volt lighting circuit. Control Contractor shall coordinate with Electrical Contractor when connecting to these circuits. Circuit directories in panelboards shall indicate where control panels are connected. When control panels require voltage other than 120 VAC, Control Contractor shall provide transformer to reduce voltage. All wiring shall conform to applicable sections of Division 26, 27 and 28 of the specifications.
 - 2. Power for damper actuators and valves which are an integral part of mechanical equipment shall be provided by the Controls Contractor and shall be obtained from the power source to the equipment or the nearest receptacle circuit. Where power requirement for the actuator or valve is different from that supplied to the equipment,

- the Controls Contractor shall provide a transformer or tap the nearest receptacle circuit or unswitched 120 volt lighting circuit. Dampers located at fans shall be considered an integral part of the mechanical equipment and shall be factory wired to the equipment power source.
3. Where equipment is controlled by a line voltage control device (thermostat, On-Off switch, Speed Switch, etc.) the Controls Contractor shall wire from the control device to the equipment, unless specifically indicated otherwise on the drawings.
 4. Where control devices that are intended to interrupt the motor or equipment power circuit are provided by the Control System Contractor and are mounted other than on or directly adjacent to the controlled equipment, the Control System Contractor shall provide wiring through these devices regardless of voltage or phases.
 5. All low voltage control wiring in inaccessible areas or in exposed areas shall be in metal conduit and shall comply with the specifications of Divisions 26, 27 and 28. All low voltage control wiring in unexposed, accessible areas shall be wire in conduit or U.L. approved plenum rated cable supported from the structure with ties spaced 4'-0" on center. Cable shall not be supported on ceiling, lights, or pipes. All low voltage control wiring penetrating walls or floors shall be in conduits. All 120 volt wiring shall be wire in conduit and shall comply with the specifications of Division 26, 27 and 28. All wall-mounted thermostats, sensors, and switches shall be mounted in recessed metal rough-in box.
 6. The Controls Contractor shall coordinate with the Electrical Contractor all 120 volt power source, connections required for the controls system. The Controls Contractor shall verify that wiring of motors and controls provides the correct sequence of operation.
 7. All equipment that has electrical connections shall have wiring terminals/connectors rated for not less than 75 deg. C. If terminals/connectors are provided and are rated for less than 75 deg. C., the mechanical contractor shall incur all costs associated with upsizing wire and conduit as required by the National Electrical Code.
- E. Domestic water temperature control wiring, equipment control wiring, and interlock wiring necessary for the proper sequence of operation of plumbing equipment shall be furnished as part of the Mechanical Work, Section 22 34 36 - COMMERCIAL GAS DOMESTIC WATER HEATER and Section 22 11 13 - DOMESTIC WATER PUMPS. Control wiring is any wiring, regardless of voltage, related to mechanical equipment that is not the equipment power circuit from the circuit breaker in the panelboard to the motor starter or safety disconnect switch and to the motor or equipment junction box. Where control devices (thermostat, On-Off switch, Aquastat, etc.) That are intended to interrupt the motor or equipment power circuit are provided by the Plumbing Contractor and are mounted other than on or directly adjacent to the controlled equipment, the Plumbing Contractor shall provide wiring through these devices regardless of voltage or phases. All wiring shall conform to applicable sections of Division 26, 27 and 28 of the specifications. All low voltage control wiring in inaccessible areas or in exposed areas shall be in metal conduit and shall comply with the specifications of Divisions 26, 27 and 28. All low voltage control wiring in unexposed, accessible areas shall be wire in conduit or U.L. approved plenum rated cable supported from the structure with ties spaced 3'-0" on center. All 120

volt wiring shall be wire in conduit and shall comply with the specifications of Division 26, 27 and 28 of the specifications.

2.4 FIRE-STOPPING

- A. Pipe penetrations of rated walls, floors, and floor-ceiling assemblies shall be constructed in accordance with Underwriter's Laboratories, Inc., Fire Resistance Directory, Volume II, Hourly Ratings for Through Firestop Penetrations. The Contractor shall provide U.L. firestop penetrations according to the particular wall, floor, or floor-ceiling assembly rating, construction type, pipe material, pipe size, insulation requirements, sleeve requirements, and the contractor's choice of firestop products as listed by U.L. Refer to the architectural drawings for the wall, floor, or floor-ceiling assembly construction types and ratings.

2.5 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. Under each applicable section of the detailed mechanical specifications, the Contractor shall furnish and install all accessories, connections, bases, guards, supports, and incidental items necessary to fully complete the work, ready for use, occupancy, and operation by the Owner.
- B. Type Numbers Specified: MSS SP-58; for selection and application, MSS SP-69. Refer to Section METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting.
- C. For Attachment to Concrete Construction
 - 1. Concrete Insert: MSS SP-69, Type 18
 - 2. Self-Drilling Expansion Shields and Machine Bolt Expansion Anchors: Fed. Spec. FF-S-325, permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed in Fed. Spec. FF-S-235.
 - 3. Power-Driven Fasteners: Permitted in existing concrete or masonry not less than four inches thick when approved by the Architect/ Engineer for each job condition. Use fasteners capable of supporting a 1000 pound test load, with the actual load not exceeding 50 pounds.
- D. For Attachment to Steel Construction; MSS SP-69:
 - 1. Welded Attachment: Type 22.
 - 2. Beam Clamps: Types 20, 21, 23, 28 or 29.
- E. Attachment to Metal Pan or Deck: As required for materials specified in Section METAL DECKING.

- F. For Attachment to Wood Construction: Wood screws or lag bolts.
- G. Hanger Rods: Hot-rolled steel, ASTM A 36 or A 575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turnbuckles shall provide 1-1/2 inches minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- H. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-1/2 inches by 1-1/2 inches, No. 12 gage, designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping, fire and sprinkler piping, or chemical waste drain piping.
 - 1. Allowable Hanger Load: Manufacturers rating less 200 pounds.
 - 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4-inch U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 2-inch galvanized steel bands, for insulated piping at each hanger.
- I. Pipe Hangers and Supports: Use hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 00, HVAC INSULATION, for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports. Provide Type 40 insulation shields at all other types of supports and hangers including those for pre-insulated piping.
 - 1. General Types (MSS SP-69):
 - a. Standard Clevis Hanger: Type 1; provide locknut.
 - b. Riser Clamps: Type 8 or 42.
 - c. Wall Brackets: Types 31, 32, or 33.
 - d. Roller Supports: Type 41, 43 and 46.
 - e. Saddle Support: Type 36, 37, or 38.
 - f. Turnbuckle: Types 13 or 15.
 - g. U-Bolt Clamp: Type 24.
 - h. For Uninsulated Copper Tube: Material compatible for use with copper to prevent electrolysis.
 - i. Supports for Plastic or Glass Piping: As recommended by the pipe manufacturer.
 - 2. HVAC Piping:
 - a. Low, Medium and High Pressure Steam:
 - (1) Provide eye rod or Type 17 eye nut near the upper attachment.
 - (2) Piping 3 Inches and Larger: Type 43 roller hanger. For roller hangers requiring seismic bracing, provide a Type 1 clevis hanger with Type 41 roller attached by flat side bars.
 - b. Spring Supports (Expansion and Contraction of Vertical Piping):

- (1) Movement up to 3/4-Inch: Type 51 or 52 variable spring unit with integral turnbuckle and load indicator.
- (2) Movement more than 3/4-Inch: Type 54 or 55 constant support unit with integral adjusting nut, turnbuckle, and travel position indicator.

3. Plumbing Piping:

- a. Sprinkler System: NFPA or Factory Mutual approved types.
 - b. Horizontal Piping: Types 1, 5, 7, 9, and 10.
 - c. Chrome Plated Piping: Chrome plated supports.
 - d. Hangers and Supports in Pipe Chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration, and compensate for all static and operational conditions.
 - e. Blocking, Stays and Bracing: Angle iron or preformed metal channel shapes, 18 gage minimum.
- J. Support hubless cast iron pipe and fittings per CISPI 301-12. Brace hubless cast iron pipe and fittings 5 inches and larger using Holdrite 117 Series No-Hub Pipe and Fitting Restraints or approved equal.
- K. Concrete Equipment Bases: Unless otherwise noted on the drawings or in the specifications, concrete pads and bases not less than 4 inches high and which project not less than 3 inches beyond the equipment on all sides shall be provided for air handling units, fans, pumps, compressors, boilers, tank supports, and other similar floor-mounted equipment which normally requires foundations. Concrete shall conform to requirements in the concrete section of these specifications. The trade responsible for the supported equipment shall establish sizes and locations of the various concrete bases required and shall provide all necessary anchor bolts, together with templates for holding these bolts in position. Anchor bolts shall be placed in steel pipe sleeves to allow for adjustment, with a suitable plate at bottom end of sleeve to hold the bolt. When indicated in the drawings or detailed specifications, other floor-mounted items of equipment shall have a similar concrete base. Special vibration isolation foundations that are required are specified in the detailed specifications.

2.6 PIPE SLEEVES

- A. Locate sleeves during normal course of work. Provide sleeves for piping and conduit passing through concrete floor slabs and concrete, masonry, tile, and gypsum wall construction. Sleeves shall not be provided for piping and conduit running embedded in concrete or slab on grade, except that copper piping shall require sleeves through slabs on grade. Sleeves through structural members shall be only as directed by Architect. In interior wall, provide 1/4 inch space all around between sleeve and conduit, piping, or insulation of piping.

- B. Sleeves placed in exterior walls below grade shall be O.Z. Gedney Type 'FSK' or equal, Thunderline 'LINK SEAL', or equal sleeve assemblies sized for the pipe or conduit encountered, except for cast iron piping. Sleeve assembly shall provide watertight seal and electrical insulation to reduce cathodic reaction. When a sleeve passes through a wall below a concrete slab on grade, the sealing assembly shall be on the outside of the wall. When a sleeve passes through a wall into a crawl space or the building interior, the sealing assembly shall be in the crawl space or interior of the building. Provide sleeve assembly for copper piping through slab on grade, with sealing assembly located on interior side of floor slab. Where cast iron pipes pass through an exterior wall below grade, provide an iron-pipe sleeve two (2) pipe sizes greater than pipe passing through. Caulk between pipe and sleeve with a rubber-based compound.
- C. Where sleeves are located through fire-rated walls and floor/ceiling assemblies, provide sleeves and protect the penetration in accordance with Underwriter's Laboratories, Inc., Fire Resistance Directory, Volume II, Ratings for Through Firestop Penetrations.
- D. Sleeves in mechanical rooms with floor drains or hose bibbs shall extend 4 inches above floor. Provide flanges or flashing rings with sleeves in floors with waterproof membrane and clamp or flash into the membrane. Provide sleeves flush with floor in other rooms.
- E. Sleeves shall be constructed of 20 gage galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. All other sleeves shall be constructed of galvanized steel pipe unless otherwise indicated.
- F. Fasten sleeves securely in floors or walls so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster, or other materials from being forced into the space between pipe and sleeve during construction.

2.7 WALL, FLOOR AND CEILING PLATES (ESCUTCHEONS)

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with setscrew for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes, and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 3/32-inch for floor plates. For wall and ceiling plates, not less than 0.025 for up to 3-inch pipe, 0.035 for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, except mechanical rooms.

2.8 ACCESS PANELS

- A. Under each applicable section of the detailed mechanical specifications, the Contractor shall provide access panels in all locations where required for access to concealed valves, traps, air cushions, controls, dampers, damper operators, junction boxes, and any other equipment or materials requiring inspection or maintenance. Access panels shall be of adequate size and properly located so that concealed items will be readily accessible for servicing or for removing and replacing if necessary, except as indicated or specified otherwise. Access panels are not required in ceilings formed of removable acoustical panels.
- B. Access panels that are not fire-rated shall be Milcor or equal. Provide modular-sized access panels in inaccessible acoustic tile ceilings sized according to the tile size. Provide Milcor metal access panels with cam lock and mounting trim to match finish encountered. Provide natural anodized aluminum finish for panels in kitchens and toilets. Provide prime finished steel for panels in other areas. Paint panels in finished areas to match finish surface.
- C. Where indicated and where access panels are installed in walls of shafts that are not sealed at each floor, access panels shall be Milcor or equal "Fire-Rated" and shall bear the Underwriters' Laboratories, Inc. Class B, 1-1/2 hour label. Openings shall be framed in accordance with the access panel manufacturer's recommendations. Frames shall be not lighter than 16-gage steel. Panels shall be not lighter than 20-gage steel and shall be insulated sandwich type. Panels shall have a continuous hinge, self-lubricating lock, a direct action-knurled knob, and an interior latch release mechanism.

2.9 CHARTS, DIAGRAMS, AND SCHEMES

- A. Charts, diagrams, and schemes listed below shall be provided under each applicable section of the detailed mechanical specifications by the Contractor, framed under glass, and installed where shown on the drawings or directed in the field. All charts, diagrams, and schemes shall be complete, neat, clear, legible, and permanent.
- B. Electric sequence control diagrams of all mechanical system components.
- C. Automatic temperature control diagrams identified as to name, sequence of operation, location, function, temperature setting, spring range, and manufacturer's part number.
- D. Valve identification chart with typewritten schedule of all valves giving their tag number, description, system served, and normal operation position.
- E. Piping schemes where required by the detailed specifications.

2.10 CATALOG DATA FOR OWNER

- A. Furnish one (1) bound copy of Catalog Data on each manufactured item of equipment used in the mechanical work, complete with index listing the products alphabetically by name, together with the names and addresses of manufacturers, sales, and service representatives. Furnish two (2) bound copies of Operating and Maintenance Instructions of each item of equipment. Catalog Data and Operating and Maintenance Instructions shall be submitted to the Engineer for review prior to transmittal to the Owner.

2.11 RECORD OF AS-BUILTS AND CONDITIONS

- A. Provide a complete set of prints of mechanical plans marked to indicate as-built conditions which are different from those shown on the original construction documents. Site as-built conditions which are different from the construction documents shall be dimensioned from building or identifiable marker. Accurate locations of all concealed utility lines, both interior and exterior shall be recorded. These drawings shall be delivered to the Architect/Engineer before being turned over to the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordination of Work:
 - 1. The Contractor shall compare the mechanical drawings and specifications with the drawings and specifications of other trades, and shall report any discrepancies between them to the Architect/Engineer, and shall obtain from him written instructions for changes necessary in the mechanical work. The mechanical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the Contractor shall make proper provision to avoid interferences in a manner approved by the Architect/Engineer. All changes required in the work of the Contractor caused by his neglect to do so shall be made by him at his own expense.
 - 2. Anchor bolts, sleeves, inserts, and supports that may be required for the work shall be fully coordinated and compatible with the related equipment or materials. Locations shall be determined by the trade installing the related equipment or materials.
 - 3. Slots, chases, openings, and recesses through floors, walls, ceilings, roofs, and partitions shall be located by the trades requiring them.
 - 4. Locations of pipes, ducts, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The installing Contractors shall coordinate their work to the building structure and to other trades as directed by the General Contractor. No additional compensation or extension of completion time will be granted for extra work caused by a lack of coordination. The installing Contractor shall provide dimensions and locations of all openings,

shafts, and similar items to the General Contractor for his coordination and execution. Work shall be installed as required so as not to interfere with or delay the building construction. Pipes, ducts, etc., shall be concealed above ceilings, in walls, or in floors as applicable in all areas of the building except in equipment rooms, unfinished storage rooms, or other areas specifically noted to the contrary.

- a. Right-of-Way: Lines which pitch shall have right-of-way over those which do not pitch. For example, plumbing drains shall normally have right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.
 - b. Offsets, transitions, and changes in direction of pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all traps, drains, air vents, sanitary vents, etc., as required to affect these offsets, transitions, and changes in direction.
5. Exact locations of items such as diffusers, grilles, thermostats, hose bibbs, wall hydrants, and other similar items in finished areas of the building and on the exterior of the building shall be coordinated with each other, the building structure, and architectural features thereof so as to be aligned with or centered on other items as applicable. Locations indicated on the drawings are approximate. Trades shall coordinate their work with door swings, block coursing, tile arrangement, and other similar features before establishing the location of any components. Before any related work has begun, the Architect/Engineer may direct reasonable minor changes in equipment locations with no increase in contract price to the Owner. Thermostats shall be mounted so that the top of the thermostat is 48” above the floor and aligned with the top of the light switch plates and 8” from the light switch if shown on the drawings adjacent to a light switch. Room thermostat locations shall be coordinated with door swings, light switches and other wall mounted items. Corridor thermostats shall be mounted 60” above finished floor. Before roughing in conduit or pipe, verify the location of equipment to be connected.
 6. Installation and Arrangement: The Contractor shall install all mechanical work to permit removal of coils, heat exchanger bundles, boiler tubes, fan shafts and wheels, filters, belt guards, sheaves and drives, and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes, ducts, and equipment to permit ready access to valves, cocks, traps, motors, control components, and to clear the openings of swinging and overhead doors and of access panels.
 7. Ductwork: The Contractor shall change the cross-sectional dimensions of ductwork when required to meet job conditions but shall maintain at least the same equivalent cross-sectional area. The Contractor shall secure the approval of the Architect/Engineer prior to fabrication of ductwork requiring substantial changes. Ductwork shall not be fabricated until coordination with available space.
 8. Drawings by Contractor: When directed by the Architect/Engineer, the Contractor shall submit for review by Architect/Engineer drawings clearly showing certain

portions of the mechanical work and its relation to the work of other trades before beginning shop fabrication or erection in the field.

9. **Dimensions:** The Contractor shall ensure that items to be furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suite the true intent and meaning of the drawings and specifications. If he concludes that there is insufficient space for installation or specified materials, he shall immediately notify the Architect/Engineer of the conflict and shall stop affected work until he receives instructions as to how to proceed from the Architect/Engineer.
10. **Damage to Work:** The Contractor is responsible for damage caused by his work or workmen. Repairing of damaged work shall be done by the Contractor as directed by the Engineer at no additional cost.
11. The Contractor shall be responsible for any interruptions to existing services and shall repair any damages to existing systems caused by his operations.

B. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations. Damaged or defective items, in the opinion of the Architect/Engineer, shall be replaced.
2. All items subject to moisture damage (such as controls and electrical equipment) shall be stored in dry, heated spaces.
3. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water, chemical or mechanical injury. Clean mechanical equipment to remove dust, oil, dirt, plaster, mortar, trash, or paint. Piping, conduit, and ductwork shall be blown out or flushed of all foreign matter before wires are pulled in or before connections are made to equipment or systems. (Clean each boiler in accordance with manufacturer's instructions before connecting to the system.) Provide temporary filters for air units that are operated during construction. After all construction dirt has been removed from the building, install new filters in air units.

C. Concrete and Grout: Use concrete and shrink compensating grout 3000 psi minimum.

D. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

E. Work in Existing Buildings:

1. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills will be permitted only with approval of the Architect/Engineer. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the Architect/Engineer for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After Architect/Engineer's approval, carefully cut opening through construction not larger than is absolutely necessary for the required installation.
2. Remove existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work or any ducts, plumbing, steam, gas or electric work without approval of Architect/Engineer. Existing work (walls, ceilings, partitions, floors, mechanical, and electrical work) disturbed or removed as a result of performing required new work shall be patched, repaired, reinstalled, replaced with new work, and refinished and left in as good condition as existed before commencing work. Existing work to be altered or extended that is found to be defective in any way shall be reported to the Architect/Engineer before it is disturbed. Materials and workmanship used in restoring work shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
3. Continuity of service shall be maintained to all existing systems, except for designated short intervals during which connections are to be made. Interruptions shall be coordinated with the Owner as to the time and duration.
4. Upon completion of contract, deliver work complete and undamaged. Damage that is caused by Contractor or Contractor's workmen to existing structures, grounds, or utilities or to work done by others shall be repaired by Contractor and left in as good condition as existed prior to damaging.
 - a. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cable, etc., of utility services or of fire protection system and communications systems (except telephone) which are not scheduled for discontinuance or abandonment.
 - b. Restoration work required by damage to telephone systems shall be done by telephone company at Contractor's expense.

3.2 PIPING

- A. Under each applicable section of the detailed mechanical specifications, the Contractor shall furnish and install as shown on the drawings or as necessary to complete the working system in accordance with the intent of the drawings and specifications, a complete system of piping, valves, supports, anchors, sleeves, and all other appurtenances. The piping drawings are diagrammatic and indicate the general location and connections. The piping may have to be offset, lowered, or raised as required or as directed at the site. This does not relieve the Contractor of responsibility for the proper erection of systems of piping in

every respect suitable for the work intended as described in the specifications and as approved by the Architect/Engineer. Wherever two dissimilar metals join in any piping system, install a dielectric fitting at their intersection.

- B. Installation: Piping shall be properly supported and adequate provisions shall be made for expansion, contraction, slope, and anchorage without damage to joints or hangers. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all windows, doors, and other openings and equipment. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe extending through the roof shall be properly flashed. All changes in direction shall be made with fittings. Wherever pipe hanger bears directly on the pipe being supported, the hanger shall be of the same material as the pipe.

- C. Arrangement: All piping shall be arranged so as not to interfere with removal of other equipment or devices nor to block access to doors, windows, manholes, or other access openings. Piping shall be arranged so as to facilitate removal of tube bundles. Flanges or unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment. Piping shall be placed and installed so that there will be no interference with the installation of the equipment, ducts, etc. All piping shall be installed to ensure noiseless circulation. All piping shall be erected and pitched to ensure proper drainage. Piping shall be installed so as to avoid liquid or air pockets throughout the work. Pipe in finished areas shall be concealed. Exposed piping shall be installed in practical alignment with the building. All valves and specialties shall be placed to permit easy operation and access, and all valves shall be regulated, packed, and glands adjusted at the completion of the work before final acceptance. Water pipes shall not be installed in attic spaces, crawl spaces or similar areas which are subject to freezing, unless indicated to be heat traced.

- D. Underground Piping: Each pipe shall be laid true to line and grade and in such manner as to form a close concentric joint with adjoining pipe and to prevent sudden offsets to flow line. As work progresses, the interior of the pipe shall be cleared of dirt and superfluous materials of every description. Where cleaning after laying is difficult because of small pipe size, a suitable swag or drag shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. Trenches shall be kept free from water until pipe jointing material has set. Pipe shall not be laid when the condition of the trench or weather is unsuitable for such work. At all times when work is not in progress, all open ends of pipe and fittings shall be securely closed so that no water, earth, or other substance will enter the pipe or fittings.

3.3 PIPE AND EQUIPMENT SUPPORTS

- A. Supports: The Contractor shall support plumb, rigid, and true to line all work and equipment furnished under each section of these specifications. The Contractor shall study thoroughly all general, structural, and mechanical drawings, shop drawings, and catalog

data to determine how equipment, fixtures, piping, ductwork, etc., are to be supported, mounted, or suspended, and shall provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper support, whether or not shown on the drawings. When directed, the Contractor shall submit drawings showing supports for review by the Architect/Engineer.

- B. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the Architect/Engineer.
- C. Use of chain, wire or strap hangers; wood for blocking stays or bracing; or hangers suspended from piping above will not be permitted. If products are rusty, replace or thoroughly clean and coat with prime paint.
- D. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 2-inch clearance between pipe or pipe covering and adjacent work.
- E. Horizontal Pipe Support Spacing:
 - 1. Cast Iron: Five feet on centers maximum spacing. At least one hanger on each full length of pipe, close to hub where possible and at least one within 24 inches of each fitting, and wherever else required to prevent tendency toward deflection due to load. Provide a hanger at upper angle at each drop. Locate hangers adjacent to hubs on multiple fittings not more than four feet on centers.
 - 2. For support spacing of all other horizontal piping, refer to MSS SP-69 and provide additional supports at valves, strainers, inline pumps and other heavy components. Provide a support within one foot of each elbow.
 - 3. Black Steel Gas Piping: 8 feet on centers maximum spacing for on-roof horizontal supports. Provide a support within one (1) foot of each elbow.
- F. Vertical Pipe Supports – HVAC and Gas:
 - 1. Vertical runs less than 15 feet long may be supported by the hangers on the connecting horizontal runs.
 - 2. Up to 6-Inch Pipe, 60 Feet Long or Not Over 12-Inch Pipe Up to 30 Feet Long: Riser clamps bolted to pipe below couplings or welded to pipe and resting securely on the building structure.
 - 3. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.
- G. Connections: All piping connecting to equipment shall be installed without strain at the piping connection. The Contractor shall be required as directed to remove the bolts in flanged connections or to disconnect piping to demonstrate that piping has been so connected.

- H. Gas Piping Supports: Shall have electro-galvanized steel top with (aluminum roller) (polymeric) supports, the roller axle, fittings and other hardware shall be galvanized steel or polymeric material. Support base shall be secured to roof with adhesive roofing mastic. Roofing membrane shall be compatible with mastic. Consult manufacturer of existing roofing system if isolation pads are required between roof membrane and support base. Consult manufacturer of existing or new roofing system to verify appropriate adhesive to bond base to roofing surface. Do not use wood as support materials. (Support base shall be secured to roof with zinc-coated bolts to structure.)
- I. Gas Piping Anchors: Shall be bolted or field welded to piping. Anchors shall be attached with zinc-coated or galvanized bolts or field welded to angle iron attached to building structure and HVAC equipment curb.

3.4 MOTOR AND DRIVE ALIGNMENT

- A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.
- B. Direct-Connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

3.5 EXCAVATION AND TRENCHING

- A. Under each applicable section of the detailed mechanical specifications, the Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the drawings or as otherwise specified. No extras will be allowed for rock unless indicated otherwise. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or suitable for backfill shall be removed and wasted as indicated on the drawings or as directed by the Architect/Engineer. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other approved method. Such sheeting and shoring shall be done as may be necessary for the protection of the work and for the safety of personnel. Unless otherwise indicated, excavation shall be by open cut except that short sections of a trench may be tunneled if, in the opinion of the Architect/Engineer, the pipe or duct can be safely and properly installed and backfill can be properly tamped in such tunnel sections.
- B. Trench Excavations (Includes under building and 5 feet outside of building): Trenches shall be of necessary width for the proper laying of the pipe or duct, and the banks shall be as nearly vertical as practicable. The bottom of the trenches shall be accurately graded to

provide uniform bearing and support for each section of the pipe or duct on undisturbed soil at every point along its entire length. Except where rock is encountered, care shall be taken not to excavate below the depths indicated. Where rock excavations are required, the rock shall be excavated to a minimum over depth of 4 inches below the trench depths indicated on the drawings or specified. Over-depths in the rock excavation and authorized over depths shall be backfilled with loose, granular, moist earth, thoroughly tamped. When corrosive material or unstable soil or material that is incapable of supporting the pipe is encountered in the bottom of the trench, the Contractor shall promptly notify the Architect/Engineer. Such unsuitable soil or material shall be removed to a depth as directed by Architect/Engineer and the trench backfilled to the proper grade with coarse sand, fine gravel, or other suitable backfill material, as directed by the Architect/Engineer.

- C. Sanitary Sewers, Storm Sewers, and Water Mains: The width of the trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench shall be between 6 and 12 inches on either side of the pipe. The width of the trench above that level may be as wide as necessary for sheeting and bracing and the proper performance of the work. The bottom of the trench shall be rounded so that at least the bottom quadrant of the pipe shall rest firmly on undisturbed soil for as much of the full length of the barrel as proper jointing operations will permit. This part of the excavation shall be done manually only a few feet in advance of the pipe laying by men skilled in this type of work.
- D. Protection of Existing Utilities: Existing utility lines to be retained that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation, as well as all utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor, at his expense.

3.6 BACKFILLING OF TRENCHES

- A. Trenches shall not be backfilled until all required pressure and other tests and inspections have been performed and until the utilities systems as installed conform to the requirements of the drawings and specifications. Trenches for piping or duct shall be carefully backfilled with materials consisting of earth, loam, sandy clay, sand and gravel, soft shale, or other approved materials saved from the excavation or borrowed as required. The backfill materials shall be granular in nature and shall not contain coal, dust, cinders, ashes, roots, sod, rubbish, corrosive materials, large clods of earth, or stones over 2-inch maximum dimension. The Architect/Engineer may reject any on-site or borrowed materials which he considers unsuitable for the intended use of the fill.
- B. Controlled compacted backfill shall be used under slabs-on-grade, building structure, concrete paving, asphaltic concrete paving, driveway, parking areas, and other areas so specified or indicated on the drawings. All backfill required to raise the surface to the desired subgrade shall be continuously controlled and placed in maximum of 8-inch loosely placed lifts and compacted to 100 percent maximum dry density beneath the building and

95 percent under all paved drives and parking areas in accordance with ASTM D 698 (Standard Proctor). The soils engineer shall check each lift and submit reports to the Architect/Engineer in accordance with Section, Earthwork.

- C. Normal Backfill: Where controlled compacted backfill is not required, such as grassed areas, the trenches shall be carefully backfilled with material in eight-inch layers and thoroughly and carefully rammed until cover is not less than one foot. The remainder of the backfill material shall then be carefully placed in the trench in one-foot layers and tamped. The surface shall be graded to a reasonable uniformity and the mounding over trenches left in a uniform and neat condition as approved by the Architect/Engineer.
- D. Test for Displacement of Sewers: Storm and sanitary sewer mains shall be checked by the Contractor to determine whether any displacement of the pipe has occurred after the trench has been backfilled to two feet or more above the pipe. A light shall be flashed between manhole locations and through each straight section of pipe. If the illuminated interior of the pipeline shows poor alignment, displaced pipe, or any other defects, in the opinion of the Architect/Engineer, such defects shall be remedied by the Contractor at his expense.
- E. Plants, turf, and surfacing that are to remain in the area of the excavation shall be carefully removed and placed where they will not be damaged. After the excavations are filled, the plants, turf, and surfacing shall be replaced as directed. Provide repairs for sidewalks, driveways, and other cement and asphalt surfaces which are damaged during excavating to match the adjacent work in material and finish.

3.7 CUTTING AND PATCHING

- A. The Contractor shall be responsible for all required digging, cutting, etc., incident to the work, and shall thereafter make all required repairs necessary to restore the cut structure or material to the condition existing prior to the cutting. In no case shall the Contractor cut into any major structural element, beam, or column without the written approval of the Architect/Engineer. All cutting, patching, repairing, or replacing of work required because of fault, error, tardiness, or damage by any trade shall be performed with no increase in the contract price to the Owner.
- B. Patch and repair roof in accordance with requirements of existing roof warranties and manufacturer's standard approved details.

3.8 LUBRICATION

- A. Under each applicable section of the detailed mechanical specifications, the Contractor shall provide all oil and grease required for the operation of all equipment until acceptance by the Owner. The type and application of all lubricants shall conform to the recommendations of the manufacturer of the equipment involved. The Contractor shall be held responsible for all damage to bearings while the equipment is being operated by him

up to the date of acceptance of the project. This Contractor shall be required to protect all bearings during installation and shall thoroughly grease or otherwise protect steel shafts and other bare ferrous parts to prevent corrosion. All equipment shall be provided with covers as necessary for proper protection against damage or deterioration during construction.

3.9 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, perform required tests as specified in Section 23 05 93, TESTING, ADJUSTING AND BALANCING FOR HVAC, and submit the test reports and records to the Architect/Engineer.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of the work.

3.10 QUIET OPERATION AND VIBRATION

- A. Systems shall operate under conditions of load without unusual or excessive noise or vibration. Unusual or excessive noise or vibration shall be corrected.

3.11 INSTRUCTIONS TO OWNER'S PERSONNEL

- A. Under each applicable section of the detailed mechanical specifications, the Contractor shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the mechanical systems. A competent representative of the Contractor shall spend not less than two days in such formal instruction and shall spend such additional time as directed by the Architect/Engineer to fully prepare the Owner to operate and maintain the mechanical systems. The Contractor shall provide letter of instruction upon completion to the Architect/Engineer stating the date of instruction and the names of those in attendance.

3.12 GUARANTEE

- A. All mechanical equipment, materials, and labor required by the contract documents for this project shall be guaranteed to be free of defective materials or workmanship for a period of one year after final acceptance of the project. Defects in equipment, materials, or

workmanship occurring during this period shall be corrected with new equipment and materials or additional labor at no cost to the Owner.

3.13 SITE VISIT REPORT

- A. Answer in writing each item of discrepancy noted on all site visit reports.

3.14 DEMOLITION

- A. Contractor shall visit the site before bidding to determine the extent and location of demolition to be performed.
- B. Contractor to remove all pipes, ducts, equipment, controls, etc. not required, reused or needed for reconnecting to the new systems. All items not required for the new system shall be removed.
- C. The Owner shall select and retain such existing items indicated or required to be removed as he desires. Items selected by the Owner to be retained shall be removed and relocated to an Owner designated location by the Contractor.
- D. All equipment, piping, ductwork, conduit, etc. to remain and be reused shall be protected from damage. Any damage to existing material shall be repaired to original condition.
- E. Coordinate all demolition activities with the phasing of construction. Demolition shall not affect operations of the building.

3.15 PHASING OF WORK

- A. The mechanical contractor is required to fully understand the phasing of work and to coordinate his work according to phasing plan drawings and related sections of the specifications.
- B. Sections of the existing building will continue to be occupied during renovation. The contractor shall be responsible for retaining existing HVAC systems to serve the occupied sections of the building. Otherwise, the contractor shall provide interim HVAC systems for the occupied sections of the building.
- C. The contractor is cautioned to fully understand the need to operate HVAC systems during construction and to block off ductwork serving areas under construction. Protect return ductwork with temporary filters at air inlet grilles, etc.

- D. Provide temporary HVAC to protect the owner's property from freeze damage and from high humidity. For new construction, provide HVAC for proper drying and application of finishes.
- E. Portions of the renovated building will be reoccupied as sections of renovation become complete. The contractor shall be responsible for providing HVAC for the reoccupied sections of building.

END OF SECTION 230000

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SECTION 230593 - TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 CONDITIONS

- A. The applicable provisions of Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) are hereby made a part of this section, and the Contractor is cautioned to read Section 230000 carefully as items of work applicable to this section are included in Section 230000.

1.2 DESCRIPTION OF WORK

- A. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems.
- B. The Contractor shall provide all labor, materials, instruments, equipment and service and shall perform all operations required for testing, adjusting, and balancing of systems and related work to obtain the performance of the systems as shown on the drawings and in the specifications.
- C. Definitions:
 - 1. Basic TAB terms used in this section: "Testing, Adjusting and Balancing" of ASHRAE Handbook, latest edition.
 - 2. TAB: Testing, adjusting and balancing. The process of checking and adjusting HVAC systems to meet design objectives.
 - 3. AABA: Associated Air Balance Council.
 - 4. NEBB: National Environmental Balancing Bureau.
 - 5. Air Systems: Includes all supply air, return air, exhaust air and outside air systems.

1.3 RELATED WORK

- A. Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).
- B. Section 230900, INSTRUMENTATION AND CONTROLS FOR HVAC.
- C. Section 232000, HVAC PIPING AND PUMPS.
- D. Section 232133, VARIABLE SPEED DRIVES.
- E. Section 233000, HVAC AIR DISTRIBUTION.

- F. Section 238100, DECENTRALIZED UNITARY HVAC EQUIPMENT.

1.4 QUALITY ASSURANCE

- A. TAB Agency Qualifications: The Contractor shall provide the services of a firm certified by the Associated Air Balancing Council, or the National Environment Balancing Bureau to adjust and balance all heating, ventilating, air conditioning, and exhaust systems. All personnel involved in the execution of the work shall be experienced in the balancing of mechanical systems. The firm shall not be the installer of the systems to be tested and shall be otherwise independent of the project.
- B. Performance Criteria: Work shall be performed in accordance with the approved TAB Agenda.
- C. Test Equipment Criteria: The basic instrumentation requirements and accuracy/calibration required by AABC (Section Two) or Section II of the NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.
- D. Guarantee: The AABC or NEBB certified firm shall guarantee that all testing, adjusting and balancing work shall be performed in accordance with NEBB standards and procedures and shall provide evidence of their certification for the Architect/Engineer.

1.5 THE TAB AGENDA

- A. Definition: The proposed TAB procedures and proposed forms, diagrams, and reports for documenting the TAB work.
- B. Preparation: By the TAB Agency for review and approval by the Architect/ Engineer.
- C. The agenda shall include one complete set of the AABC or NEBB publications or, in the case of other TAB organizations, comparable publications to establish an approved systematic and uniform set of procedures.
- D. The Agenda shall also include the following detailed narrative procedures, system diagrams and forms for test results.
 - 1. Specific standard procedures required and proposed for each system. Additional procedures for variable flow systems shall be developed by the TAB Agency and included for review and approval.
 - 2. Specified test forms for recording each TAB procedure and for recording sound and vibration measurements. Additional test forms for any variable flow systems shall be developed by TAB agency and submitted for review and approval.

3. System diagrams for each air and water system. Diagrams may be single line. In addition to the information recorded for standard AABC or NEBB procedures, report the following information:
 - a. Air Handling Units: Show design and actual CFM (outside air, return air, supply air). Measure and record each mode (minimum OA and 100% OA) where economizer cycle is specified.
 - b. Duct Distribution Systems: Record residual pressures at inlets of volume controlled terminals at ends of system. Show actual pressures at all static pressure control points utilized for constant or variable flow systems.

1.6 SUBMITTALS

- A. In accordance with Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) General Requirements, furnish the following:
 1. TAB Agency qualifications, submit name and qualifications of job supervisor.
 2. Upon approval of TAB Agency, submit TAB AGENDA for approval.
 3. After completion of tests, the Contractor shall submit three copies of complete test reports for approval. Applicable NEBB or AABC reporting forms shall be used. Where test results differ from specified design conditions, indicating a contract deficiency, include explanatory comments in report. The Contractor shall submit final reports prior to requesting the final inspection for the project.
 4. Approved copy of report shall be bound in Operations and Maintenance Manuals; see Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The TAB agency shall be responsible for all items or materials necessary for connection of its instrumentation to the ductwork, piping or equipment. Test ports in ducts and plenums shall be installed by the Mechanical Contractor as directed by the TAB agency during the construction of the systems. Test ports shall be identified. Do not proceed with testing, adjusting, and balancing work until systems are complete and operational.

PART 3 - EXECUTION

3.1 GENERAL

- A. The General Contractor shall furnish a complete set of HVAC drawings and specifications to the TAB agency. The agency shall review plans and specifications prior to systems installation and submit a written report indicating deficiencies in the system that would preclude the proper adjusting, balancing, and testing of the system. The HVAC system shall be complete and fully operational with clean air filters and clean pipe strainers prior to system balancing. The TAB agency shall review the installed system for proper installation of testing, adjusting, and balancing equipment and submit a written report indicating system conditions. The Mechanical Contractor shall provide support through factory representatives, equipment mechanics, and control technicians to work with the balancing organization to adjust equipment and controls to obtain design performance.
- B. Coordinate TAB procedures with any phased construction requirements for the project so that usable increments of finished work may be accepted for beneficial occupancy. Systems serving partially occupied phases of the project may require balancing for each phase prior to final balancing.
- C. Allow sufficient time in construction schedule for TAB prior to final inspection for the project.
- D. Accomplish TAB in accordance with the Agenda approved by the Architect/Engineer. Put all HVAC systems into full operation and continue operation of the systems during each working day of TAB.
- E. Notify Architect/Engineer 48 hours prior to TAB work.
- F. The TAB agency shall be responsible for adjusting sheaves to acquire required air quantities. If the sheaves require replacement, the sheaves and belts will be replaced by the installer of the equipment.
- G. One week before the final site visit, the balancing organization shall provide the Architect/Engineer with three (3) typed copies of balance reports, in format recommended by NEBB. The report shall contain the following:
 - 1. Project name, location, contractors names, balancing organizations' name, and date.
 - 2. Balancing organizations' certification and individual certified qualifications of persons responsible for supervising and performing the actual work.
 - 3. Brief description of balancing instruments used for this project and their latest calibration performance.
 - 4. Weather conditions at the beginning and end of each day to include; outside dry bulb and wet bulb temperatures, general weather description and cloud cover.
 - 5. System data for each unit:
 - a. Installation data as applicable; mark, location, manufacturer, model, size, arrangement, motor HP, voltage, phase, and full load amps.

- b. Design quantities and balance readings taken during the balancing operation indicating the quantity measured on the first reading, and the final, balanced, measured quantity for air and hydronic balance.

3.2 AIR BALANCE

- A. Place all interactive systems in operation with all filters installed and automatic control systems completed and operating. Artificially load air filters by partial blanking or other means to produce air pressure drop midway between the clean and dirty condition. Set/reset room thermostats as necessary to check heating and cooling function, and flow rates for factory set air terminal units and adjust units if not correct.
- B. Balance systems to design ratings. Adjust fan speeds to provide design flows, including system diversities, at actual system pressures. V-belt drives, including fixed pitch requirements, are specified in Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) General Requirements. Coordinate VAV balancing, including supply and return fan volume controls, with Section 230900, Instrumentation and Controls for HVAC. Set supply fan static pressure control as low as practicable and still maintain required pressure at the remote terminal units. The drive motor of each fan shall not be loaded over the corrected full load amperage rating of the motor involved.
- C. Make pitot tube traverses of all trunk lines and major branches when required to determine proper proportioning of air flows. Air flow measuring devices, where installed, may be utilized for this purpose.
- D. Record pressure drop readings across all major systems.
- E. Make flow measurements at each terminal device and each supply, return, or exhaust diffuser. Adjust each air outlet unit within plus or minus 10 percent of design requirements. Adjust grilles and diffusers to minimize drafts in all areas.
- F. Adjust outside air and return air quantities for all systems to within plus or minus 10 percent.
- G. Adjust exhaust systems to CFM requirements. After balance is completed, change variable shims to fixed shims.
- H. Test function of automatic dampers and operation of air terminal units.
- I. Any adjustments necessary to achieve the specified results shall be provided by the Contractor who furnished and installed such equipment under his contractual obligations. Such adjustments may encompass, but are not necessarily restricted to, the changing of pulleys and belts.
- J. Report the air balance readings for the following as further specified in 3.01.G:

1. Air handling equipment - Outdoor air quantity, return air quantity, supply air quantity, fan speed (rpm), static pressure at fan suction and discharge (inches wg.), and actual motor amp and voltage reading.
2. Exhaust fans - Air quantity, fan speed (rpm) and static pressure, actual motor amps and voltage reading.
3. Each air distribution outlet and inlet identified by location and size, air velocity (fpm) and computed air quantity (cfm).
4. Water coils - Air flow (cfm), entering and leaving air temperatures (DB and WB), load (BTU or MBH).
5. Temperature in each room in building and thermostat setting.

3.3 TEMPERATURE CONTROL TEST

- A. After the heating, ventilating and air conditioning systems have been adjusted and balanced completely, a six hour test shall be run on both the heating and cooling cycles, including the economizer cycle, to determine whether the systems are responding to the temperature controls. Thermostat settings, thermostat temperature readings, and an independent temperature measurement at the thermostat shall be recorded at each thermostat. If the tests on both the heating and cooling cycles can not be made together because of the time of the year, the test not made shall be performed later when conditions are acceptable. A supplement to the final report shall be filed when later tests are made.
- B. Test Verification - The TAB agency shall attest by letter that all equipment has been wired and tested to see that the indicated sequence of motor control is established, that all safety controls function properly, that all motor protective devices are sized correctly, and that the systems are operating at the points set on the controls.
- C. Control Setting - During the performance tests, control settings may require adjustment and if so, shall be adjusted to produce the best balanced system operation. The final setting of each operating and safety control shall be recorded. This shall include but not be limited to thermostats, limit controls, damper position switches, smokestats, firestats, freezestats, aquastats, and other similar items.
- D. Marking of settings - Upon completion of system balancing the settings of adjustment devices including valves and dampers shall be permanently marked. Do not mark room mounted thermostats.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 CONDITIONS

- A. The applicable provisions of Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) General Requirements, are hereby made a part of this section, and the Contractor is cautioned to read Section 230000 carefully as items of work applicable to this section are included in Section 230000.

1.2 DESCRIPTION OF WORK

- A. The work to be performed under this section of the specifications comprises the furnishing of all labor and materials and the completion of all work of this section as shown on the drawings and/or herein specified.
- B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.
- C. In general, the work included under this section consists of, but is not limited to, the following:
 - 1. Field applied insulation for thermal efficiency and condensation control for HVAC and plumbing piping, ductwork and equipment.

1.3 RELATED WORK

- A. Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).
- B. Section 232000, HVAC PIPING AND PUMPS.
- C. Section 233000, HVAC AIR DISTRIBUTION.
- D. Section 238100, DECENTRALIZED UNITARY HVAC EQUIPMENT.

1.4 SUBMITTALS

- A. In accordance with Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) General Requirements, furnish the following:

1. Manufacturer's Literature and Dimension Cuts:
 - a. Insulation Materials: Each type used. State surface burning characteristics and thermal properties.
 - b. Insulation Facings and Jackets: Each type used. State vapor barrier properties. State that white finish will be furnished for exposed pipe, ductwork, casings, and equipment.
 - c. Insulation Accessory Materials: Each type used.
 - d. Manufacturer's installation and fitting fabrication instructions for elastomeric unicellular insulation.
 - e. Make reference to applicable specification paragraph numbers for coordination.

1.5 DEFINITIONS

- A. Air Conditioned Space: Space directly supplied with cooled air.
- B. Cold: Equipment, ductwork or piping handling media at design temperature of 60 Deg. F. or below.
- C. Hot: Ductwork handling air at design temperature above 60 Deg. F.; equipment or piping handling media above 105 Deg. F.
- D. PCF: Density, pounds per cubic foot.
- E. VOC's: Volatile Organic Compounds
- F. Runout: Branch pipe connection up to one inch nominal size and not over 12 feet in length to a floor mounted or ceiling mounted terminal unit.
- G. Thermal Conductance: Heat flow rate through materials.
 1. Flat Surface: BTU per hour per square foot.
 2. Pipe or Cylinder: BTU per hour per linear foot.
- H. Thermal Conductivity (k): $(\text{BTU} \cdot \text{in thickness}) / (\text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F temperature difference})$.
- I. Outside: Open to view beyond the exterior side of walls, above the roof and unexcavated or crawl spaces, above or beneath pier floors, in tunnels or exposed on all sides in trenches connected or not connected to an exterior portion of a building.
- J. Finished Spaces: Spaces used for habitation or occupancy where rough surfaces are plastered, paneled, or otherwise treated to provide a pleasing appearance.

- K. Unfinished Spaces: Spaces used for storage or work areas where appearance is not a factor, unexcavated spaces, crawl spaces, etc.
- L. Concealed Spaces: Spaces between a ceiling and floor construction above or between double walls or furred-in areas, pipe and duct shafts, etc.
- M. Exposed: Open to view inside the building. For example, pipe run through a room, and not covered by other construction, is exposed.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Building characteristics of insulation materials shall comply with NFPA 90A, pertinent parts of which are noted as follows:
 - 1. Duct coverings, duct linings, vapor barrier facings, tapes, and core materials in panels used in duct systems shall have a flame spread rating not over 25 without evidence of continued progressive combustion and a smoke developed rating not higher than 50. If coverings and linings are to be applied with adhesives, they shall be tested as applied with such adhesives, or the adhesives used shall have a flame spread rating not over 25 and a smoke developed rating no higher than 50 when in the final dry state.
 - 2. Duct coverings and linings shall not flame, glow, smolder, or smoke when tested in accordance with ASTM C 411 at the temperature to which it is exposed in service. In no case shall the test temperature be below 250 Deg. F.
 - 3. Pipe insulation and coverings shall meet the requirements of 2-3.3.1 and 2-3.3.2 when installed in ducts, plenums, or concealed spaces used as part of the air distribution system.
 - 4. In addition to NFPA, the insulation material shall not transform into a molten flaming liquid during combustion as characterized by some polyethylenes.
- B. Test Methods: ASTM E 84, UL 723, or NFPA 255.
- C. Insulation shall be Johns Manville, Owens Corning, Pittsburg Corning, or Armacell. Trade names are used herein, unless indicated otherwise, to establish a standard of quality.
- D. Specified k factors are at 75 Deg. F. mean temperature unless stated otherwise. Where optional insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For a flat surface, thermal conductance equal thermal conductivity (k) divided by the thickness of the insulation. For runout insulation and condensation control insulation, no thickness adjustment need be made.

- E. All materials shall be compatible and suitable for service temperature and shall not contribute to corrosion or otherwise attack surfaces to which applied in either the wet or dry state.
- F. Underwriters' Laboratories, Inc. label or listing, or satisfactory certified test report from an approved testing laboratory will be required to show that surface burning characteristics for materials to be used do not exceed specified ratings.
- G. All sealants and adhesives must comply with all applicable South Coast Air Quality Management District (SCAQMD) VOC limits including but not limited to Rule #1168. All mastics and coatings must comply with all applicable Green Seal GS-11 VOC limits.

2.2 FACINGS AND JACKETS

- A. Fed. Spec. HH-B-100 for Vapor Barrier Types I and II:
 - 1. Puncture Test Method: ASTM D 781.
 - 2. Type I, Low Vapor Transmission (0.02 Perm Rating), Beach Puncture 50 Units: For insulating facing on exposed ductwork, casings, and equipment, and for all pipe insulation jackets. Facings and jackets shall be white all service type (ASJ) suitable for painting without priming.
 - 3. Type II, Medium Vapor Transmission, Beach Puncture 25 Units: Foil-Scrim-Kraft (FSK) type for concealed ductwork and equipment.
 - 4. Factory composite materials may be used provided they have been tested and certified by the manufacturer to meet Beach puncture units specified above.
 - 5. Fire and smoke treatment of jackets and facings shall be permanent. The use of water soluble treatments is not acceptable.
 - 6. Pipe insulation jackets shall have 1-1/2 inch minimum lap at longitudinal joints and not less than 3-inch butt strips at end joints. Facing on board, blanket and block insulation shall have 2-inch laps or 3-inch minimum butt strips. Butt strip material shall be the same as the jacket or facing. Laps and butt strips may be self-sealing type with factory applied pressure sensitive adhesive.

2.3 MINERAL FIBER INSULATION

- A. Owens-Corning Faced Duct Wrap Fiberglass Insulation - FRK Type 100, ASTM C 553-92 (Blanket, Flexible), Density 1 pcf, $k = 0.31$, for temperatures up to 250 Deg. F.
 - 1. Concealed supply air ductwork within building's thermal envelope shall be 1-1/2 inch thick insulation.
 - 2. Concealed outdoor air ductwork within building's thermal envelope shall be 2-inch thick insulation.
 - 3. Concealed supply air ductwork outside building's thermal envelope shall be 2-inch thick insulation.

4. Concealed return air ductwork within building's thermal envelope need not be insulated.
 5. Concealed return air ductwork outside building's thermal envelope shall be 2-inch thick insulation.
 6. Concealed exhaust air ductwork within building's thermal envelope and within 10 feet of connection to outdoors shall be 1-1/2 inch thick insulation.
 7. Concealed exhaust air ductwork outside building's thermal envelope shall be 1-1/2 inch thick insulation.
 8. Concealed ductwork with acoustic lining within the building's thermal envelope need not be insulated.
 9. Concealed ductwork with acoustic lining outside building's thermal envelope shall be 1-1/2 inch thick insulation.
- B. Owens-Corning 705 Rigid Board Fiberglass Insulation, ASTM 612, 6 pcf density, with white laminated kraft-aluminum foil reinforced all-service vapor barrier facing.
1. Exposed outside air ductwork shall be 2-inch thick insulation.
 2. Exposed supply air ductwork shall be 1-1/2 inch thick insulation.
 3. Exposed return air ductwork and exhaust air ductwork in non-air conditioned spaces shall be 1-1/2 inch thick insulation.
 4. Exposed ductwork with acoustic lining need not be insulated.
- C. Owens-Corning Fiberglass SSL II ASJ Heavy Density Sectional Pipe Insulation, Fed. Spec. HH-I-558, Form D, Type III (Molded), Class 12, k = 0.24.
- D. Molded pipe fitting covering: Fed. Spec. HH-I-558, Form E. Class 16, k = 0.26, for temperatures up to 370 Deg. F.
- E. Insulation thickness and type for various piping systems shall be as indicated in the following table (Pipe Size/Insulation Thickness).

PIPE SIZE/INSULATION THICKNESS(1)

System	Temp. Range (°F)	Less than 1"	1" to 1-1/4"	1-1/2" to 3"	4" to 6"	8" & Up	Ins. Type (4)
Domestic Hot Water	90-159	1.5	1.5	2.0	2.0	2.0	A
Misc.	80-89	1.0	1.0	1.0	1.0	1.0	A,B
Domestic Cold Water	56-79	1.0	1.0	1.0	1.0	1.0	A

Condensate Drain	45-75	0.5	0.5	1.0	1.0	1.0	A,B
Refrig./ Brine	Below 40 (6)	1.0	1.0	1.5	1.5	1.5	B

NOTES:

- (1) Minimum thickness for insulation listed in preceding table is based on Thermal Conductivity, 'k' not exceeding 0.27 Btu per inch/hr. x sq. ft. x Deg. F. based on Mean Temperature of 75 Deg. F. Insulation with greater Thermal Conductivity shall have increased thickness to provide same performance characteristics as specified.
- (2) All horizontal storm piping above lowest floor including roof drains from underside of deck to just below fitting at top of vertical portion of stack. Fittings at top and bottom of vertical sections of horizontal offsets shall be insulated. Lap joints, tape and seal.
- (3) A - Fiberglass type insulation; B - Elastomeric type insulation.
- (4) Runouts to individual terminal units (not exceeding 12 ft. in length).
- (5) Also insulate all refrigerant pipes located in hot spaces such as attics.

2.4 ELASTOMERIC INSULATION

- A. Armstrong Armaflex II Pipe Insulation, Fed. Spec. HH-I-573 and HH-I-1751/2, k = 0.27, flame spread not over 25, smoke developed not over 50 (1/2-inch thick test material), for temperatures from minus 40 Deg. F. to 211 Deg. F. No jacket required.

2.5 CELLULAR GLASS INSULATION

- A. Pittsburgh Corning Foamglas Insulation, ASTM C 552, Type II, class 2, 8.5 pcf, closed cell rigid type.
 1. Buried steam piping, not in conduit, shall have 2 inch thick insulation.
 2. Buried pumped condensate piping, not in conduit, shall have 1 inch thick insulation.
 3. Outside piping shall have insulation thickness as indicated in table or as indicated on drawing. Protect with aluminum jacket.

2.6 CALCIUM SILICATE

- A. Hot water heater storage tanks shall be insulated with IIG/Johns Manville hydrous calcium silicate block insulation, 1-1/2" thick, with edges tightly butted and secured with galvanized steel bands 12" on centers. Finish shall be 1/2" thick coat of insulating cement troweled over chicken wire and 1/2" thick coat of hard finish cement, troweled smooth.

2.7 ACCESSORY MATERIALS

A. Insulation inserts at pipe supports:

1. Material: Cellular glass or calcium silicate 1/2 section of insulation, same thickness as adjacent insulation.
2. Provide inserts for all insulated piping greater than 1-1/2 inch diameter. Install with metal insulation shields furnished with pipe supports, Section 23 00 00, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) General Requirements. Minimum insert length: 10 inches for up to 3 inch pipe, 12 inches for 3 to 6 inch pipe, 16 inches for 8 to 10 inch pipe, and 22 inches for pipe 12 inches and larger.

B. Adhesives, Mastics, Cement:

1. Mil. Spec. MIL-A-3316B, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
2. Mil. Spec. MIL-A-3316B, Class 2: Adhesive for laps for adhering insulation to metal surfaces.
3. Mil. Spec. MIL-A-24179A, Type II, Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
4. Mil. Spec. MIL-B-19565B, Type 1 or Type II and be listed on Qualified Products Database (QPD): Vapor barrier compound for outdoor use.
5. Fed. Spec. SS-C-160A, Type IIIB, (ASTM C 449): Mineral fiber hydraulic-setting thermal insulating and finishing cement.
6. Other: Insulation manufacturer's published recommendations.

C. Mechanical Fasteners:

1. Pins, Anchors: Welded pins, or metal or nylon anchors with tin-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
2. Staples: Outward clinching monel or stainless steel.
3. Wire: 18 gage soft annealed galvanized, or 14 gage copper clad steel or nickel copper alloy.
4. Bands: 3/4-inch nominal width, brass, aluminum or stainless steel.

D. Reinforcement and Finishes:

1. Glass Fabric, Open Weave: ASTM D 1668, Type III (resin treated) and Type 1 (asphalt treated).
2. Glass Fiber Fitting Tape: Mil. Spec. MIL-C-20070, Type II, Class 1.
3. Tape for Flexible Unicellular Insulation: Scotch No. 472, Nashua PE-12, or approved equal recommended by the insulation manufacturer.

- 4. PVC Fitting Cover: Fed. Spec. L-P-535D, Composition A, Type II, Grade GU, with Form B mineral fiber insert, for media temperature 45 Deg. F. to 250 Deg. F. Below 45 Deg. F. and above 250 Deg. F., provide double layer insert. Provide color matching, vapor barrier, pressure sensitive tape.
- E. Firestopping Material: Refer to Section 23 00 00, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).

2.8 METAL JACKETS

- A. Aluminum jackets shall be ASTM B 209, temper H14, 0.016-inch thick, smooth. Secure jackets in place with aluminum or stainless steel bands and screws.
- B. Fittings in Outdoor Locations: Finish elbows and fittings with factory-fabricated metal covers. Covers shall be same thickness and materials as jackets on adjacent piping. Secure metal covers in place with metal bands and seal with a waterproof coating. Protect fittings with a weatherproof coating prior to installation of metal covers.
- C. Protect pipe and fittings with a vapor barrier mastic prior to installation of metal covers.

PART 3 - EXECUTION

3.1 GENERAL

- A. Required pressure tests of joints and connections shall be completed before application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale, and rust removed.
- B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work. If any insulation material has become wet because of transit or job site exposure to moisture or water, the Contractor shall not install such material, and shall remove it from the job site. No insulation material shall be installed that has become damaged in any way. The Contractor shall also use necessary means to protect his work and materials.
- C. Except for specific exceptions, insulate entire specified equipment, piping, and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.
- D. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor barriers shall be continuous and uninterrupted throughout

systems with operating temperature 60 Deg. F. and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports, and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of six inches.

- E. Insulation on hot piping and equipment shall be terminated square or beveled with insulating cement, covered with jacket, at items not to be insulated, access openings and nameplates.
- F. On cold systems, vapor barrier performance is extremely important. Particular care must be given to vapor sealing the fitting cover or finish to the insulation vapor barrier. All penetrations of the jacket and exposed ends of insulation must be sealed with vapor barrier mastic. All valve stems must be sealed with caulking which allows free movement of the stem but provides a seal against moisture incursion.
- G. HVAC Work Not To Be Insulated:
 - 1. Internally insulated ductwork and air handling units.
 - 2. Equipment: Heating water pumps, expansion tanks.
 - 3. In Hot Piping: Unions, flexible connectors, control valves and discharge vent piping.
 - 4. Factory insulated flexible ducts.
 - 5. Factory insulated supply air diffusers.
- H. Plumbing Work Not To Be Insulated:
 - 1. Piping and valves of fire protection system.
 - 2. Chromium plated brass piping (except hot water and drain piping under handicapped lavatories).
 - 3. Domestic Hot Water: Unions, flexible connectors, control valves, expansion tank, pump.
- I. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastics and coatings at the manufacturer's recommended minimum coverage.

3.2 INSTALLATION

- A. Flexible Mineral Fiber Blanket:
 - 1. Adhere insulation to metal with 4-inch wide strips of insulation bonding adhesive at 8 inches on center. Additionally secure insulation to bottom of ducts exceeding 24 inches in width with pins welded or adhered 18 inches on centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to assist in securing insulation. Seal all vapor barrier penetrations with vapor barrier mastic. Sagging duct insulation will not be acceptable.

2. Supply air ductwork to be insulated includes main and branch ducts from fan discharge to room supply outlets and the bodies of ceiling outlets to prevent condensation. To prevent condensation, insulate trapeze type supports and angle iron hangers for flat oval ducts.

B. Molded Mineral Fiber Pipe and Tubing Covering:

1. Fit insulation to pipe aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor barrier penetrations with vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports.
2. Fittings, Flange and Valve Insulation:
 - a. Fiberglass Pipe insulation shall be installed with joints butted firmly together. Valves and devices requiring access shall be insulation with mitered sections of insulation equal in thermal resistance and thickness to the adjoining insulation. Fittings shall be covered with Schuller "Zeston" type, pre-molded PVC fitting covers. Jackets on pipe insulation shall be stapled using outward clinching type staples spaced 3" apart at least 1/4" from the lap edge on systems operating at 80 Deg. F. and above; below 80 Deg. F. the laps are to be vapor sealed using self-sealing lap, lap seal gun, or adhesive. All insulation elbows, fittings, flanges, joints, laps, voids, punctures, and end tapers shall be sealed with two coats of Foster Vapor Out 30-33 or Childers Chil Out CP-33 vapor barrier mastic and reinforcing mesh (total 35 mils or 0.9 mm dry film thickness) regardless of service and before Zeston covers are applied.
 - b. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least two inches.

C. Elastomeric Insulation:

1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions.
2. Pipe and Tubing Insulation:
 - a. Use proper size material. Do not stretch or strain insulation.
 - b. To avoid undue compression of insulation, provide inserts at supports as recommended by the insulation manufacturer. Insulation shields are provided under Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).
 - c. Elastomeric insulation shall be slipped on the pipe prior to connection wherever possible. Pipe leak tests shall be performed prior to the insulation of fittings. Where the slip-on technique is not possible longitudinal slit insulation shall be snapped on the pipe. All seams, voids, and butt joints shall be sealed with a Foster 85-75 or Childers CP-82 vapor barrier adhesive or taped with 1-1/2 inch wide 3M #471 tape.

- d. Fittings and valves shall be insulated with mitered sections of insulation. All joints shall be secured and sealed with vapor barrier adhesive. Approved factory-made fittings such as F & D Mfgr. and Supply Co. may be used.
 3. On exterior refrigerant suction piping, provide two coats of Armstrong Armaflex Finish (vinyl lacquer) or Foster 30-64 on the insulation.
- D. Rigid Mineral Fiber Board: Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from edge of boards and spaced not more than 18-inch centers and secured with washers and clips. Spot-weld anchor pins or attach with a Foster 85-60 or Childers CP-127 adhesive especially designed for use on metal surfaces. Apply insulation with joints tightly butted. Where vapor barrier is specified, all joints, breaks, seams, punctures, and voids shall be filled with vapor barrier mastic and covered with vapor seal material identical to that surrounding. Neatly bevel insulation around name plates and access plates and doors. Each pin or anchor shall be capable of supporting a 20-pound load. Protruding ends of clips shall be cut off flush after clips are secured and sealed with aluminum backed pressure sensitive tape and coated with vapor barrier mastic.
- E. Duct-mounted heating coils and variable air volume terminal box heating coils shall be insulated with external duct insulation as specified for cold systems. Where adjacent duct or unit is internally lined, extend external insulation minimum 2" onto adjacent item. Completely vapor seal insulation around coil and seal to adjacent surface.

END OF SECTION 230700

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SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 CONDITIONS

- A. The applicable provisions of Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) are hereby made a part of this section and the Contractor is cautioned to read Section 230000 carefully, especially paragraph 2.3 Motors, Control and Electrical Wiring as items of work applicable to this section.

1.2 RELATED WORK

- A. Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).
- B. Section 230593, TESTING, ADJUSTING, AND BALANCING FOR HVAC
- C. Section 232000, HVAC PIPING AND PUMPS
- D. Section 232133, VARIABLE SPEED PUMPING SYSTEM
- E. Section 232200, HVAC PIPING AND PUMPS.
- F. Section 233000, HVAC AIR DISTRIBUTION.
- L. Section 238100, DECENTRALIZED UNITARY HVAC EQUIPMENT

1.3 COORDINATION OF SPECIFICATIONS

- A. Control Valves: Furnish per 230900; Install per 232000.
- B. Control Pipe Wells: Furnish per 230900; Install per 232000
- C. Motorized Dampers: Furnish Damper per 233000; Furnish Actuator per 230900; Install Damper per 233000; Install Actuator per 230900.
- D. Temperature Control Wiring: Furnish and install per 230000 and 230900.
- E. Wall Rough-in for Controls: Furnish and install per 230000 and 230900.
- F. Interlock Wiring for Smoke Detector and Fire Alarm: Furnish and install per Electrical Specifications.

- G. Central Controls Panel Connections for Power, Modem and Fire Alarm: Furnish and install per Electrical Specifications. (The Mechanical Contractor shall be responsible for these connections as they may not be indicated on the electrical drawings.) Power connections for all Building Automation System (BAS) control panels shall be connected to emergency electrical circuits designated on the Electrical Drawings. Circuit breakers will be provided as shown on Electrical Panel Schedule.
- H. NOTE: The technical specifications are arranged for convenience and such arrangement shall not operate to make the Architect/Engineer an arbiter in establishing the limits of any subcontract or trade.

1.4 WORK INCLUDED

- A. Furnish a BACnet-based system, including an operator's workstation using Microsoft Windows as the operating system or latest version and shall be based on a distributed control system in accordance with this specification. The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate primarily using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2001, BACnet. Gateways may be used for communication to existing systems or to systems installed under other sections. Gateways may also be used by non-native BacNet vendors to translate their proprietary protocols into the BacNet Standard protocol. UNDER NO CIRCUMSTANCE WILL THIS RELIEVE THE NON-NATIVE BACNET VENDOR OF THE REQUIREMENTS AND SYSTEM PERFORMANCE REQUIREMENTS SPECIFIED IN THIS DOCUMENT.
- B. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers. If a device does not meet the PICS requirement, it must be stated it does not meet the standard. Partially compliant devices and software are expected. To insure the non-native BACnet system provides the full functionality required in this specification it is the responsibility of the non native BACnet vendor to provide additional information outlined in Section 1.6.A
- C. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
- D. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
- E. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- F. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.

- G. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.
- H. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
- I. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
- J. Provide a comprehensive operator and technician training program as described herein.
- K. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- L. Provide new sensors, dampers, valves, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.
- M. The new controls shall tie into existing RCPS Trane Tracer Ensemble enterprise server.

1.5 SYSTEM DESCRIPTION

- A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be primarily based on ANSI/ASHRAE Standard 135-2001, BACnet. Alternative BACnet based systems which are not native BACnet compliant are acceptable as long as ALL requirements of Section 1.4 are met. This system is to control all mechanical equipment, including all unitary equipment such as fan-powered terminal boxes, AC units, etc. and all air handlers, boilers, chillers, lighting control and any other listed equipment using native BACnet-compliant components.
- B. Operator's workstation software shall be a Microsoft Windows computer operating system. Any version of the operating system that is not fully supported for the next three years from the manufacturer is not acceptable. The operating system shall be compatible with the RCPS VM Infrastructure. The Energy Management and Control System (EMCS) application program shall be written to communicate specifically utilizing BACnet protocols. Software functions delivered on this project shall include password protection, scheduling (including optimum start), alarming, logging of historical data, full graphics including animation, after-hours billing program, demand limiting, full suite of field engineering tools including graphical programming and applications. Systems using operating systems other than that described above are strictly prohibited. All software required to program application specific controllers and all field level devices and controllers will be left with the owner. All software passwords required to program and make future changes to the system will also become the property of the owner. All software required to make any program changes anywhere in the system along with scheduling and trending applications will be left with the owner. All software passwords required to

program and make future changes to schedules, trends and related program changes will also become the property of the owner. All software required for all field engineering tools including graphical programming and applications will be left with the owner. All software passwords required to program and make future changes to field engineering tools including graphical programming and applications will be left with the Owner.

- C. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage. E. All application controllers for every terminal unit (FTB, CUH, UH, etc.), air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller via BACnet LAN.
- D. Room sensors shall be provided with the room setpoint within preset limits and set desired override time. User shall also be able to start and stop unit from the sensor. Include all necessary wiring and firmware such that room sensor includes field service mode. Field service mode shall allow technician to balance VAV zones and access any parameter in zone controller. Room sensors shall be architecturally pleasing, sense temperature, allow tenant to override system and adjust temperature setpoint, and include a jack that allows the service technician to adjust any zone parameter. Include all wiring for sensor and field service tool.

1.6 APPROVED MANUFACTURERS

- A. Only approved control manufacturers may bid upon meeting all requirements of the specifications.
- B. Approved Control Manufacturers:
 - 1. The Trane Company
- C. All non-native BACnet manufacturers will be required to provide the following additional information prior to bid date. It is the responsibility of the non-native BACnet vendor or representative to lay out in intimate detail how their partially compliant BACnet system will meet the requirements of this specification. Failure to provide ALL of the documentation listed below prior to bid date will be cause for rejection of the vendor.
 - 1. Direct Digital Control System Hardware:
 - a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.

- b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below:
 - (1) Direct digital controllers (controller panels)
 - (2) All gateway devices
 - (3) All devices used to translate proprietary communication protocols into BACNET Standard, ASHRAE/ANSI 135-2001, BACnet
 - (4) Control panels
 - (5) Power supplies
 - (6) Operator interface equipment
 - (7) Wiring
 - c. Wiring diagrams and layouts for each control panel, GATEWAY DEVICES, AND ALL DEVICES USED TO TRANSLATE PROPRIETARY COMMUNICATION PROTOCOLS INTO BACNET STANDARD. Show termination numbers.
 - d. Floor plan schematic diagrams indicating field sensor and controller locations.
2. Central System Hardware and Software:
- a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
 - b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below: and for relevant items furnished under this contract not listed below:
 - (1) Central Processing Unit (CPU) and web server
 - (2) Interface equipment between CPU or server and control panels
 - (3) Operating System software
 - (4) Operator interface software
 - (5) Color graphic software
 - (6) Third-party software
 - (7) ALL GATEWAY DEVICES
 - (8) ALL DEVICES USED TO TRANSLATE PROPRIETARY COMMUNICATION PROTOCOLS INTO BACNET STANDARD, ASHRAE/ANSI 135-2001, BACnet
 - c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.
 - d. Network riser diagrams of wiring between central control unit and control panels.
3. Controlled Systems:
- a. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.

- b. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
 - c. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
 - d. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified in Section 230900. Indicate alarmed and trended points.
4. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface. If a device does not meet the PICS requirement, it must be stated it does not meet the standard.

1.7 QUALITY ASSURANCE

- A. The BAS system shall be designed and installed, commissioned and serviced by manufacturer employed, factory trained personnel. Manufacturer shall have an in-place support facility within 2 hours response time of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment. Distributors or licensed installing contractors are not acceptable.

The manufacturer shall provide full time, experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the BAS system.

The Bidder shall be regularly engaged in the manufacturing, installation and maintenance of BAS systems and shall have demonstrated technical expertise and experience in the manufacture, installation and maintenance of BAS systems similar in size and complexity to this project. Bidders shall provide a list of at least 10 projects, similar in size and scope to this project completed within the past 3 years.

- B. The BAS system manufacturer must have a Dealer or Customer Support call-in Center located at the corporate headquarters or corporate manufacturing facilities. The Customer Support call-in Center will be staffed by fully trained and certified technicians.
- C. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.
- D. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX.
- E. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

- F. Control system shall be engineered, programmed and supported completely by representative's local office that must be within 100 miles of project site.

1.8 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof , shall govern design and selection of equipment and material supplied:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - 2. ANSI/ASHRAE Standard 135-2001, BACnet.
 - 3. Uniform Building Code (UBC), including local amendments.
 - 4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
 - 5. National Electrical Code (NEC).
 - 6. FCC Part 15, Subpart J, Class A
 - 7. EMC Directive 89/336/EEC (European CE Mark)
 - 8. UL-864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences
- B. City, county, state, and federal regulations and codes in effect as of contract date.
- C. Except as otherwise indicated the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

1.9 SUBMITTALS

- A. Drawings:
 - 1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.
 - 2. Drawings shall be submitted in the following standard sizes: 11" x 17" (ANSI B).
 - 3. Eight complete sets (copies) of submittal drawings shall be provided.
 - 4. Drawings shall be available on CD-ROM.
- B. System Documentation - Include the following in submittal package:
 - 1. System configuration diagrams in simplified block format.
 - 2. All input/output object listings and an alarm point summary listing.
 - 3. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
 - 4. Complete bill of materials, valve schedule and damper schedule.

5. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
 6. Overall system operation and maintenance instructions—including preventive maintenance and troubleshooting instructions.
 7. For all system elements—operator's workstation(s), building controller(s), application controllers, routers, and repeaters,—provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2001.
 8. Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.
 9. A list of all functions available and a sample of function block programming that shall be part of delivered system.
- C. Project Management: The vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents and shall indicate timing and dates for system installation, debugging, and commissioning.
- D. BACnet Device Object Naming Conventions:
1. The BAS manufacturer's representative shall submit a BACnet Device Object Naming Convention Plan (DONCP) to the owner and consulting engineer during the submittal process. The plan must be approved by the owner and consulting engineer prior to implementation. It is the responsibility of the BAS contractor to coordinate the DONCP with the owner and consulting engineer.
 2. The DONCP shall be designed to eliminate any confusion between individual points in a facility/campus wide EMCS system. It will also be designed to allow for future expansion and consistency. Each device on a BACnet internetwork (including other manufacturer's devices) must have a unique device instance. This is a major consideration when adding to an existing system or interconnecting networks. Thorough and accessible site documentation is critical.
 3. A consistent object (point) naming convention shall be used to facilitate familiarity and operational ease across an eventual large campus or inventory of facilities. The following section is designed as recommendations only. It is the responsibility of the BAS contractor to coordinate the DONCP with the owner and consulting engineer
 4. BACnet requires that all devices have a Device object name that is unique throughout the entire internetwork. To comply with this requirement all BACnet devices should be configured with a Device Object Name that is based on the naming conventions described in this section. This includes all physical devices as well as any logical BACnet devices that are represented by gateways. The vendor shall coordinate with the owner's staff to ensure that the correct names are used. Device Object Name properties shall support strings of at least 50 characters in length.
 5. Every system device has addresses by which any other BACnet device can identify it and route information to and from it. Although there are a number of addresses to consider, the scheme is fairly straightforward. It can become complicated, however,

if addresses have not been documented adequately or there is no logical addressing scheme.

6. When you set up and plan a BACnet network or add to an existing network, considering and documenting your addressing scheme is of the utmost importance. Adopt a hierarchical and uniform addressing scheme for device instances to help you quickly identify the function and location of different devices when troubleshooting. Additionally, it's very important to document every element of your addressing scheme and update the site documentation with any changes.
7. This section first covers the important addressing issues with respect to BACnet LANs and it gives a practical application you can use to check your understanding.
 - a. **BACnet Addressing:** Three types of addresses are important in any BACnet system: network numbers, media access control (MAC) addresses, and device instances. Each BACnet device has these addresses associated with it. Though all three can be thought of as addresses, they are all very different both in how they function and how they are assigned.
 - b. **Network Numbers:** Identifies the network to which a BACnet device belongs. Every network on a BACnet LAN has a unique numerical identifier—a network number. This network number is used by BACnet devices only; it does not rely on nor does it affect any other network protocols. LANs connected by a router must have different network numbers. No interconnected BACnet networks can have the same network number. Network number range is 1–65534, for a maximum of 65534 interconnected BACnet networks.
 - c. **IMPORTANT BACnet reserves network numbers 0 and 65,535 for special purposes. Don't use network 0 or 65,535.**
 - d. **MAC addresses Hardware-oriented.** The MAC address uniquely identifies a device on its particular network. Each network type—Ethernet and MS/TP—has its own MAC addressing scheme. A device that exists on two or more networks will have a MAC address for each one. Devices can have the same MAC addresses as long as they are on networks with different network numbers.
 - e. **Note It's helpful to think of the MAC address as a house number and the network number as the street number. Two houses can have the same house number (MAC address) as long as they are on different streets (networks).**
 - f. **Ethernet devices - For Ethernet LANs, the IEEE assigns a certain range of MAC addresses to manufacturers of Ethernet products. manufacturer then assigns a unique MAC address to each of its Ethernet devices.**
 - g. **MS/TP devices - For devices on an MS/TP LAN, you assign the MAC address for each controller. For BACtalk VLCs, these are assigned with DIP switches. Devices on an MS/TP LAN are designated as either masters or slaves, which affects how they can be addressed. This is a requirement of the BACnet specification. All BACtalk MS/TP devices are masters.**
 - h. **IMPORTANT BACnet reserves MS/TP MAC address 255 for special purposes. Don't use MS/TP MAC 255.**

- i. Device instances Software-oriented. The device instance identifies the device to the BACnet software and is the address most often encountered. The device instance is a shortcut to having to specify a MAC address and network number each time an operation is performed. Device instances range from 0–4194302.
- j. Note BACnet reserves device instance 4194303 for special purposes. Don't use device instance 4194303.

1.10 WARRANTY

- A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system acceptance.
- B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours Monday through Friday, 48 hours on Saturday and Sunday.
- C. This warranty shall apply equally to both hardware and software.

PART 2 - PRODUCTS

2.1 OPERATOR'S WORKSTATION

- A. General structure of workstation interaction shall be a standard client/server relationship. Server shall be used to archive data and store system database. Clients shall access server for all archived data. Each client shall include flexibility to access graphics from server or local drive. Server shall support a minimum of 50 clients simultaneously.
- B. BACnet Conformance:
 - 1. Operator's workstation shall as a minimum support Point-to-Point (PTP) and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device. Operator's terminal shall comply with the requirements of a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Clock Functional Group
 - b. Event Response Functional Group
 - c. Time Master Functional Group
 - d. Device Communications
 - 2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be

thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

3. Standard BACnet object types accessed by the workstation shall include as a minimum: Analog Value, Analog Input, Analog Output, Binary Value, Binary Input, Binary Output, Calendar, Device, Event Enrollment, File, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
4. The Operator Workstation shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs). Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network.

C. Displays

1. Operator's workstation shall display all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display all data using three-dimensional graphic representations of all mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user. Workstation shall allow user to change all field-resident EMCS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc. from any screen no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.
2. All displays and programming shall be generated and customized by the local EMCS supplier and installer. Systems requiring factory development of graphics or programming of DDC logic are specifically prohibited.
3. Binary objects shall be displayed as ACTIVE/INACTIVE/NULL or with customized text. Text shall be justified left, right or center as selected by the user. Also, allow binary objects to be displayed as individual change-of-state graphic objects on the display screen such that they overlay the system graphic. Each binary object displayed in this manner shall be assigned up to three graphic files for display when the point is ON, OFF or in alarm. For binary outputs, toggle the object's commanded status when the graphic item is selected with the system mouse. Similarly, allow the workstation operator to toggle the binary object's status by selecting with the mouse a graphic of a switch or light, for example, which then displays a different graphic (such as an "ON" switch or lighted lamp). Additionally, allow binary objects to be displayed as an animated graphic. Animated graphic objects shall be displayed as a sequence of multiple graphics to simulate motion. For example: when a pump is in the OFF condition, display a stationary graphic of the pump. When the operator

selects the pump graphic with the mouse, the represented object's status is toggled and the graphic of the pump's impeller rotates in a time-based animation. The operator shall be able to click on an animated graphical object or switch it from the OFF position to ON, or ON to OFF. Allow operator to change graphic file assignment and also create new and original graphics online. System shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. Systems that do not allow customization or creation of new graphic objects by the operator (or with third-party software) shall not be allowed.

4. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic. Each analog input object may be assigned a minimum of five graphic files, each with high/low limits for automatic selection and display of these graphics. As an example, a graphic representation of a thermometer would rise and fall in response to either the room temperature or its deviation from the controlling setpoint. Analog output objects, when selected with the mouse, shall be displayed as a prompted dialog (text only) box. Selection for display type shall be individual for each object. Analog object values may be changed by selecting either the "increase" or "decrease" arrow in the analog object spinner box without using the keypad. Pressing the button on the right side of the analog object spinner box allows direct entry of an analog value and accesses various menus where the analog value may be used, such as trendlogs.
5. Analog objects may also be assigned to an area of a system graphic, where the color of the defined area changes based on the analog object's value. For example, an area of a floor-plan graphic served by a single control zone would change color with respect to the temperature of the zone or its deviation from setpoint. All editing and area assignment shall be created or modified online using simple icon tools.
6. A customized menu label (push-button) shall be used for display selection. Menu items on a display shall allow penetration to lower level displays or additional menus. Dynamic point information and menu label push buttons may be mixed on the same display to allow sub-displays to exist for each item. Each display may be protected from viewing unless operator has appropriate security level. A security level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.
7. A mouse shall be used to move the pointer arrow to the desired item for selection of new display or to allow the operator to make changes to object data.

D. Password Protection:

1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.
2. Each operator's terminal shall provide security for 200 users minimum. Each user shall have an individual User ID, User Name and Password. Entries are alphanumeric characters only and are case sensitive (except for User ID). User ID shall be 0–8 characters, User Name shall be 0–29 characters, and Password shall be 4–8 characters long. Each system user shall be allowed individual assignment of only

those control functions and menu items to which that user requires access. All passwords, user names, and access assignments shall be adjustable online at the operator's terminal. Each user shall also have a set security level, which defines access to displays and individual objects the user may control. System shall include 10 separate and distinct security levels for assignment to users.

3. System shall include an Auto Logout Feature that shall automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period shall be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal shall display message on screen that user is logged out after Auto Logout occurs.

E. Operator Activity Log:

1. Operator Activity Log shall be included with system that tracks all operator changes and activities. System shall track what is changed in the system, who performed this change, date and time of system activity and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation.
2. Log shall be gathered and archived to hard drive on operator workstation as needed. Operator shall be able to export data for display and sorting in a spreadsheet.
3. Any displayed data, that is changeable by the operator, may be selected using the right mouse button and the operator activity log shall then be selectable on the screen. Selection of the operator activity log using this method shall show all operator changes of just that displayed data.

F. Scheduling:

1. Operator's workstation shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily with events being the highest.
2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
3. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.
4. System shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right clicking on value displayed on graphic and then selecting Schedule.
5. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.

G. Alarm Indication and Handling:

1. Operator's workstation shall provide audible, visual, and printed means of alarm indication. The alarm dialog box shall always become the top dialog box regardless of the application(s), currently running. Printout of alarms shall be sent to the assigned terminal and port.
2. System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment and identification of operator acknowledging alarm .
3. Alarm messages shall be in user-definable text (English or other specified language) and shall be entered either at the operator's terminal or via remote communication.
4. System shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through all steps necessary for alarm generation. Wizard shall have its own pull-down selection for startup or may be started by right clicking on value displayed on graphic and then selecting alarm setup.

H. Trendlog Information:

1. System server shall periodically gather historically recorded data stored in the building controllers and archive the information Archived files shall be appended with new sample data, allowing samples to be accumulated. Systems that write over archived data shall not be allowed, unless limited file size is specified. Samples may be viewed at the operator's workstation. Operator shall be able to scroll through all trended data. All trendlog information shall be displayed in standard engineering units.
2. Software shall be included that is capable of graphing the trend logged object data. Software shall be capable of creating two-axis (x,y) graphs that display up to ten object types at the same time in different colors. Graphs shall show object values relative to time.
3. Operator shall be able to change trend log setup information. This includes the information to be logged as well as the interval at which it is to be logged. All input, output, and value object types in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics on which object is displayed.
4. System shall include a trend Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup, or may be started by right clicking on value displayed on graphic, and then selecting Trendlogs from the displayed menu.

I. Energy Log Information:

1. System server shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data

shall not be allowed unless limited file size is specified. Display all energy log information in standard engineering units.

2. All data shall be stored in data base file format for direct use by third-party programs. Operation of system shall stay completely online during all graphing operations.
3. Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. System shall support using flow and temperature sensors for BTU monitoring.
4. System shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format the user shall be able to select a specific period of data to view.

J. Demand Limiting:

1. System shall include demand limiting program that includes two types of load shedding. One type of load shedding shall shed/restore equipment in binary fashion based on energy usage when compared to shed and restore settings. The other type of shedding shall adjust operator selected control setpoints in an analog fashion based on energy usage when compared to shed and restore settings. Shedding may be implemented independently on each and every zone or piece of equipment connected to system.
2. Binary shedding shall include minimum of 5 priority levels of equipment shedding. All loads in a given priority level shall be shed before any loads in a higher priority level are shed. Load shedding within a given priority level shall include two methods. In one the loads shall be shed/restored in a “first off-first on” mode and in the other the loads are just shed/restored in a linear fashion.
3. Analog shed program shall generate a ramp that is independently used by each individual zone or individual control algorithm to raise the appropriate cooling setting and lower appropriate heating setting to reduce energy usage.
4. Status of each and every load shed program shall be capable of being displayed on every operator terminal connected to system. Status of each load assigned to an individual shed program shall be displayed along with English description of each load.

K. Tenant Activity:

1. System shall include program that monitors after-hours overrides by tenants, logs that data and generates a bill based on usage and rate charged for each tenant space. Tenant Activity program shall be able to assign multiple zones, from a list of every zone connected to system, to a particular tenant. Every zone is monitored for after-hour override usage and that data logged in server. Operator may then generate a bill based on the usage for each tenant and the rate charged for any overtime use.
2. Configuration shall include entry of the following information for use in logging and billing.
 - a. Tenants contact name and address

- b. One or multiple tenant zones that make up a total tenant space including a separate billing rate for each separate zone.
 - c. Minimum and maximum values an event duration and event limit
 - d. Property management information
 - e. Overall billing rate
 - f. Seasonal adjustments or surcharge to billing rate
 - g. Billing notification type such including, but not limited to printer, file and email
 - h. Billing form template
 3. Logging shall include recording the following information for each and every tenant event.
 - a. Zone description
 - b. Time the event begins
 - c. Total override time
 - d. Limits shall be applied to override time.
 4. A tenant bill shall be generated for a specific period using all the entered configuration data and the logged data. User with appropriate security level shall be able to view and override billing information. User shall be able to select a billing period to look to view and be able to delete events from billing and be able to edit a selected tenant activity event's override time.
- L. Configuration/Setup: Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.
- M. Field Engineering Tools:
1. Operator's workstation software shall include field-engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
 2. User shall be able to pick graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
 3. Programming tools shall include a real time operation mode. Function blocks shall display real time data and be animated to show status of data inputs and outputs when in real time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.
 4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to

select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.

5. Field engineering tool shall include Device Manager for automatic detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computers hard drive. If needed, this file shall be downloaded to the appropriate controller by selection using the mouse.
6. System shall include backup/restore function that will back up entire system to selected medium and then restore system from that media.

N. Workstation Hardware:

1. Provide operator's workstation in Maintenance Office 1119B.
2. Workstation/Server Computer Minimum Requirements
 - a. Pentium Duo, 1.5 Ghz or better
 - b. 1 GB RAM or better
 - c. 100 GB hard disk or better
 - d. High-performance graphics adapter
 - e. Ethernet 10/100 network interface card
 - f. Keyboard, monitor, mouse and CD/DVD-RW
 - g. Windows (compatible with RCPS VM Infrastructure)
 - h. Color Printer (Inkjet or Laser)

- O. Software: At the conclusion of project, contractor shall leave with owner a CD ROM that includes the complete software operation system and project graphics, setpoints, system parameters, etc. This backup shall allow the owner to completely restore the system in the case of a computer malfunction.

2.2 WEB INTERFACE

- A. General: BAS supplier shall provide web-based access to the system as part of standard installation. User shall be able to access all displays of real-time data that are part of the BAS via a standard Web browser. Web browser shall tie into the network via owner-supplied Ethernet network connection. Web-page host shall be a separate device that resides on the BAS BACnet network, but is not the BAS server for the control system. BAS server must be a separate computer from the Web-page host device to ensure data and system integrity. The web-page software shall not require a per user licensing fee or annual fees. The web-page host must be able to support on average 50 simultaneous users with the ability to expand the system to accommodate an unlimited number of users.
- B. Browser Technology: Browser shall be standard version of Microsoft IE 7.0 or later and Netscape Navigator 4.76 or later. No special vendor-supplied software shall be needed on computers running browser. All displays shall be viewable and the Web-page host shall

directly access real-time data from the BAS BACnet network. Data shall be displayed in real time and update automatically without user interaction. User shall be able to change data on displays if logged in with the appropriate user name and password.

C. Communications:

1. Web-page host shall include two Ethernet network connections. One network connection shall be dedicated to BAS BACnet network and shall be used to gather real-time data from all the BACnet devices that form the BAS. This network shall communicate via BACnet, allowing the Web-page host to gather data directly from units on the local LAN or from other projects connected over a WAN. This network shall also provide the connection to the BAS server for Web page generation.
2. The second Ethernet connection shall provide the physical connection to the Internet or an IP-based WAN. It shall be the port that is used for the browser to receive Web pages and data from the Web-page host.. The Web-page host shall act as a physical barrier between the BAS network and the WAN or Internet connection that allows the browser to receive web pages and data. The two separate network connections provide for a physical barrier to prevent raw BACnet traffic being exposed on the IP network.
3. The Web-page host shall provide for complete isolation of the IP and BACnet networks by not routing networking packets between the two networks.
4. BAS BACnet Ethernet network shall be provided and installed by the BAS supplier. Owner shall provide and incur any monthly charges of WAN/Internet connection.

D. Display of Data:

1. Web page graphics shown on browser shall be replicas of the BAS displays. User shall need no additional training to understand information presented on Web pages when compared to what is shown on BAS displays. Web page displays shall include animation just as BAS displays. Fans shall turn, pilot lights shall blink, coils shall change colors, and so on.
2. Real-time data shall be shown on all browser Web pages. This data must be directly gathered via the BACnet network and automatically updated on browser Web page displays without any user action. Data on the browser shall automatically refresh as changes are detected without re-drawing the complete display.
3. It shall be possible for user from browser Web page to change data if the user is logged on with the appropriate password. Clicking on a button or typing in a new value shall change digital data. Using pull-down menus or typing in a new value shall change analog data.
4. Data displays shall be navigated using pushbuttons on the displays that are simply clicked on with the mouse to select a new display. Alternatively, the standard back and forward buttons of the browser can be used for display navigation.

E. Time Schedule Adjustment:

1. Web access shall allow user to view and edit all schedules in the system. This includes standard, holiday and event schedules as described in BAS specification.

- Display of schedules shall show interaction of all schedules on a single display so user sees an overview of how all work together. User shall be able to edit schedules from this display.
2. Display of all 3 schedules must show all ON times for standard, holiday and event schedules in different colors on a given day. In addition, OFF times for each must also be shown in additional colors. User shall be able to select from standard calendar what days are to be scheduled and same display shall show all points and zones affected. User shall be able to set time for one day and select all days of the week that shall be affected as a recurrence of that same schedule for that given day.
 3. Schedule list shall show all schedules currently defined. This list shall include all standard, holiday and event schedules. In addition, user shall be able to select a list that shows all scheduled points and zones.
- F. **Logging of Information:** User shall use standard browser technology to view all trend logs in system. User shall be able to view logged data in tabular form or graphical format. User shall be able to adjust time interval of logged data viewed and shall be able to adjust y axis of data viewed in graphical format. User shall also be able to down-load data through the web interface to local computer. Data shall be in CSV format.
- G. **Alarm Handling:** Web interface shall display alarms as they occur. User shall be able to acknowledge alarms using browser technology. In addition, user shall be able to view history of alarm occurrence over a user selected time frame. In addition, those alarms may be filtered for viewing per user selected options. A single selection shall display all alarms that have not been acknowledged.
- H. **Web Page Generation:** Web pages shall be generated automatically from the BAS displays that reside on the BAS server. User shall access Web-page host via the network and shall initiate a web page generation utility that automatically takes the BAS displays and turns them into Web pages. The Web pages generated are automatically installed on the Web page host for access via any computer's standard browser. Any system that requires use of an HTML editor for generation of Web pages shall not be considered.
- I. **Password Security and Activity Log:** Access via Web browser shall utilize the same hierarchical security scheme as BAS system. User shall be asked to log in once the browser makes connection to Web-page host. Once the user logs in, any and all changes that are made shall be tracked by the BAS system. The user shall be able to change only those items that the user has authority to change. A user activity report shall show any and all activity of the users that have logged in to the system regardless of whether those changes were made using a browser or via the BAS workstation.
- J. **BACnet Communication:** Web server shall directly communicate to all devices on the BAS network using BACnet protocol. No intermediate devices shall be necessary for BACnet communication.

2.3 BUILDING CONTROLLER

A. General Requirements:

1. Building Controller shall be of modular construction such that various modules may be selected to fit the specific requirements of a given project. Modules shall consist of a power supply module, a BACnet Ethernet-MS/TP module, a BACnet MS/TP only module and a modem module for telephone communication as a minimum. Those projects that require special interfaces may use Modbus modules as needed. However, all Ethernet communications and all controllers including central plant controllers, advanced application controllers and unitary controllers supplied by BMS manufacturer shall utilize the BACnet protocol standard.
2. Modules shall be selected to fit the particular project application. Up to 7 modules shall be powered by a single power supply module. All modules shall be panel mounted on DIN rail for ease of addition and shall be interconnected via simple plug in cable. A module in the middle shall be replaceable without removing any other modules.
3. All modules shall be capable of providing global control strategies for the system based on information from any objects in the system regardless if the object is directly monitored by the building controller module or by another controller. The software program implementing these strategies shall be completely flexible and user definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, via a wide area network or downloaded via remote communications are not acceptable. Changing global strategies via firmware changes is also unacceptable.
4. Programming shall be object-oriented using control function blocks, supporting DDC functions, 1000 Analog Values and 1000 Binary Values.. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.
5. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's workstation or field computer.
6. Controller shall have a memory needed to ensure high performance and data reliability. Battery shall provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Battery back up shall maintain real-time clock functions for a minimum of 20 days.
7. Global control algorithms and automated control functions shall execute via 32-bit processor.
8. Schedules:
 - a. Each building controller module shall support a minimum of 80 BACnet Schedule Objects and 80 BACnet Calendar Objects.
 - b. Building controller modules shall provide normal 7 day scheduling, holiday scheduling and event scheduling.

9. Logging Capabilities:
 - a. Each building controller shall log as minimum 320 values. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
 - b. Logs may be viewed both on-site or off-site via WAN or remote communication.
 - c. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired.
 - d. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

10. Alarm Generation:
 - a. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
 - b. Each alarm may be dialed out as noted elsewhere.
 - c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications.
 - d. Controller must be able to handle up to 320 alarm setups stored as BACnet event enrollment objects – system destination and actions individually configurable.

11. Demand Limiting:
 - a. Demand limiting of energy shall be built a built in function that shall be user configurable. Each controller module shall support shedding of up to 200 loads using a minimum of two types of shed programs.
 - b. Load shedding programs in Building Controller Modules shall operate as defined in section 2.1.J of this specification.

12. Tenant Activity Logging:
 - a. Tenant Activity logging shall be supported by Building Controller Module. Each independent module shall support a minimum of 80 zones.
 - b. Tenant Activity logging shall functions as defined in section 2.1.K of this specification.

- B. Ethernet – MS/TP Module:
 1. Ethernet – MS/TP Module shall support every function as listed under paragraph A, General Requirements, of this section and the following.
 2. All communication with operator workstation and all application controllers shall be via BACnet. Building controller Ethernet – MS/TP module shall incorporate as a minimum, the functions of a 2-way BACnet router. Controller shall route BACnet

messages between the high-speed LAN (Ethernet 10/100MHz) and master slave token passing (MS/TP) LAN. Ethernet – MS/TP module shall also route messages from all other Building Controller modules onto the BACnet Ethernet network.

- a. MS/TP LAN must be software configurable from 9.6 to 76.8Kbps.
- b. The RJ-45 Ethernet connection must accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).

3. BACnet Conformance:

- a. Ethernet – MS/TP module shall as a minimum support MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Global controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
 - (1) Clock Functional Group
 - (2) Files Functional Group
 - (3) Reinitialize Functional Group
 - (4) Device Communications Functional Group
 - (5) Event Initiation Functional Group
- b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- c. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- d. The Building Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).

C. MS/TP Module:

1. MS/TP Module shall support every function as listed under paragraph A, General Requirements, of this section and the following.

2. Building Controller MS/TP module communications shall be via BACnet master slave token passing (MS/TP) LAN to all advanced application and application specific controllers. MS/TP module shall also route messages to Ethernet-MS/TP module for communication over WAN.
 - a. MS/TP LAN must be software configurable from 9.6 to 76.8Kbps
 - b. Configuration shall be via RS-232 connection.
 3. BACnet Conformance:
 - a. MS/TP module shall as a minimum support MS/TP BACnet LAN type. It shall communicate directly via this BACnet LAN as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
 - (1) Clock Functional Group
 - (2) Files Functional Group
 - (3) Reinitialize Functional Group
 - (4) Device Communications Functional Group
 - (5) Event Initiation Functional Group
 - b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - c. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- D. Power Supply Module:
1. Power supply module shall power up to 7 Building Controller Modules. Input for power shall accept between 17 and 30 VAC, 47 to 65 Hz.
 2. Power supply module shall include rechargeable battery for orderly shutdown of controller modules including storage of all data in flash memory and for continuous operation of real time clocks for minimum of 20 days.

E. Modem Module:

1. Provide all functions that will allow remote communications via modem module to off-site locations. Modem module shall integrate directly into modular controller without any special software or hardware. Include one modem module along with all cabling necessary for installation for the system.
2. Provide Windows 2000 software for off-site computer that allows operator to view and change all information associated with system on color graphic displays. Operator shall be able to change all parameters in this section from off-site location including all programming of building controllers and all programmable application controllers including all terminal unit controllers.
3. Building controller shall have capability to call out alarm conditions automatically. If desired, controller may also send encoded message to digital pager. If an alphanumeric pager is in use by the operator, building controller shall be capable of sending a text or numeric string of alarm description. All building controllers connected to the local LAN shall be capable of calling out alarm messages through one or more shared modems connected to one or more of the building controllers on the local LAN.
4. Building controller shall have capability to call a minimum of 20 different phone numbers. Numbers called may be controlled by type of alarm or time schedule.
5. Owner shall provide standard voice-grade phone line for remote communication function.
6. Building controller and internal modem shall be capable of modem-to-modem baud rates of 33.6 Kbps minimum over standard voice-grade phone lines. Lower baud rates shall be selectable for areas where local phone company conditions require them.

F. TUX Module:

1. TUX Module shall support every function as listed under paragraph A, General Requirements, of this section and the following.
2. Building Controller TUX module communications shall be via Alerton TUX Trunk to up to 64 Alerton TUX's. TUX module shall convert TUX data into BACnet objects and create virtual BACnet devices for every TUX connected to the TUX module. TUX module shall also route messages to Ethernet-MS/TP module for BACnet Ethernet communication over WAN.
 - a. TUX Module shall support TUX communication at 4800 and 9600 baud.
 - b. Configuration shall be via RS-232 connection.
3. BACnet Translation:
 - a. All TUX data shall be automatically translated into BACnet objects by the TUX module. No configuration by the user shall be necessary. Predefined BACnet objects shall be automatically assigned for each type of TUX controller connected.

- b. Every TUX controller shall become a virtual BACnet device for ease of use with the BACnet workstation for configuration and operation.
- c. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

2.4 CENTRAL PLANT AND AIR HANDLER APPLICATION CONTROLLERS

- A. Provide one or more native BACnet application controllers for each air handler and provide native BACnet application controllers as needed for central plant control that adequately cover all objects listed in object list. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident on operator workstation and be the same tool as used for the building controller. No auxiliary or non-BACnet controllers shall be used.
- B. BACnet Conformance:
 - 1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as native BACnet devices. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
 - 2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - 3. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermistors, 0–10VDC, 0–5 VDC, 4–20 mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of 3 inputs that accept pulses.

Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0–10VDC or 0–20mA. Software shall include scaling features for analog outputs. Application controller shall include 24VDC voltage supply for use as power supply to external sensors.

- D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator’s terminal. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator’s terminal section.
- E. Application controller shall include support for intelligent room sensor (see section 2.9.B.) Display on intelligent room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.5 TERMINAL UNIT APPLICATION CONTROLLERS (AC UNITS)

- A. Provide one native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.
- B. BACnet Conformance:
 - 1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
 - 2. Please refer to section 22.2, BACnet Functional Groups in the BACnet standard for a complete list of the services that must be directly supported to provide each of the

functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

3. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, 4–20 mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.
 - D. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.
 - E. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.6 VAV BOX CONTROLLERS

- A. Provide one native BACnet application controller for each VAV box that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include on board CFM flow sensor, inputs, outputs and programmable, self-contained logic program as needed for control of units.
- B. BACnet Conformance:
 1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:

- a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 3. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, and dry contact signals. Inputs on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall also include binary outputs on board. For applications using variable speed parallel fans, provide a single analog output selectable for 0-10 V or 0-20 mA control signals. Application controller shall include microprocessor driven flow sensor for use in pressure independent control logic. All boxes shall be controlled using pressure independent control algorithms and all flow readings shall be in CFM (LPS if metric).
- D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using the same programming tool as Building Controller and as described in operator workstation section. All programming tools shall be provided as part of system.
- E. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence for specific display requirements for intelligent room sensor.
- F. On board flow sensor shall be microprocessor driven and precalibrated at the factory. Precalibration shall be at 16 flow points as a minimum. All factory calibration data shall be stored in EEPROM. Calibration data shall be field adjustable to compensate for variations in VAV box type and installation. All calibration parameters shall be adjustable through

intelligent room sensor. Operator workstation, portable computers and special hand-held field tools shall not be needed for field calibration.

- G. Provide duct temperature sensor at discharge of each terminal box that is connected to controller for reporting back to operator workstation.

2.7 SENSORS and MISCELLANEOUS DEVICES

- A. Temperature Sensors: All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches about finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.

- B. Carbon Monoxide Detector:

- 1. Provide Fyrnetics carbon monoxide detector or equal (120V-1PH) complete with auxiliary hearing impaired strobe light in each Mechanical Room with gas-fired equipment.
- 2. The system shall monitor parts per million of carbon monoxide and shall alarm at a predetermined level of concentration (adjustable setpoint). The alarm shall activate the unit alarm light, horn, and a remote strobe light located at all entrances to mechanical rooms. The detector shall de-energize the horn upon safe carbon monoxide levels, however, the warning lights shall require manual reset. Detector shall be complete with remote sensors output for Building Automation System.
- 3. Alarms shall be monitored through the DDC control system.

- C. Field Service Tool:

- 1. Field service tool shall allow technician to view and modify all setpoints and tuning parameters stored in application controller. In addition, technician shall be able to view status of all inputs and outputs on digital readout. Each piece of data shall have a data code associated with it that is customizable.
- 2. Field service tool shall plug into wall sensor and provide all the functionality specified. Operator workstation shall include the capability to disable operation of the field service tool.
- 3. Provide Field Service Tools for this project or laptop PC.

D. Network Connection Tool:

1. Network connection tool shall allow technician to connect a laptop to any MS/TP network or at any MS/TP device and view and modify all information throughout the entire BACnet network. Laptop connection to tool shall be via Ethernet or PTP.
2. Provide quick connect to MS/TP LAN at each controller. Tool shall be able to adjust to all MS/TP baud rates specified in the BACnet standard.
3. Proved Network Connection Tools for this project.

2.8 ELECTRONIC ACTUATORS AND VALVES:

A. Quality Assurance for Actuators and Valves:

1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
2. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
3. Five-year manufacturers warranty. Two-year unconditional and three-year product defect from date of installation.

B. Execution Details for Actuators and Valves:

1. Furnish a Freeze-stat and install “Hard Wire” interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
2. Each DDC analog output point shall have an actuator feedback signal, independent of control signal, wired and terminated in the control panel for true position information and troubleshooting. Or the actuator feedback signal may be wired to the DDC as an analog input for true actuator position status.
3. VAV box damper actuation shall be Floating type or Analog (2-10vdc, 4-20ma).
4. Booster-heat valve actuation shall be Floating type or Analog (2-10vdc, 4-20ma).
5. Primary valve control shall be Analog (2-10vdc, 4-20ma).

C. Actuators for Damper and Control Valves ½" to 6" shall be Electric unless otherwise specified, provide actuators as follows:

1. UL Listed Standard 873 and Canadian Standards association Class 481302 shall certify Actuators.
2. NEMA 2 rated actuator enclosures are. Use additional weather shield to protect actuator when mounted outside.
3. 5 year Manufacturers Warranty. Two-year unconditional + Three year product defect from date of installation.
4. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
5. Position indicator device shall be installed and made visible to the exposed side of the Actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the Actuator.

6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for Butterfly Valve actuators.
7. A push button gearbox release shall be provided for all non-spring actuators.
8. Modulating actuators shall be 24Vac and consume 10VA power or less.
9. Conduit connectors are required when specified and when code requires it.

D. Damper Actuators:

1. Outside Air and Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
2. Economizer Actuators shall utilize Analog control 2-10 VDC, Floating control is not acceptable.
3. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
4. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See below execution section for more installation details.)

E. Valve Actuators ½" to 6":

1. Mechanical spring shall be provided on all actuators for pre-heat coil and actuators for AHU heating or cooling coil when units are mounted outside. See plans for fail save flow function: Normal Open or Normal Closed. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
2. All zone service actuators shall be non-spring return unless otherwise specified.
3. The valve actuator shall be capable of providing the minimum torque required for proper valve close off for the required application.
4. All control valves actuators shall have an attached 3-foot cable for easy installation to a junction box.
5. Override handle and gearbox release shall be provided for all non-spring return valve actuators.

F. Control Dampers. The BAS contractor shall furnish and size all automatic control dampers unless provided with packaged equipment. The sheet metal contractor shall install all dampers unless provided with packaged equipment.

1. All dampers used for modulating service shall be opposed blade type arrange for normally open or normally closed operation as required. The damper is to be sized so that when wide open the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.
 2. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
 3. Damper linkage hardware shall be constructed of aluminum or corrosion resistant zinc & nickel-plated steel and furnished as follows:
 4. Bearing support bracket and drive blade pin extension shall be provided for each damper section. Sheet metal contractor shall install bearing support bracket and drive blade pin extension. Sheet metal contractor shall provide permanent indication of blade position by scratching or marking the visible end of the drive blade pin extension.
 5. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For Single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.
 6. Damper manufacturer shall supply alignment plates for all multi-section dampers.
- G. Control Valves ½” to 6”:
- The BAS contractor shall furnish all specified motorized control valves and actuators. BAS contractor shall furnish all control wiring to actuators. The Plumbing contractor shall install all valves. Equal Percentage control characteristic shall be provided for all water coil control valves. Linear valve characteristic is acceptable for 3-way valves 2½ inch and above.
1. Characterized Control Valves shall be used for hydronic heating or cooling applications and small to medium AHU water coil applications to 100GPM. Actuators are non-spring return for terminal unit coil control unless otherwise noted. If the coil is exposed to the Outside Air stream then see plans for Spring Return requirement.
 - a. Leakage is Zero percent, Close-off is 200psi, Maximum differential is 30psi. Rangeability is 500:1.
 - b. Valves 1/2 inch through 2 inches shall be nickel-plated forged brass body, NPT screw type connections.
 - c. Valves 1/2 inch through 1-1/4 inches shall be rated for ANSI Class 600 working pressure. Valves 1-1/2 inch and 2 inches shall be rated for ANSI Class 400 working pressure.
 - d. The operating temperature range shall be 0° to 250° F.
 - e. Stainless steel ball & stem shall be furnished on all modulating valves.
 - f. Seats shall be fiberglass reinforced Teflon.
 - g. Two-way and three-way valves shall have an equal percentage control port. Full stem rotation is required for maximum flow to insure stable BTU control of the coil.
 - h. Three-way valve shall be applicable for both mixing and diverting.
 - i. The characterizing disc is made of TEFZEL and shall be keyed and held secure by a retaining ring.
 - j. The valves shall have a blow out proof stem design.

- k. The stem packing shall consist of 2 lubricated O-rings designed for on-off or modulating service and require no maintenance.
 - l. The valves shall have an ISO type, 4-bolt flange, for mounting actuator in any orientation parallel or perpendicular to the pipe.
 - m. A non-metallic thermal isolation adapter shall separate valve flange from actuator.
 - n. One fastening screw shall secure the direct coupling of the thermal isolation adapter between the actuator and the valve. This will prevent all lateral or rotational forces from affecting the stem and its packing O-rings.
2. Globe valves ½" to 2" shall be used for steam control or water flow applications.
- a. Valves shall be bronze body, NPT screw type, and shall be rated for ANSI Class 250 working pressure.
 - b. Valves 1/2 inch (DN15) through 2 inches (DN50) with spring return actuators shall close off against 50 psi pressure differential with Class III leakage (.1%).
 - c. The operating temperature range shall be 20° to 280° F.
 - d. Spring loaded TFE packing shall protect against leakage at the stem.
 - e. Two-way valves shall have an equal percentage control port.
 - f. Three-way valves shall a linear control and bypass port.
 - g. Mixing and diverting valves must be installed specific to the valve design.
3. Globe Valve 2 ½ to 6"
- a. Valves 2-1/2 inch (DN65) through 6 inches (DN50) shall be iron body, 125 lb. flanged with Class III (.1%) close-off leakage at 50 psi differential.
 - b. Valves with spring return actuators shall close off against 50 psi pressure differential with Class III leakage (.1%).
 - c. Flow type for two-way valves shall be equal percentage. Flow type for three-way valves shall be linear.
 - d. Mixing and diverting valves must be installed specific to the valve design.
- H. Butterfly valves: Butterfly Valves shall be sized for modulating service at 60-70 degree stem rotation. Isolation valves shall be line-size. Design velocity shall be less than 12 feet per second when used with standard EPDM seats.
- 1. Body is Cast Iron.
 - 2. Disc is Aluminum Bronze standard.
 - 3. Seat is EPDM Standard.
 - 4. Body Pressure is 200 psi, -30F to 275F.
 - 5. Flange is ANSI 125/250.
 - 6. Media Temperature Range is -22F to 240F.
 - 7. Maximum Differential Pressure is 200 psi for 2" to 6" size.

- I. Butterfly Valve Industrial Actuators:
 1. Actuators shall be approved under Canadian Standards Association or other Nationally Recognized Testing Laboratory to UL standards. CSA Class 4813 02 or equal. Enclosure shall be NEMA 4 (weatherproof) enclosure and will have an industrial quality coating.
 - a. Actuator shall have a motor rated for continuous duty. The motor shall be fractional horsepower; permanent split capacitor type designed to operate on a 120 VAC, 1 pH, 60 Hz supply. Two adjustable cam actuated end travel limit switches shall be provided to control direction of travel. A self-resetting thermal switch shall be imbedded in the motor for overload protection.
 - b. Reduction gearing shall be designed to withstand the actual motor stall torque. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.
 - c. Actuator shall have a 6 ft wiring harness provided for ease in field wiring (above 1500 in-lbs). Two adjustable SPDT cam-actuated auxiliary switches, rated at 250 VAC shall be provided for indication of open and closed position. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.
 - d. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator and when in manual operation electrical power to the actuator will be permanently interrupted. The hand wheel will not rotate while the actuator is electrically driven.
 - e. The actuator shall be Analog, floating, or two position as called out in the control sequence of operation. All Analog valves shall be positive positioning, and respond to a 2-10 VDC, 4-20 mA, or adjustable signal as required. Analog actuators shall have a digital control card allowing any voltage input for control and any DC voltage feedback signal for position indication.
 2. Performance Verification Test:
 - a. Control loops shall cause productive actuation with each movement of the actuator and actuators shall modulate at a rate which is stable and responsive. Actuator movement shall not occur before the effects of previous movement have affected the sensor.
 - b. Actuator shall have capability of signaling a trouble alarm when the actuator Stop-Go Ratio exceeds 30%.
 3. Actuator Mounting for Damper and Valve arrangements shall comply to the following:
 - a. Damper Actuators: Shall not be installed in the air stream
 - b. A weather shield shall be used if actuators are located outside. For Damper Actuators use clear plastic enclosure.

- c. Damper or valve actuator ambient temperature shall not exceed 122 Deg. F. through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary
- d. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.
- e. Damper mounting arrangements shall comply to the following:
 - (1) The ventilation subcontractor shall furnish and install damper channel supports and sheet metal collars.
 - (2) No jack shafting of damper sections shall be allowed.
 - (3) Multi-section dampers shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per section.
- f. Size damper sections based on actuator manufacturers specific recommendations for face velocity, differential pressure and damper type. In general:
 - (1) Damper section shall not exceed 24 ft-sq. with face velocity £ 1500 FPM.
 - (2) Damper section shall not exceed 18 ft-sq. with face velocity £ 2500 FPM.
 - (3) Damper section shall not exceed 13 ft-sq. with face velocity £ 3000 FPM.
- g. Multiple section dampers of two or more shall be arranged to allow actuators to be direct shaft mounted on the outside of the duct.
- h. Multiple section dampers of three or more sections wide shall be arranged with a 3-sided vertical channel (8” wide by 6” deep) within the duct or fan housing and between adjacent damper sections. Vertical channel shall be anchored at the top and bottom to the fan housing or building structure for support. The sides of each damper frame shall be connected to the channels. Holes in the channel shall allow damper drive blade shafts to pass through channel for direct shaft mounting of actuators. Open side of channel shall be faced down stream of the airflow, except for exhaust air dampers.
- i. Multiple section dampers to be mounted flush within a wall or housing opening shall receive either vertical channel supports as described above or sheet metal standout collars. Sheet metal collars (12” minimum) shall bring each damper section out of the wall to allow direct shaft mounting of the actuator on the side of the collar.

4. Valve Sizing for Water Coil:
- a. On/Off Control Valves shall be line size.
 - b. Modulating Control Valve Body Size may be reduced at most two pipe sizes from the line size or not less than ½ the pipe size. The BAS contractor shall size all water coil control valves for the application as follows:
 - (1) Booster-heat valves shall be sized not to exceed 4-9psi differential pressure. Size valve for 50% Valve Authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
 - (2) Primary valves shall be sized not to exceed 5-15psi differential pressure. Size valve for 50% Valve Authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
 - (3) Butterfly valves shall be sized for modulating service at 60-70 degree rotation. Design velocity shall be 12 feet per second or less when used with standard EPDM seats.
 - c. Valve Mounting arrangements shall comply to the following:
 - (1) Unions shall be provided on all ports of two-way and three-way valves.
 - (2) Install three-way equal percentage Characterized Control valves in a mixing configuration with the “A” port piped to the coil.
 - (3) Install 2½ inch and above, Three-Way globe valves, as manufactured for mixing or diverting service to the coil.

2.9 ENCLOSURES

- A. All controllers, power supplies and relays shall be mounted in enclosures.
- B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.
- C. Enclosures shall have hinged, locking doors.
- D. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8” thick sized appropriately to make label easy to read.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.

- B. Notify the owners' representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.

3.2 INSTALLATION (GENERAL)

- A. Install in accordance with manufacturer's instructions.
- B. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

3.3 LOCATION AND INSTALLATION OF COMPONENTS

- A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3'-0" clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
- B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture and high or low temperatures.
- C. Identify all equipment and panels. Provide permanently mounted tags for all panels.
- D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections—sized to suit pipe diameter without restricting flow.

3.4 INTERLOCKING AND CONTROL WIRING

- A. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 16 and all national, state and local electrical codes.
- B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
- C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.
- D. Provide auxiliary pilot duty relays on motor starters as required for control function.

- E. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings—coordinate with electrical contractor.
- F. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring to be installed neatly and inconspicuously per local code requirements. If local code allows, control wiring above accessible ceiling spaces may be run with plenum rated cable (without conduit).

3.5 DDC OBJECT TYPE SUMMARY

- A. Provide all database generation.
- B. Displays: System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.
- C. Run Time Totalization: At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
- D. Trendlog: All binary and analog object types (including zones) shall have the capability to be automatically trended.
- E. Alarm: All analog inputs (High/Low Limits) and selected binary input alarm points shall be prioritized and routed (locally or remotely) with alarm message per owner's requirements.
- F. Database Save: Provide back-up database for all stand-alone application controllers on disk.

3.6 FIELD SERVICES

- A. Prepare and start logic control system under provisions of this section.
- B. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- C. Provide the capability for off-site monitoring at control contractor's local or main office. At a minimum, off-site facility shall be capable of system diagnostics and software download. Owner shall provide phone line for this service for 1 year or as specified.
- D. Provide Owner's Representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

3.7 TRAINING

- A. Provide application engineer to instruct owner in operation of systems and equipment.
- B. Provide system operator's training to include (but not limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands and request of logs. Provide this training to a minimum of 3 persons.
- C. Provide on-site training above as required, up to 16 hours as part of this contract.

3.8 DEMONSTRATION

- A. Provide systems demonstration under provisions of Section 15010.
- B. Demonstrate complete operating system to owner's representative.
- C. Provide certificate stating that control system has been tested and adjusted for proper operation.

PART 4 - SEQUENCE OF OPERATIONS

4.1 GENERAL

- A. Provide a complete and operational temperature control and building automation system based on the following points and sequence of operation. The system shall be complete as to sequences and standard control practices. The determined point list is the minimum amount of points that are to be provided. If additional points are required to meet the sequence of operation, they will be provided.
- B. BACnet Object List
 - 1. The following points as defined for each piece of equipment are designated as follows:
 - a. Binary Out (BO) - Defined as any two-state output (start/stop) (enable/disable), etc.
 - b. Binary In (BI) - Defined as any two-state input (alarm, status), etc.
 - c. Analog In (AI) - Defined as any variable input (temperature) (position), etc.
 - d. Analog Out (AO) - Defined as any electrical variable output. 0–20mA, 4–20mA and 0–10VDC are the only acceptable analog outputs. The driver for analog outputs must come from both hardware and software resident in the controllers. Transducers will not be acceptable under any circumstance.

4.2 CONTROL SEQUENCES

- A. Computer Room Air Conditioners: See section 238100 2.0.1.L.

SECTION 232000 - HVAC PIPING AND PUMPS

PART 1 - GENERAL

1.1 CONDITIONS

- A. The applicable provisions of Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) are hereby made a part of this section, and the Contractor is cautioned to read Section 230000 carefully as items of work applicable to this section are included in Section 230000.

1.2 DESCRIPTION OF WORK

- A. Piping to connect HVAC equipment, including the following:
 - 1. Steam Piping
 - 2. Condensate Piping
 - 3. Pumped Condensate Piping
 - 4. Heating Water Piping
 - 5. Chilled Water Piping
 - 6. Condenser Water Piping
 - 7. Heat Pump Water Piping
 - 8. Refrigerant Piping
 - 9. Condensate Drain Piping
- B. Installation of control valves and instrument wells referred to in other Division 23 sections.
- C. Steam System Components
- D. Hydronic System Components
- E. Chemical Feeders
- F. Condensate Pumps
- G. In-Line Pumps
- H. End Suction Pumps
- I. Vertical and Horizontal Split Case Pumps
- J. Suction Diffuser

1.3 RELATED WORK

- A. Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).
- B. Section 230548, VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT.
- C. Section 230593, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- D. Section 230700, HVAC INSULATION.
- E. Section 230900, INSTRUMENTATION AND CONTROL FOR HVAC.
- F. Section 233000, HVAC AIR DISTRIBUTION.
- G. Section 235000, CENTRAL HEATING EQUIPMENT.
- H. Section 236000, CENTRAL COOLING EQUIPMENT.
- I. Section 237000, CENTRAL HVAC EQUIPMENT.
- J. Section 238100, DECENTRALIZED UNITARY HVAC EQUIPMENT.
- K. Section 238200, CONVECTION HEATING AND COOLING UNITS.

1.4 SUBMITTALS

- A. In accordance with Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC), furnish the following:
 - 1. Manufacturer's Literature and Data with pump curve (where applicable):
 - a. Pipe and equipment supports. Submit calculations for variable spring and constant support hangers
 - b. Pipe and tubing, with specification, class or type, and schedule
 - c. Pipe fittings, including miscellaneous adapters and special fittings
 - d. Flanges, gaskets and bolting
 - e. Valves of all types
 - f. Strainers
 - g. Steam traps
 - h. Gages
 - i. Refrigerant valves and components
 - j. Flexible connectors for water service
 - k. All specified hydronic system components

- l. Water flow measuring devices
 - m. Chemical feeders
 - n. Underground piping system
 - o. Thermometers and tests wells
 - p. Condensate Pump
 - q. In-Line Pump
 - r. End Suction Water Pumps
 - s. Suction Diffuser
 - t. Vertical Split Case Pump
 - u. Horizontal Split Case Pump
- B. Manufacturer's Certified Data Report for ASTM Pressure Vessels:
- 1. Air separators.
 - 2. Expansion tanks.

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

- A. Provide in accordance with specifications in Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).

2.2 PIPE AND TUBING

- A. Steam, Condensate and Pumped Condensate Piping:
- 1. Black Steel: ASTM A 53 Grade B ERW or seamless Schedule 40 standard weight for steam and ASTM A53 Grade B ERW or seamless Schedule 80 extra heavy for condensate and pumped condensate.
- B. Heating Water Piping, Chilled Water Piping, and Heat Pump Water Piping (2-1/2 Inch and Larger):
- 1. Black Steel: ASTM A 53 Schedule 40 standard weight.
- C. Heating Water Piping, Chilled Water Piping, and Heat Pump Water Piping (2-Inch and Smaller):
- 1. Black Steel: ASTM A 53 Schedule 40 standard weight.
 - 2. Copper Water Tube Option: ASTM B 88, Type L, hard drawn. Except underground lines shall be Type K hard drawn copper tubing.

- D. Extension of Domestic Water Make-Up Piping: ASTM B 88, Type L, hard drawn copper tubing.
- E. Condenser Water Piping (5" and smaller):
 - 1. Galvanized steel: ASTM A53 Schedule 40 standard weight.
- F. Condenser Water Piping (6" and larger):
 - 1. Black steel: ASTM A53 Schedule 40 standard weight.
- G. Cooling Coil Condensate Drain Piping:
 - 1. From Air Handling Units: Copper water tube, ASTM B 88, Type L, hard drawn copper tubing.
- H. Refrigerant Piping:
 - 1. Copper Tubing: ASTM B 280, type ACR, cleaned, dehydrated and sealed seamless.

2.3 FITTINGS FOR STEEL PIPE

- A. 2-1/2 Inch and Larger: Welded, flanged, or grooved joints suitable for 125 psi service.
 - 1. Butt Weld Fittings: ANSI B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type unless otherwise noted.
 - 2. Welding Flanges and Bolting: ANSI B16.5.
 - a. Water Service: Weld neck or slip-on plain face, with 1/8-inch thick full face neoprene gasket suitable for 220 Deg. F.
 - b. Flange Bolting: Carbon steel machine bolts or studs and nuts, ASTM A 307, Grade B.
 - c. Grooved: ASTM A-536 ductile iron couplings, ASTM A-153 galvanized, Victaulic Style 77.
 - (1) Heating water gasket suitable for 230 Deg. F continuous service.
 - (2) Chilled water gaskets shall be suitable for the intended service.
 - (3) Steam service not applicable.
- B. 2-Inch and Smaller: Threaded or welded, suitable for 125 psi service.
 - 1. Butt Welding: ANSI B16.9 with same wall thickness as connecting piping.
 - 2. Forged Steel, Socket welding or Threaded: ANSI B16.11.

3. Threaded: 150 pound malleable iron, ASTM B16.3. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
 4. Unions: Fed. Spec. WW-U-531.
 5. Water Hose Connection Adapter: Brass, pipe thread to 3/4-inch garden hose thread, with hose cap nut.
- C. Welded Branch and Tap Connections: Forged steel weldolets and thredolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ANSI B16.11 may be used for drain, vent and gage connections.
- 2.4 FITTINGS
- A. Copper Tubing:
1. Solder Joint: Wrought copper, ANSI B16.22.
 - a. Solder for Drain Piping: 95-5 tin-antimony, ASTM B 32 (95TA).
 - b. Solder for Refrigerant Piping: Silver brazing alloy.
- B. Bronze Flanges and Flanged Fittings: ANSI B16.24.
- 2.5 DIELECTRIC FITTINGS
- A. Provide where copper and ferrous metal are joined.
1. 2 Inch and Less: Threaded dielectric union.
 2. 2-1/2 Inch and Larger: Flange union with dielectric gasket and bolt sleeves.
- 2.6 THREADED JOINTS
- A. Pipe Thread: ANSI B2.1.
- B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.
- 2.7 VALVES
- A. Valves shall be Stockham, Milwaukee, Nibco, or Victaulic. All valves shall be suitable for 125 psi working pressure unless noted otherwise. Valves shall have threaded or grooved connections, except where flanges are specified they shall have flanged connections or where installed in hard drawn copper lines they may have sweat connections.

- B. Service Valves:
1. 2-1/2 Inch and Smaller:
 - a. Gate valve: ASTM B-62 bronze body and solid wedge disc, rising stem MSS SP-80, Class 125.
 - b. Ball valve: ASTM B-584 Alloy 844 bronze body and stainless steel ball with teflon seats, conventional port, and blowout proof stems MSS SP-110, 150 PSI/600 PSI non-shock. Provide extended stem per application.
 2. 3 Inch and Larger:
 - a. Water service: ASTM A-536 ductile iron body butterfly, ASTM B-148 alloy 954/955 disc, EPDM seats, Class 200, locking-type manual lever.
 - b. Steam service (low pressure): Iron body gate, solid bronze wedge disc, flanged, outside screw and yoke, MSS SP-70, bronze mounted, Class 1 (125 psig).
- C. Globe Valves:
1. 2-Inch and Smaller: ASTM B-62 bronze body and disc, MSS SP-80, Class 125.
 2. 2-1/2 Inch and Larger: Similar to above, but ASTM A-126 flanged cast iron body, with bronze trim, bolt bonnet, OS & Y, renewable seat and disc.
- D. Check valves in sizes up to and including 2 inch shall be all bronze, swing type, with regrinding disc capable of being reground without removing the valve body from the line. Sizes 2-1/2 inch and larger shall be iron body, bronze-trimmed, regrinding seat, swing type, for water service.
- E. Refrigerant components shall include sight glass, filter drier, solenoid valve, charging valve, expansion valve and isolation valves. Refrigerant valves shall conform to ANSI B31.5. Refrigerant drier shall conform to ARI 710. Refrigerant circuit access ports shall be fitted with locking type tamper resistant caps in strict accordance with the IMC.
- F. Balancing Cocks: Combination balancing and shut-off valves shall incorporate a position indicator and memory stop or locking device so the valve can be closed without disturbing the setting, and be returned to the balanced position without further adjustment.
1. 4-Inch and Larger: Butterfly valves or plug valves.
 2. 3-Inch and Smaller: Resilient faced eccentric plug or lubricated plug type, iron or steel body, bronze plug and bearings, wrench operated, rated 175 psig at 200 Deg. F.
- G. Triple-Duty Valve: ITT Bell and Gossett triple duty valve designed to perform the functions of a non-slam check valve, throttling valve, shut-off valve, calibrated balancing valve and system flow meter. The valve shall be of heavy-duty cast iron construction with standard 125 psig ANSI flanged connections, and rated for a maximum working pressure of

175 psig at 250 degrees F. The valve shall be fitted with a bronze seat, replaceable bronze disc, stainless steel stem and chatter-preventing spring. The valve design shall permit repacking under full system pressure. Each valve shall be equipped with brass readout valves with integral check valve for taking differential pressure readings across the orifice to accurately balance the system to specified design conditions.

2.8 STRAINERS

A. Mueller Steam Specialty Co. No. 351 Y type.

1. Steam Services: Rated 150 psig saturated steam at 450 degrees F.
 - a. 2-1/2 Inch and Larger: Flanged, iron body.
 - b. 2-Inch and Smaller: Bronze.
2. Water Services: Rated 125 psig saturated steam at 450 Deg. F.
 - a. 2-1/2 Inch and Larger: Flanged, iron body, basket type (No. 165).
 - b. 2-Inch and Smaller: Bronze, threaded ends, Y type (No. 351).
3. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows:
 - a. Steam Service: 0.045-inch diameter perforations.
 - b. Water Service:
 - (1) 2-1/2 Inch and Larger: 1/16-inch diameter perforations.
 - (2) 2 Inch and Smaller: 1/32-inch diameter perforations.

B. Provide blow off outlet with pipe nipple and gate valve.

2.9 FLEXIBLE CONNECTORS FOR REFRIGERANT PIPING

- ### A. Flexible bronze or stainless steel piping connectors shall be Spring-Flex type MFP, style BF as manufactured by Vibration Mountings and Controls, Inc.

2.10 FLEXIBLE CONNECTORS FOR WATER SERVICE

- ### A. Flexible pipe joints shall be Flexonics Model PCS, stainless steel braided hose, pipe line size, flanged, minimum 125 psi working pressure at 250 degrees F.

2.11 EXPANSION JOINTS

- A. Expansion joints shall be Flexonic internally guided, corrugated bellows, expansion compensator, Type HB, 2" minimum stroke, suitable for (steam) (hot water) service. Grooved pipe couplings and expansion compensators shall provide for expansion in grooved piping systems.
- B. Expansion joints shall be Kelflex GTI-M-311 (or equal) dual or single internally guided, corrugated bellows, expansion compensator, 2" minimum stroke, suitable for hot water service. Grooved pipe couplings and expansion compensators shall provide for expansion in grooved piping systems. Provide necessary pipe alignment guides as required for expansion joint installation.

2.12 FLEXIBLE CONNECTORS FOR WATER SERVICE

- A. Flexible pipe joints shall be Flexonics Model PCS, stainless steel braided hose, pipe line size, flanged, minimum 125 psi working pressure at 250 Deg. F.

2.13 STEAM SYSTEM COMPONENTS

- A. Steam traps shall be Sarco, Webster, Hoffman, or Trane thermostatic, inverted bucket, or float and thermostat type as indicated. Traps shall be sized by the trap manufacturer to pass condensate at 2-1/2 times the condensation rate of the connected heating appliance (at 1 psi drop on low pressure system) (at 5 psi drop on medium pressure systems). Steam main drip traps shall be 3/4" bucket traps, or Yarway Series 130 impulse trap may be used in lieu of strainer and bucket trap. Traps shall be rated for (15 psi service on low pressure systems) (60 psi service on medium pressure systems.)
- B. Reducing valves for steam service shall be Leslie, Spence, or Aerco self-contained, external pilot, piston- or diaphragm-operated cast iron or bronze body with single-seated stainless steel valve for dead-end service. Valves shall be adjustable over a 2 to 35 psi range and shall provide not less than 75% accuracy of regulation at 10% of the rated capacity. Inlet pressure shall be _____ psi.
- C. Steam pressure relief valves for reducing stations shall be Consolidated, bronze or cast iron body, manual test lever, and suitable for steam service of sufficient capacity to relieve the full discharge capacity of the connected reducing valve. Discharge port of relief valves shall be piped full size to 6" above floor drain or floor and shall be supported so that no strain is on the valve.

2.14 HYDRONIC SYSTEM COMPONENTS

- A. Tangential Air Separators: Bell and Gossett "Rolairtrol", ASME Pressure Vessel Code construction for 125 psig working pressure, flanged tangential inlet and outlet connection,

internal perforated stainless steel air collector tube designed to direct released air into expansion tank, bottom blowdown connection.

- B. Closed Expansion (Compression) Tanks: Bell and Gossett, ASME Pressure Vessel Code construction for 125 psig working pressure, rustproof coated. Provide gage glass, with protection guard, and angle valves with tapped openings for drain (bottom) and plugged vent (top).
 - 1. Horizontal Tank: Provide cradle supports and following accessories:
 - a. Air Control Tank Fittings: Provide in each expansion tank Bell and Gossett No. ATF or ATFL "Airtrol" tank fitting to facilitate air transfer from air separator, or purger, into tank while restricting gravity circulation. Fitting shall include an integral or separate air vent tube, cut to length of about 2/3 of tank diameter, to allow venting air from the tank when establishing the initial water level in the tank.
 - b. Tank Drainer-Air Charger: Bell and Gossett No. DT-2 "Drain-O-Tank" air charger shall incorporate a vent tube, cut to above 2/3 of tank diameter, and drain valve with hose connection draining and recharging with air.
 - c. Boiler Fitting: Bell and Gossett Model ABF or AFBF as applicable, top or side discharge as required.
- C. Fill valves shall be Watts No. N256 complete with strainer and check valve. Valve shall be adjustable 10 to 25 psi and shall be factory set at 15 psi. Provide full size manual bypass with cutoffs around fill valve for fast fill and purging.
- D. Fill valves shall be Watts No. U5B complete with strainer. Valve shall be adjustable 25 to 75 psi and shall be factory set at 50 psi. Provide full size manual bypass with cutoffs around fill valve for fast fill and purging.
- E. (Safety relief valves for water heating systems shall be Watts ASME rated, Series 740. Valves for heating systems shall be sized to relieve the full heating capacity of the heater installed in the heating system at set pressure of 10 psi over operating pressure and not to exceed the operating design pressure of the heater.) (Safety relief valves for cooling systems shall be Watts ASME rated, Series 174A, 3/4" x 3/4" and shall have a set pressure of 10 psi over the operating pressure and not to exceed the operating design pressure of the cooling equipment.) Pipe discharge ports full size to floor drain and support so that no strain is on valve body.
- F. Regulating relief valves shall be adjustable setting type, bronze body, modulating action relief valve as manufactured by Klipfel, Illinois, or Consolidated. Size to relieve 50% of pump capacity. Set to relieve when system head is 5 foot w.g. above specified system pump head.
- G. Air Vents:

1. Automatic air vents shall be Hoffman No. 79, suitable for 75 psi service, and shall provide venting operation under all conditions. Exhaust port from each vent shall be extended with a concealed 1/4" copper tubing to floor of equipment rooms, to a drain, or to 6" above grade at building exterior.
 2. Manual air vents shall be chromium-plated brass 1/8" NPT coin-operated type. Provide extension tube if required to maintain access to vent operator.
- H. Drains: Drains shall be accessible with 3/4" hose-end drain valve unless indicated otherwise.

2.15 WATER FLOW MEASURING DEVICES

- A. Circuit setters shall be Bell and Gossett bronze balance valve with provisions for connecting a portable differential pressure meter. Meter connections shall have built-in check valves. An integral pointer shall register degree of valve opening. Each balance valve shall be constructed for 125 lbs. working pressure at 250 Deg. F. Furnish one differential meter Model RO-5 complete with meter, cutoffs, piping, fitting, and hose. The valve pressure drop and the setting shall determine the actual system flow rate.
- B. Automatic Flow Control Valves shall be Griswold, Autoflow, Hays or equal and shall be provided at all water source heat pump units. Valves shall be automatic pressure compensating type and factory set to provide specified flow rates within five (5) percent regardless of system pressure. Valves shall be selected to provide specified flow rates with a minimum pressure differential of 2 psig and maximum pressure drop of 10 feet of water. Where system differential exceeds 32 psig, valves shall be selected for a range of 4-57 psig. Valve body shall be suitable for use with piping system and internal working parts shall be stainless steel, nickel plated brass or elastomeric diaphragm. All valves shall be provided with union and pressure-temperature test ports suitable for connecting differential pressure measuring devices. All valves shall be wye configuration for removal of controlling element without removing valve from piping. Each valve shall be identified as to direction of flow and flow rate. One differential pressure meter shall be provided complete with dual hose kit, valves, flow conversion chart and carrying case. Meter and accessories shall be turned over to the Owner upon final acceptance of the project.

2.16 GAGES, PRESSURE AND COMPOUND

- A. Pressure gauges shall be Ashcroft bourdon tube, general service type suitable for 125 psi service. Gauges shall not be less than 4" dial type with aluminum case and gauge cock. Gauges shall be graduated in feet of water and psi.
- B. Range of Gages: Provide range equal to at least 150 percent of normal operating range.

2.17 THERMOMETERS

- A. Weksler Instruments Type AA, Fed. Spec. GG-T-321, non-mercury fluid filled type, blue column, clear plastic window, with 6-inch brass stem, straight, adjustable angle as required for each in reading.
- B. Scale: Not less than nine inches, range as described below, two degree graduations.
- C. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.
- D. Scale ranges may be slightly greater than shown to meet manufacturer's standard.

2.18 UNDERGROUND PIPING

- A. Heated or Chilled water lines underground: Pipe and insulation shall be Rovanco or Ricwel insulated piping system complete with pipe, insulation, outer jacket, and matching fittings for a complete installation. Pipe shall be Schedule 40 electric resistance weld steel pipe. Pipe shall be factory insulated with polyurethane closed cell foam completely filling the annular space between the service pipe and the outer jacket. The insulation shall be 1.68 inches thick having a thermal resistance (R) of 7.5 per inch thickness. The outer jacket shall be watertight, high impact seamless polyvinylchloride (PVC) suitable for Department of Highway H2O Classification. Provide pipe anchors as indicated and as required to control pipe expansion. Provide compressible material at expansion legs. Insulated piping system shall be installed in strict accordance to the manufacturer's recommendations.
- B. Manufacturer's Field Installation Instruction: On completion of the installation, the Contractor shall deliver to the Owner a certificate from the manufacturer stating that the installation has been made in accordance with the manufacturer's recommendations.

2.19 CHEMICAL FEEDERS

- A. Chemical feeders shall consist of a one shot feeder and a one-year supply of chemicals as manufactured by Neptune. The feeder shall have an 11 gauge steel body of two-gallon capacity, with holes at top and bottom tapped for 1" pipe thread and four holes tapped for 3/8" pipe thread. The feeder shall be complete with fill and drain valves, minimum 3-1/2" opening, flow regulator valve, and miscellaneous fittings for connection of fill and drain accessories. Design operating pressure shall be 300 psi maximum @ 200°F. The cap shall be constructed of cast iron with epoxy coated underside and square ring gasket seal. The feeder shall include structural legs to elevate the feeder off the floor. The legs shall have holes to allow mounting by anchor bolts.

2.20 CONDENSATE PUMP

- A. Condensate pump shall be Federal Model CCV duplex type. The pumping unit shall consist of 2 pumps and motors, 1 condensate receiver, 2 motor starters, and alternator equipment which shall provide for automatic alternate operation of the 2 pumps, operation of both pumps under peak load conditions, and automatic operation of the stand-by pump in case the active pump fails to function. Pumps and motors shall be flanged to a cast iron receiving tank. The receiving tank shall be provided with a remote-mounted inlet strainer. Pumps shall be close coupled to NEMA motors with drip-proof enclosure. Pumps shall have mechanical shaft seal and bronze shaft sleeve. Motors and rotating assembly shall be removable without disturbing the discharge piping. Entire unit shall be factory assembled with all controls mounted and wired thereon.

2.21 IN-LINE PUMPS

- A. General - Pumps shall operate at not over 1750 rpm and shall be suitable for pumping water at 210 degrees F. Submit the manufacturer's certified characteristics performance curve for the impeller size to be furnished. The operating point on the characteristic performance curve shall be to the left (shut-off side) of the curve. The pump motor shall be non-overloading at any point on the head-capacity curve.
- B. In-line pump shall be U.L. Listed Bell & Gossett Little Red (Model LR-20BF iron body) (Model LR-15B bronze body) Booster Pump or equal complete with U.L. Listed motor, glass filled Noryl enclosed impeller, carbon steel shaft, mechanical seals, bronze-sleeve oil lubricated bearings. Unit maximum working pressure shall be 125.0 psi @ a maximum operating temperature of 225.0 degrees F. The motor shall be non-overloading at any point on the pump curve. Motor shall be open, drip proof, sleeve-bearing, quiet-operating construction. The permanent split capacitor motor shall be equipped with thermal overload protection. Motor rating shall be (1/20 HP, 115 volts, 60 Hz, single phase @ 2900 RPM) (1/12 HP, 115 volts, 60 Hz, single phase @ 3150 RPM) (The pump shall have a capacity of _____ GPM @ _____ feet ahead.)
- C. In-line pump shall be Bell & Gossett Booster Pump (Model _____) or equal complete with U.L. Listed motor, flexible spring noise-dampening coupler or flexible sleeve-type, bronze-sleeve oil lubricated pump bearings, precision ground oversized pump shaft, mechanical seals, (brass) (cadmium plated steel) (cast iron) close impeller and oil lubrication system. Unit maximum working pressure shall be 125.0 psi @ a maximum operating temperature of 225.0 degrees F. The motor shall be non-overloading at any point on pump curve. The motor shall be of the drip-proof, sleeve-bearing, quiet-operating, rubber-mounted construction. Motors shall have built-in thermal overload protectors. All 3-phase motors shall be furnished and installed with a magnetic starter for each booster pump, with at least two thermal overload protectors. The starter shall be equipped with manual reset buttons. (Motor rating shall be _____ volts _____ cycle _____ phase.) (The pump shall have a capacity of _____ GPM at _____ Ft. head.) (Pump on domestic water service shall be all bronze construction.)

- D. In-line pump(s) shall be Bell & Gossett Series 60 or equal with capacities as shown on plans. Pumps shall be capable of installation in vertical or horizontal piping. Pump shall be serviced without disturbing piping connections. Pump body shall be of Class 30 cast iron, rated 175 psi working pressure, with gauge ports at nozzles, and with vent and drain ports. Impeller shall be non-ferrous material, enclosed type, dynamically balanced, keyed to the shaft and secured by a locking cap screw or nut. The liquid cavity shall be sealed off at the motor shaft by an internally flushed mechanical seal with ceramic seal seat, and carbon seal ring, suitable for continuous operation at 225 Deg. F. A non-ferrous shaft sleeve shall completely cover the wetted area under the seal. Pump bearing bracket shall have oil lubricated bronze journal and thrust bearings. Bracket shaft shall be alloy steel having ground and hardened thrust bearing faces. A flexible coupling shall dampen starting torque and torsional vibrations. Motor shall meet NEMA specifications and shall be the size and voltage called for on the plans. Pump shall be factory tested, cleaned, and painted with high-grade machinery enamel prior to shipment.
- E. Line-mounted pumps shall be Bell & Gossett Series 80 or equal. Pumps shall be in-line type, close-coupled, single-stage design, for installation in vertical or horizontal position, and capable of being serviced without disturbing piping connections. Pump casing shall be Class 30 cast iron. The impeller shall be of cast bronze, enclosed type, dynamically balanced, keyed to the shaft and secured by a locking cap screw. The liquid cavity shall be sealed off at the motor shaft by an internally-flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225 deg. F. A bronze shaft sleeve shall completely cover the wetted area under the seal. Pumps shall be rated for minimum of 175 psi working pressure. The pump case shall have gauge tappings at the suction and discharge nozzles and will include vent and drain ports. Motor shall meet NEMA specifications and shall be the size and voltage called for on the plans. It shall have heavy-duty grease lubricated ball bearings, completely adequate for the maximum load for which the pump is designed. Each pump shall be factory tested, cleaned, and painted with high-grade machinery enamel prior to shipment.
- F. In-line pump shall be Bell & Gossett Series 90 or equal. Pumps shall be in-line type, close-coupled, single-stage design, for installation in vertical or horizontal position, and capable of being serviced without disturbing piping connections. Pump volute shall be of Class 30 cast iron, and impeller shall be of bronze/brass, enclosed type, dynamically balanced, keyed and secured to the shaft by a locking cap screw or nut. The liquid cavity shall be sealed off at the motor shaft by an internally-flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225 Deg. F. A shaft sleeve shall completely cover the wetted area under the seal. Pumps shall be rated for maximum of 175 psi working pressure. Casings shall have gauge ports at nozzles, and vent and drain ports in casing. Motor shall meet NEMA specifications and shall be the size and voltage called for on the plans. It shall have heavy-duty grease lubricated ball bearings, completely adequate for the maximum load for which the motor is designed. Pump shall be factory tested, cleaned, and painted with high-grade machinery enamel prior to shipment.

2.22 END SUCTION WATER PUMP

- A. General - End suction water pump shall operate at not over 1750 rpm and shall be suitable for pumping water at 210°F.
- B. End suction water pump shall be Bell & Gossett base-mounted pump Series 1510 or equal with Class 30 cast iron volute with integrally-cast support, cast bronze impeller, enclosed type, dynamically balanced, mechanical shaft seals with carbon seal ring for continuous operation @ 225.0 Deg. F, minimum working pressure of 175 psi. Casings shall have gauge ports at nozzles and vent and drain ports at top and bottom of casing. Housing assembly shall have replaceable heavy-duty regreasable ball bearings. Pump and motor shall be mounted on a common base. Base ends, with securely welded cross members and fully open grouting area. A flexible-type coupler shall connect the pump and U.L. Listed motor. The coupler shall be complete with safety guard meeting compliance with ANSI B15.1, Section 8 and OSHA 1910.219. Contractor to level and grout each unit according to manufacturer's instructions. The motor shall meet NEMA specifications and shall be the size and voltage called for on the plans. Pump and motor shall be factory aligned, and shall be realigned by Contractor after installation. Each pump shall be factory tested, cleaned, and painted with high-grade machinery enamel. Unit shall be checked by the Contractor and regulated for proper differential pressure, voltage, and amperage draw. Data shall be noted on a permanent tag and fastened to the pump.
- C. Submit the manufacturer's certified characteristics performance curve for the impeller size to be furnished. The operating point on the characteristic performance curve shall be to the left (shut-off side) of the curve. The pump motor shall be non-overloading at any point on the head-capacity curve.

2.23 SUCTION DIFFUSER

- A. Provide Bell & Gossett Model (NPT) (FLG) suction diffuser for each base-mounted pump. (Flange connections for field piping shall be drilled and faced per 150# ANSI Standards.) Units shall consist of angle type body with straightening vanes and combination Diffuser-Strainer-Orifice Cylinder with maximum 3/16" diameter openings for pump protection. Diffuser shall be equipped with a disposable, bronze, 16 fine mesh strainer which shall be removed after system start-up. Orifice cylinder shall be designed to withstand pressure differential equal to pump shutoff head and shall have a free area equal to five times cross section area of pump suction opening. Straightening vanes shall extend the full length of the orifice cylinder and shall be replaceable. Unit shall be provided with adjustable support foot to help carry weight of suction piping. Maximum working pressure shall be 175 psi @ maximum operating temperature of 250°F. The unit pressure drop shall not exceed 1.0 psi for design pump gpm.

2.24 VERTICAL SPLIT CASE PUMPS

- A. Water pumps shall be B & G Series VSC, single stage, double suction, vertically split case design, capable of being serviced without disturbing pump, volute or motor. The impeller shall be bronze enclosed double suction type, dynamically balanced, keyed to the shaft and secured with a slightly press and suitable lock-nut arrangement. The liquid cavity shall be sealed off by an internally-flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225 degrees F. The seals shall be capable of being serviced without disconnecting the pump from piping. The pump casing shall be of class 30 cast iron, suitable for 175 psi working pressure. Flanges shall be 125 psi ANSI. The pump volute shall be supplied with plugged vent, drain, and gauge tapplings. The pump bearings shall be regreasable cam lock, ball bearing type with provision for purging or flushing through the bearing surface, and capable of being inspected by removing the bearing covers. The shaft shall be of 18-8 stainless steel. A flexible type, center drop-out design coupler, capable of absorbing torsional vibration, shall be employed between the pump and motor. Coupler shall be shielded by a coupler guard securely fastened to the base.
- B. Motor shall meet NEMA specifications and shall be the size and voltage called for on the plans. Pump and motor shall be factory aligned, and shall be realigned by the Contractor after installation, prior to start up. The pump and motor shall be mounted on a common baseplate of heavy structural steel design and securely welded cross members and open grouting area.
- C. Each pump shall be factory tested per Hydraulic Institute standards, prior to shipment.
- D. Submit the manufacturer's certified characteristics performance curve for the impeller size to be furnished. The operating point on the characteristic performance curve shall be to the left (shut-off side) of the curve. The pump motor shall be non-overloading at any point on the head capacity curve.

2.25 HORIZONTAL SPLIT CASE PUMPS

- A. Water pumps shall be B & G Series HSC, single stage, double suction, horizontal split case design. Casing shall be close-grained cast iron for working pressures up to 175 psig and shall be of axially split design with suction and discharge flanges and mounting feet cast integral with the lower half casing. Tapped and plugged holes shall be provided for priming, vent, drain, and gauge connections. Upper half casing shall be removed without disturbing suction or discharge piping. Flanges shall be of 125 psi ASA Standard. Suction and discharge shall be on a common centerline in both the horizontal and vertical planes. Impeller shall be of the enclosed double suction type made of bronze non-overloading in operating characteristics and statically and hydraulically balanced. The impeller shall be keyed to the shaft and fixed in an axial position. Hub shall have sufficient metal thickness to allow machining for installation of impeller rings. Maximum diameter shall be less than 90 percent of shaft to casing lip distance for quiet operation. Shaft shall be made of 416

stainless steel ample size to operate under load with a minimum of deflection. Mechanical seals shall be mounted directly on the shaft and located so that seal lubrication liquid is directed immediately over the seal faces. Seals shall be John Crane Type 21 or equal. Arrangement shall assure that seal leakage cannot enter the bearing housings. Seals shall be suitable for conditions stated. Piping shall be supplied to provide seal lubrication and shall be mounted on the upper half of the casing. Casing rings shall be made of bronze and shall be installed with an anti-rotation device, and designed to prevent leakage across the ring fit. Impeller rings made of bronze shall be mounted on the impeller hubs to provide the renewable clearances. Bearings shall be grease lubricated ball type, single row inboard selected to carry radial thrust only, and double row outboard selected to carry radial thrust loads. Bearing housings shall be maintained in positive alignment by a 360 degree male-female fit. The housings shall provide a fit for the inboard bearing that allows freedom for thermal expansion while the outboard bearing shall be clamped in place to take all thrust loads and keep the rotating element in its proper axial location. Plugged openings for adding new grease and draining old grease shall be provided. Baseplate shall be channel steel with drip rim, sufficiently rigid to support the pump and driver. Final alignment of pump and driver shall be made after grouting and installation, and shall be approved by customer prior to operation. Coupling shall be flexible type with steel flanges connected to a rubber sleeve for torque transmission. Coupling guard shall be the all metal type.

- B. Motor driver shall be selected in accordance with pump's non-overloading performance characteristics. Motor horsepower rating shall be chosen in keeping with the pump's possible peak horsepower requirements. In sizing the motor, maximum brake horsepower shall not exceed the motor's nominal nameplate rating. Motor shall be mounted with pump on baseplate at pump manufacturer's plant and shipped as one unit. Nameplates and other data plates shall be stainless steel, suitably secured to the pump.
- C. Submit the manufacturer's certified characteristics performance curve for the impeller size to be furnished. The operating point on the characteristic performance curve shall be to the left (shut-off) side of the curve. The pump motor shall be non-overloading at any point on the head capacity curve.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. General:
 - 1. The drawings show the general arrangement of pipe and equipment but do not show all fittings and offsets that may be necessary.
 - 2. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.

3. Support piping securely. Refer to Section 23 00 00, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC). Suspended horizontal piping shall be supported by adjustable wrought steel clevis hangers, except that straight runs of piping with 40 feet or more between anchor and expansion device shall be supported on roller type hangers or supports. Protection saddle, welded to pipe, shall be provided at each roller support. All supports shall be attached to the building structure and shall in no way be attached to the supports or other equipment, piping, or ductwork. Where supports bear on copper pipe, they shall be copper plated. Chain, strap, or other makeshift devices will not be permitted as hangers or supports. Maximum pipe support spacing shall be in accordance with Table 1 – MAXIMUM PIPING SUPPORT SPACING, except where grooved couplings are used, no pipe length shall be left unsupported between any two grooved couplings:

Table 1 - Maximum Piping Support Spacing

PIPING MATERIAL	MAXIMUM HORIZONTAL SPACING (feet)	MAXIMUM VERTICAL SPACING (feet)
ABS Pipe	4	10 ^c
Aluminum Pipe and Tubing	10	15
Brass Pipe	10	10
Brass Tubing, 1/4-inch Diameter & Smaller	6	10
Brass Tubing, 1/2-inch Diameter & Larger	10	10
Cast-Iron Pipe ^b	5	15
Copper or Copper-Alloy Pipe	12	10
Copper or Copper-Alloy Tubing, 1/4-inch Diameter and Smaller	6	10
Copper or Copper-Alloy Tubing, 1/2-inch Diameter & Larger	10	10
CPVC Pipe or Tubing, 1-inch & Smaller	3	10 ^c
CPVC Pipe or Tubing, 1/4-inch & Larger	4	10 ^c
Lead Pipe	Continuous	4
PB Pipe or Tubing	2-2/3 (32 inches)	4
PEX Tubing	2-2/3 (32 inches)	10 ^c
Polypropylene (PP) Pipe or Tubing, 1-inch or Smaller	2-2/3 (32 inches)	10 ^c
Polypropylene (PP) Pipe or Tubing, 1/4-inch or Larger	4	10 ^c
PVC Pipe	4	10 ^c
Steel Tubing	8	10
Steel Pipe	12	15
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm a. See Section 301.18. b. The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed. c. Mid-story guide.		

4. Supports on chilled water and condensate drain lines shall be provided with a 12" long section of hydrous calcium silicate, which shall have joints sealed and covered with a vapor barrier jacket. Hanger rods shall be 3/8" diameter size for pipes up through 2", 1/2" diameter size for 1-1/2" through 3", 5/8" diameter for pipes 4" through 5", and 7/8" diameter size for 6" through 12". Pipe hanger rods shall be attached to the top chord only on steel joists and beams by joist or beam clamps without welding. Welding of support rods and connection at any place other than the top chord will not be permitted unless written approval is granted by the Architect.
5. Install piping generally parallel to walls and column centerlines, unless shown otherwise on the drawings. Space piping, including insulation, to provide one inch minimum clearance between adjacent piping or other surface. Pipe shall be installed to permit free expansion and contraction without damage to joints or hangers. Slope piping down in the direction of flow not less than one inch in 40 feet. Provide eccentric reducers to keep bottom of sloped piping flat. All high points in water lines shall be provided with manual-air vents, all low points with drains. Condensate drain lines shall slope 1/8" per foot in direction of flow.
6. Anchors for pipe shall be provided as indicated or as required at the job site to localize expansion and contraction of pipe. Anchors shall consist of heavy steel or brass collars bolted or welded to the pipe and rigidly connected to the building structure unless indicated otherwise. Anchor braces shall not be attached in places where they will damage or injure the structure during installation or by the weight or expansion force of the pipe line after installation.
7. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Control valves usually require reducers to connect to pipe sizes shown on the drawings. Isolation service valves shall be installed on each side of major piece of equipment such as a pump, boiler, chiller, heating coil, cooling coil and other similar items, and at any other points indicated or required for draining, isolation or sectionalizing purposes. Control valves shall be installed in accordance with control manufacturer's recommendations.
8. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line takeoffs with 3-elbow swing joints where noted on the drawings.
9. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tee, which is two return lines entering opposite ends of a tee and exiting out the common side or two supply lines exiting opposite ends of a tee and entering the common side.
10. Connect piping to equipment as shown on the drawings. Piping connections to equipment shall be provided with unions or flanges. (Banked water coils shall be piped in reverse return arrangement.) (Steam coils shall be trapped individually.) (Vacuum breaker shall be provided at steam supply connection to each steam coil or steam bundle.) A straight spool piece equal in length to impeller diameter shall be provided at suction connection to each pump. Install components furnished by others such as:

- a. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
 - b. Thermometer Wells: In pipes 2-1/2 inches and smaller, increase the pipe size to provide free area equal to the upstream pipe area.
- B. Pipe Joints:
1. Sweated: Copper tubing shall be cut square, ends reamed, and all filings and dust wiped from interior of pipe. Joints shall be soldered with solder drawn through the full fitting length. Excess solder shall be wiped from joint before solder hardens. Solder shall be 95/5 composition; 50/50 will not be allowed.
 2. Threaded: Threaded joints shall be made with tapered threads properly cut. Joints shall be made tight with a stiff mixture of litharge and glycerin or other approved thread joint compound applied with a brush to the male threads only. Not more than three threads shall show after the joint is made up.
 3. Grooved: Pipe coupling joints shall be assembled according to manufacturer's specifications. Pipe shall be square cut and grooved in accordance to manufacturer's specifications. Gaskets shall be verified as suitable for the intended service and shall be coated on the lips and back with a thin uniform coat of lubricant. The coupling housing shall be assembled over the gasket and shall engage both grooves. The nuts shall be uniformly tightened until the housing pads are firmly together metal to metal.
 4. Welded: Joints shall be fusion-welded by qualified welders in accordance with ANSI B31.10, unless otherwise required. Changes in direction of piping shall be made with fittings only. Mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Saddle-type welding outlets may be used for equipment take-offs from the mains.
 5. Flanges and Unions: Fittings shall be faced true and made square and tight. Unions shall be 125 psi service, bronze seat type. Flanges shall be ANSI Standard 125 psi service with 1/16" thick red rubber gaskets. Unions and flange joints shall be provided on each side of each valve 2-1/2" or larger and in each line immediately preceding the connection to each major piece of equipment such as a (pump), (converter), (boiler), (chiller), (heating coil), (cooling coil) and other similar items.
 6. Dielectric fittings such as couplings, unions, or flanges, shall be installed to isolate pipes of non-ferrous metal where connection is made to ferrous metal. Isolation shall be accomplished by non-metallic, unthreaded sleeves or gaskets or a combination of both. Fittings shall be so designed that the installing tools cannot come in contact with the insulating material. Materials shall withstand pressure and temperature as required.
- C. Leak Testing: Inspect all joints and connections for leaks and workmanship and make corrections as necessary.
1. A hydrostatic test at 1.5 times design pressure for 4 hours. Factory tested equipment (converters, exchangers, coils, etc.) need not be field tested. Avoid excessive pressure on mechanical seals and safety devices.

2. Refrigerant Piping:
 - a. Refrigerant Piping System: The system shall be tested for tightness after installation and before insulation is applied. Controls and other equipment that may be damaged by the test pressure employed shall be temporarily removed or made inoperative before the tests are made and the openings shall be plugged or capped. Threaded, soldered, or brazed joints that leak shall be corrected by having the joints remade. Welded joints that leak shall be repaired by cutting out the faulty weld affected section and rewelding the joint or renewing the section of pipe.
 - b. Test Pressures: Refrigerant system test pressures for tightness shall not be less than ANSI 15 or ANSI B31.5 test pressures specified.
 - c. Charging the System for Test: The low and high pressure side of the system shall be charged with a dry, inert gas, such as nitrogen or anhydrous carbon dioxide using a small amount of the refrigerant gas to act as a tracer. A pressure limiting or reducing valve with pressure gage shall be used on the high pressure gas tank to limit the pressure in the system to the specified test pressure for the respective refrigerant.
 - d. Leakage Test: With the system charged to the desired pressure, the gas supply shall be tightly shut off and the system held for 30 minutes, during which time there shall be no loss of pressure. If a pressure drop, not attributable to temperature changes, occurs during this period the entire system shall be checked with a halide torch or an electronic leak detector. When leaks are found, they shall be repaired and another 30 minute period at the test pressure shall be made. Testing and repair shall continue until there is no loss of pressure.
 - e. Evacuation: After completion of testing of refrigerant system for leaks, remove all air and moisture from the system by using a high vacuum pump. The pump shall be capable of reducing the absolute pressure in the system to a point where any water present in the lines will vaporize at a temperature appreciably below the ambient temperature and will be withdrawn from the system. Before conducting the evacuation test, inspect the vacuum pump oil for purity and provide new oil charge if existing charge is contaminated. Evacuate the system to a maximum absolute pressure of 0.020-inches of mercury (500 microns) or lower. During the evacuation, the ambient temperature shall not be less than 35 degrees F. Pressure gages shall be used for measurement of pressure. Upon achieving evacuation of system, valve off the vacuum pump from the system for a period of at least 12 hours. The system shall be considered tight and dry and free of air if the absolute pressure has not increased by more than .002-inches of mercury (50 microns) at the expiration of this period. Repeat the pressure test if the pressure rise exceeds 0.02-inches of mercury which indicates a leak in the system or presence of moisture. If no leaks are found, resume the evacuation test and continue until dryness of system is achieved. When a satisfactory vacuum has been obtained, it shall be broken with the introduction of vapor (no liquid) and subsequent sealing off of the system.

- f. Charging: Provide the initial charge of refrigerant. Charge by connecting the drums of refrigerant to the system charging connection, to feed the liquid refrigerant into the low side of the system where it will be evaporated. The gross and net weights of the drum shall be noted, and the drum placed on a scale so that it may be determined when it has been emptied. The charging connection shall be loosely connected to the system connection, so that the initial flow of refrigerant will expel air from the connection, following which the loose joint shall be tightened. When the system vacuum has been broken by the refrigerant, the compressor shall be started and operated while charging continues. The following procedures and precautions shall be exercised during the charging operation:
- (1) The refrigerant condensing system shall be placed in operation.
 - (2) The fluid circulation system of water coolers or evaporator fans of a direct expansion system, shall be placed in operation.
 - (3) Compressor discharge pressure shall not be permitted to become excessive.

3.2 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Steam, Condensate, and Pumped Condensate Piping--Flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Bypass factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 6 feet per second, if possible. Connect deadend supply and return heads as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary or permanent piping and Contractor's booster pumps. Flush until clean.
- B. Water Piping: Clean systems as recommended by the suppliers of the boiler water treatment chemicals specified in this section.
1. Initial Flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Bypass factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 6 feet per second, if possible. Connect deadend supply and return heads as necessary.

Flush bottoms of risers. Install temporary strainers where necessary to protect downstream equipment. Supply and remove flushing water and drainage by various type hose, temporary or permanent piping and Contractor's booster pumps. Flush until clean.

2. **Cleaning:** Using products recommended by the suppliers of the boiler water treatment chemicals specified in this section, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by initial flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where deadend debris accumulation cannot occur. Sectionalize system as possible, to circulate at velocities not less than 6 feet per second. Circulate each section for not less than 4 hours. Blowdown all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.
3. **Final Flushing:** Return system to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all deadends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush not less than one hour.

3.3 WATER TREATMENT

- A. The Contractor shall provide services of a boiler water treatment firm to test the raw water at the site and provide chemicals necessary to maintain the following characteristics of water in the boiler for a period of one year:

Hardness:	0.00
Iron:	0.00
Total Dissolved Solids:	1500-1750 ppm (as Ca C03)
Silica:	60 ppm or less
pH:	10.4 or above

- B. Close and fill system as soon as possible after final flushing to minimize corrosion.
- C. Charge system with chemicals.

3.4 PUMPS

- A. Provide concrete pads for all pumps.
- B. Provide vibration isolation as specified in Section 23 05 48, VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT.

- C. After all piping is properly installed and connected, verify final pump shaft alignment is within tolerances as recommended by the pump manufacturer during both hot and cold temperature operation.

3.5 OPERATING AND PERFORMANCE TEST AND INSTRUCTION

- A. Perform all tests and make reports in accordance with Section 23 00 00, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) and Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

END OF SECTION 232000

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SECTION 232133 - VARIABLE SPEED DRIVES

PART 1 - GENERAL

1.1 CONDITIONS

- A. The applicable provisions of Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC), are hereby made a part of this section and the Contractor is cautioned to read Section 230000 carefully as items of work applicable to this section are included in Section 230000.

1.2 DESCRIPTION OF WORK

- A. Variable Speed Drive
- B. Variable Speed Drive Bypass

1.3 RELATED WORK

- A. Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).
- B. Section 230593, TESTING, ADJUSTING AND BALANCING FOR HVAC
- C. Section 230900, INSTRUMENTATION AND CONTROL FOR HVAC
- D. Section 232000, HVAC PIPING AND PUMPS.
- E. Section 233400, HVAC FANS.
- F. Section 236500, COOLING TOWERS.
- G. Section 237000, CENTRAL HVAC EQUIPMENT.
- H. Section 238100, DECENTRALIZED UNITARY HVAC EQUIPMENT.

1.4 REFERENCES

- A. ANSI - American National Standards Institute
- B. NEMA - National Electrical Manufacturers Association
- C. UL - Underwriters Laboratories. Inc.

- D. ETL - Electrical Testing Laboratories
- E. CSA - Canadian Standards Association
- F. NEC- National Electrical Code
- G. ISO - International Standards Organization
- H. IEC - International Electrotechnical Commission

1.5 SUBMITTALS

- A. Submittals shall include the following:
 - 1. Shop drawing indicating dimensions, required clearances and location and size of each field connection.
 - 2. Power and control wiring diagrams.
- B. Submittals must be specific to this project. Generic submittals will not be accepted.

1.6 QUALITY ASSURANCE

- A. The manufacturer shall have a minimum of 10 years experience in the design and construction of variable speed drives.
- B. All functions of the variable speed drive shall be tested at the factory prior to shipment. This test shall be conducted with motors connected to the VFD output and it shall test all inputs, outputs and program execution specific to this application.
- C. Manufacturer shall be listed by Underwriter's Laboratories as a manufacturer of variable speed drives.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the specifications, the following manufacturers shall be acceptable:
 - 1. Danfoss
 - 2. A.B.B.
 - 3. Graham
 - 4. Eaton

2.2 GENERAL

- A. This section of the specifications applies variable speed drives (VSD's) for pumps, and other equipment not specified to be provided as factory installed with equipment.

2.3 VARIABLE SPEED DRIVES

- A. Furnish and install variable speed drives for equipment where shown on the plans.
- B. The variable speed drive(s) shall be pulse width modulation (PWM) type, microprocessor-controlled design. Unit shall be the VLT 6000 Series manufactured by Danfoss or equal.
- C. The variable speed drive, including all factory installed options, shall have UL approval.
- D. Enclosure shall be NEMA 1 ventilated for installation as a wall or free-standing rack mounted unit, depending on the amp rating. Drive shall be equipped with an input disconnect switch and fuses to protect against ground faults. A hand-off-automatic switch and speed potentiometer shall be mounted on the front of the enclosure. VSD's shall be provided with phase loss protection.
 - 1. Variable speed drive shall utilize a diode bridge rectifier to convert three phase AC to a fixed DC voltage. Power factor shall remain above 0.95 regardless of speed or load. VSDs employing power factor correction capacitors shall not be acceptable.
 - 2. Insulated gate bipolar transistors shall be used in the inverter section to convert the fixed DC voltage to a three phase, adjustable frequency.
 - 3. The following customer modifiable adjustments shall be provided:
 - a. Accel time: 0.1 to 1800 seconds
 - b. Decel time: 0.1 to 1800 seconds
 - c. Minimum frequency: 0 Hz
 - d. Maximum frequency: 120 Hz
 - e. Analog input filter: 0.1 to 10 seconds
 - f. Analog outputs: 10 to 1 gain
 - g. Volts/Hertz ratio
 - 4. Speed reference signal shall be customer selectable for 0-10 VDC at 4-20 mA.
 - 5. The VSD shall be suitable for elevations to 3300 feet above sea level without derating. Maximum operating ambient temperature shall not be less than 104 Deg. F. VSD shall be suitable for operation in environments up to 95% non-condensing humidity.
 - 6. The VSD shall be capable of displaying the following information in plain English via a 40-character alphanumeric display:
 - a. Frequency
 - b. Voltage

- c. Current
 - d. Kilowatts per hour
 - e. Fault identification
 - f. Percent torque
 - g. Percent power
 - h. RPM
- 7. All VSDs shall be warranted for a period of 24 months after shipment. This warranty shall cover parts and labor.
 - 8. VSDs shall be compatible and coordinated to operate with the control system as provided under Section 23 09 00, INSTRUMENTATION AND CONTROL FOR HVAC.
- E. Variable Speed Drive Bypass
- 1. The variable speed drive system shall be equipped with bypass for the system.
 - 2. Bypass shall consist of a main power disconnect with ground fault protection, a pair of interlocked contactors and a motor overload relay. All are to be mounted in the VSD enclosure.
 - 3. Bypass contactors shall be equipped with thermal motor overload protection.
 - 4. A drive-off-bypass switch shall be provided on the front of the VSD enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install unit and accessories in accordance with manufacturer's written instructions and NEC.
- B. Verify variable speed drive is being provided compatible with the associated motor.
- C. Variable speed drives shall be installed and coordinated to operate and communicate with the system specified in Section 23 09 00, INSTRUMENTATION AND CONTROL FOR HVAC.

3.2 TESTS

- A. Perform tests and make reports in accordance with Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) and Section 230593, TESTING, ADJUSTING AND BALANCING FOR HVAC.

END OF SECTION 232133

SECTION 233000 - HVAC AIR DISTRIBUTION

PART 1 - GENERAL

1.1 CONDITIONS

- A. The applicable provisions of Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) are hereby made a part of this section, and the Contractor is cautioned to read Section 230000 carefully as items of work applicable to this section are included in Section 230000.

1.2 DESCRIPTION OF WORK

- A. Ductwork and accessories for HVAC including the following.
1. Supply air, return air, and general exhaust systems
 2. Low pressure corrosion resistant exhaust systems
 3. Sound attenuators
- B. Installation of control dampers and smoke detectors referred to in other Division 23 sections.
- C. Definitions:
1. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
 2. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc. Publication entitled HVAC Duct Construction Standards Metal and Flexible, latest recognized edition.
 3. Duct Pressure Classifications:
 - a. General Duct System: 1-inch water column pressure class unless noted otherwise.
 - b. Variable Volume Duct System: 2-inch water column pressure classification for duct upstream of the variable volume dampers.
 - c. (AC-__ & AC-__) Duct Systems: (2, 3, 4, 6, or 10) inch water column pressure classification for supply ductwork.
 4. Exposed Duct: Exposed to view in a finished room.
 5. Outside Duct: Exposed to view beyond the exterior side of walls or above the roof.

1.3 RELATED WORK

- A. Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).
- B. Section 230593, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- C. Section 230700, HVAC INSULATION.
- D. Section 230900, INSTRUMENTATION AND CONTROL FOR HVAC.
- E. Section 233400, HVAC FANS.
- F. Section 237000, CENTRAL HVAC EQUIPMENT.
- G. Section 238100, DECENTRALIZED HVAC EQUIPMENT.
- H. Section 238200, CONVECTION HEATING AND COOLING UNITS.

1.4 QUALITY ASSURANCE

- A. Fire Safety Code: Comply with NFPA 90A.
- B. Duct System Construction: SMACNA standards are the minimum acceptable quality.
- C. Duct accessories exposed to the air stream, such as dampers of all types and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

1.5 SUBMITTALS

- A. In accordance with Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC), furnish the following:
 - 1. Manufacturer's Literature and Data:
 - a. Volume, Motorized, and Backdraft Dampers
 - b. Roof Mounted Duct Supports
 - c. Prefabricated Metal Ductwork: Manufacturer's details for round and oval duct and fittings.
 - d. Duct Liner
 - e. Duct Access Doors, Panels, and Sections
 - f. Underfloor Ducts
 - g. Breeching and Chimney

- h. Flexible ducts, connections fittings and clamps, with manufacturer's installation instructions.
- i. Flexible connections
- j. Fabric Duct System
- k. Air Outlets and Inlets
- l. Duct Silencers
- m. Duct-mounted filters
- n. Louvers
- o. Fire dampers
- p. Smoke dampers
- q. Fire/Smoke Dampers

PART 2 - PRODUCTS

2.1 DUCT MATERIALS AND SEALANTS

- A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A 653, coating G90.
- B. Specified Corrosion Resistant Systems: Stainless steel sheet, ASTM A 167, Class 302 or 304, Condition A (annealed), Finish No. 4 for exposed ducts and Finish No. 2B for concealed duct.
- C. All Ductwork Associated with Supply, Return and Exhaust Air Systems for Locker and Shower Room Areas: Aluminum alloy sheets, ASTM B 209, alloy 1100, 3003, or 5052.
- D. All ductwork exposed to view in finished spaces shall have paint grip to accept field painting.
- E. Joint Sealing: Refer to Paragraphs 2.2 and 2.3 for sealing requirements. In addition all general duct systems shall meet Seal Class C and shall comply with South Coast Air Quality Management District (SCAQMD) Rules 1113, 1168 and Green Seal Standards GS-11 and GS03 for VOC limits.
 - 1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork. Use products as recommended by the manufacturer for each applicable system pressure. Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
 - 2. Tape: The use of pressure sensitive tape as a general duct sealant is not acceptable.
 - 3. A few of the many satisfactory sealants are as follows:

- a. Moore Tuff-Bond, #29 for low pressure, #12 for high pressure.
 - b. Minnesota Mining and Manufacturing Company EC 800.
 - c. Hardcast R 6350 tape and activator/adhesive.
 - d. United Sheet Metal R-5966 (N), Listing #1.
 - e. Borden Arabol E-3806 lagging adhesive plus 6 ounce canvas.
4. Gaskets in Flanged Joints: Soft neoprene.
- F. Approved factory-made joints such as DUCTMATE SYSTEM may be used. Locking-type longitudinal joints and seams, other than the snap-lock and button-lock types, need not be sealed as specified in this section.
- 2.2 METAL DUCTS
- A. Gages, Reinforcement, Joints, Seams, Sealing, Fittings, Supports, and Other Details per SMACNA: Construct ducts not shown otherwise for 2 inches wg static pressure rating.
- B. Sealing: All supply and return ductwork and plenums, regardless of pressure class, shall be sealed to SMACNA Seal Class A. Exhaust ductwork and plenums of pressure class greater than 2" shall be sealed to Seal Class A. All other exhaust ductwork and plenums shall be sealed to Seal Class C.
- C. Kitchen Hood/Dishwasher Hood Exhaust Ducts: 18 gage stainless steel, liquid tight welded construction. Mechanical fasteners shall not be used for assembly or support where such fasteners could penetrate the duct walls. Ducts shall run continuous from the hood connection to the exhaust fan connection above the roof. Access doors shall be provided in the side of each horizontal section of duct for cleaning purposes. Access doors shall be a minimum of 12 inches or shall be the full width of the duct and shall be located at a maximum spacing of 20 feet.
- D. Laboratory Fume Exhaust Ducts: Laboratory fume exhaust ducts shall be 18-gauge stainless steel, liquid tight, and fully welded construction from the fume hood to the fan.
- E. Volume Dampers: Single louver type and multi-louver type as detailed in SMACNA. Maximum blade louver width shall be 8-inch. Volume dampers exceeding 8-inch shall be multi-louver type. Dampers shall be a minimum two gauges heavier than duct in which installed.
1. Manual dampers shall be opposed blade construction for modulating service. Manual operator mechanism shall be locking-type quadrant operator as manufactured by Young Regulator Company or equal. End of damper rod on each damper shall be grooved to show damper position. Quadrant operators shall be installed on 1-1/2" high 4-bend galvanized steel bracket allowing duct insulation to be extended and sealed under the quadrant operator. (Where dampers occur behind

- or above finished portions of the building, operating rods shall be extended to 301 or 315 regulators installed flush with the finished surface.)
2. Motorized dampers shall be opposed blade construction for modulating service and parallel blade construction for two-position service. Motorized dampers shall be constructed with brass bearings, channel iron frame, interlocking blades and air-tight felt seals. Motor operators for dampers are specified in Section 23 09 00, INSTRUMENTATION AND CONTROL FOR HVAC.
- F. Backdraft Dampers: Self-operating, multi-blade damper to open fully on 0.06 inch wg pressure difference and close by gravity. Aluminum, 16 gage frame, 0.023-inch blades of flat or elliptical shape, with tie-bar to connect blades for parallel operation. Provide resilient gasket for air seal and quiet operation. Blade pivots shall be in the nylon bushings. Provide adjustable counter-balance weight(s) as necessary for proper operation.
- G. Turning Vanes: Provide in all square elbows even though not shown on the drawings. Turning vanes shall be factory fabricated. Vanes shall be hollow, double thickness in all ducts 18" or larger.
- H. Air Deflectors: Factory fabricated for air diversion and volume control with operator as required for location in an accessible position. Adjustable deflectors shall be Young Air Extractor Model 890 with worm gear operator when behind grilles, with 301 operator when above plaster ceilings, and with 433 operator when it is accessible.
- I. Provide a 4-inch diameter galvanized steel exhaust duct for all residential clothes dryers. Duct shall discharge outside the building and terminate with a weatherproof wall cap.
- J. Plenums and Casings (Site Fabricated Units): Construct of galvanized steel panels joined by standing seams on outside of casing. Rivet or bolt all seams and joints on approximately 6" centers and seal with sealant. Reinforce with steel angles and provide diagonal bracing. Access doors shall be 36" x 18" with frame welded to plenum, three brass hinges and three brass tension fasteners operable from either side of door.
- K. Roof mounted duct supports shall be factory fabricated duct mounting pedestals as manufactured by Roof Products and Systems, Inc. (RPS) or equal. Pedestals shall be minimum 12 inches high, complete with equipment rail, slide channel "U" shaped mounting brackets, 18 gauge threaded galvanized rods, lateral spacer bracket and galvanized slide assembly. Supports shall be located to adequately support duct with no more than 4 feet of duct unsupported.

2.3 PREFABRICATED METAL DUCTWORK

- A. Gages, joints, seams, reinforcement, fittings, sealing, supports and other details for rectangular, round and oval duct shall be in accordance with SMACNA.

- B. All supply and return ductwork and plenums, regardless of pressure class, shall be sealed to SMACNA Seal Class A. Exhaust ductwork and plenums of pressure class greater than 2" shall be sealed to Seal Class A. All other exhaust ductwork and plenums shall be sealed to Seal Class C.
- C. Ducts and Casings: Submit details of proposed joints/sealing system. Unless shown otherwise, construct supply duct to 2 inches wg static pressure. Provide bolted construction and tie-rod reinforcement where required.
- D. Round and Oval Ducts:
 - 1. Spiral duct and all fittings shall be Semco, MKT or United McGill spiral lock-seam duct.
 - 2. Elbows: Diameters 3 through 8 inches shall be two sections die stamped, all others shall be gored construction with all seams continuously welded. Coat galvanized areas of fittings damaged by welding with corrosion-resistant aluminum paint or galvanized repair compound.
 - 3. Provide bellmouth, conical tees, laterals, reducers, and other low loss fittings as shown in SMACNA Standards.
 - 4. Double wall insulated duct: Spiral double wall insulated pipe with matching fittings constructed from galvanized steel meeting ASTM-A527 and SMACNA. Outer shell for straight spiral pipe shall be 24-gauge for duct diameters through 24 inch, 22 gauge for duct diameters 25 inch through 34 inch, and 20 gauge for duct diameters 35 inch through 48 inch. Outer shell for fittings shall be 22 gauge for duct diameters 24 inch, and 20 gauge for duct diameters up to 48 inch. Insulation between pipe walls shall be 1-inch thick fiberglass with a thermal conductivity of 0.26 BTU/Hr./Sq. Ft./Deg. F. Inner shell shall be metal solid liner. Spiral pipe liner shall be 28 gauge. Fittings liner shall be solid metal type of 26 gauge for diameters through 34 inch and 24 gauge for diameters 35 inch through 48 inch diameter. Branch takeoffs shall be bell mouth type. Elbows shall be five-section type. Transitions shall be conical type. Duct connectors and fittings shall be casketed air-tight seal. Ductwork shall be provided and handled for "exposed" installation. Duct finish shall be A-60 annealed, paintable steel. Provide duct hangers, dampers, and appurtenances for a complete installation. All "exposed" ductwork shall be installed in a neat finished workmanlike manner and without visible duct sealant. Provide dimensional duct layout with shop drawing. Coordinate duct takeoffs with roof truss system.
- E. Provide flat side reinforcement of oval ducts as recommended by the manufacturer and SMACNA. Because of high pressure loss, do not use internal tie-rod reinforcement unless approved by the Architect/Engineer.
- F. Duct Hangers and Supports: Refer to SMACNA. Avoid use of trapeze hangers for round duct.

2.4 DUCT LINER (WHERE INDICATED ON DRAWINGS)

- A. General: Liner shall be 1 inch thick, fiberglass duct liner with a smooth mat, bonded surface on air side. Liner shall meet ASTM C1071 with excellent abuse resistance and shall not support mold or fungus growth. Flame spread, fuel contribution, and smoke development ratings shall comply with NFPA Standard 90A and ASTM E84.
- B. 'K' Value: 0.26 at 75 Deg. F, ASTM C518.
- C. Noise Reduction Coefficient: 0.60 or higher based on "Type A mounting" and tested in accordance to ASTM C423.
- D. Air Surface Coating: Acrylic coating treated with EPA registered anti-microbial agent proven to resist microbial growth as determined by ASTM G21 and G22.
- E. Maximum Velocity: 5,000 ft/min.
- F. Adhesive: Meets ASTM C916.
- G. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.

2.5 DUCT ACCESS DOORS, PANELS AND SECTIONS

- A. Provide access doors in accordance with NFPA 90A, sized and located for maintenance work, upstream where possible, in the following locations:
 - 1. Each automatic control damper.
 - 2. Each duct mounted smoke detector.
 - 3. Each fire damper and smoke damper.
 - 4. Each apparatus requiring service or inspection.
 - 5. Each kitchen hood exhaust duct elbow and six foot intervals of horizontal grease duct.
- B. Openings shall be 15" x 18" unless noted otherwise, except where size of duct will not accommodate this size, they shall be made as large as practical. Access doors shall be of rigid type and shall be provided with gasket to make air tight. Door shall be provided with galvanized hinges having bronze pins and two approved brass fasteners. Access doors in insulated ducts shall be of the insulated type. Doors shall swing so that fan pressure or suction and direction of air flow holds the door closed.
 - 1. For Rectangular Ducts: Refer to SMACNA and provide lock type 2 (door latch, not sash lock).
 - 2. For Round Ducts: Access sections shall be not less than 20 gage housing welded or riveted to a duct section.

2.6 UNDERFLOOR DUCTS

- A. Under-floor ducts shall be watertight fabricated with terra cotta, concrete, or fiberglass reinforced plastic duct, except ducts under 18" diameter may be galvanized sheet steel encased in at least 2" thick concrete. Terra cotta or concrete pipe shall have bell and spigot or tongue and groove joints with O-ring seal.

2.7 BREECHING AND CHIMNEY

- A. Breeching and chimney for the boiler and water heater shall be Selkirk Metalbestos Model PS positive pressure modular prefabricated double wall piping system. Boiler and water heater stack system shall be UL listed and shall be continuous from boiler and water heater outlets to stack outlet. The inner and outer wall shall be Type 304 stainless steel. System shall consist of straight sections, stack top, storm collar, roof support, roof flashing, tees, drained tee cap, increasers and other accessories as required for a complete system.
- B. (Boiler breeching) (Boiler and water heater breeching) shall be constructed of 12-gauge black sheet steel and welded construction with 1" angle stiffeners 4'-0" on center.
- C. (Boiler and water heater vent pipe) (Unit heater and water heater vent pipe) shall be (16-gauge galvanized sheet steel) (U.L. Approved Type B gas vent as manufactured by Dura-Vent) complete with flashing ring, necessary fittings, and rain cap.
- D. Breeching for the laundry equipment shall be 20 gauge galvanized steel. Stack top, storm collar, roof flashing, roof support, tees, connectors, cleanouts, and other fittings shall be provided.
- E. Breeching shall slope upward 1/4-inch per foot in direction of flow. Hangers for breeching shall be band type with hanger rods.

2.8 FLEXIBLE AIR DUCTS

- A. General: Factory fabricated, complying with NFPA 90A for connectors up to 14 feet maximum length and not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier as defined in Section 23 00 00, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC). Provide approximate lengths indicated on the drawings. Provide insulated, acoustical air duct connectors in supply air duct systems and elsewhere as shown.
- B. Flexible ducts shall be acoustically insulated type as manufactured by Thermaflex or Flexmaster. Duct shall be fabricated with an acoustically transparent CPE inner film, 1" fiberglass insulation, and reinforced metalized vapor barrier. Vapor barrier permeance shall be .05 per ASTM E96, Procedure A. The rated positive pressure shall be 10" water

gage and the recommended operating pressure for 90 degree bends shall be 6" water gage for 12" diameter duct. The minimum 'R' value shall be minimum 4.2, except in unconditioned attic type spaces the minimum 'R' value shall be 5.5. Entire assembly shall have maximum Flame-Spread rating of 25, a Smoke Developed Rating less than 50, and shall meet all NFPA 90A requirements. Connections between flexible duct and ductwork fittings or diffusers shall be made with draw bands and sealed with an approved pressure-sensitive tape. Flexible duct shall be UL 181 listed, ETL Class1.

Duct Insertion Loss, dB

Octave Band Frequency, Hz	2 125	3 250	4 500	5 1000	6 2000
6 inch duct	7	19	34	37	38
8 inch duct	8	13	29	35	36
12 inch duct	20	26	27	33	26

- C. All round duct take-offs shall be made with SPIN-IN fittings or pre-manufactured tap fittings with flanged low-loss boot and round connection collar. Units shall have a balancing damper and a factory-installed spring-loaded retractable bearing and a positive locking wing nut for easy readjustment. Provide 2" insulation stand-off for balancing damper handle.
- D. Connection between high velocity duct and variable air volume boxes shall be made with high pressure flexible duct runouts unless shown otherwise. Insulation shall be a nominal 1-inch by 1 lb/cf fiberglass sheathed in a seamless vapor barrier jacket. The duct shall be rated for 15 inches of water pressure. Connection between flexible duct and ductwork fittings or variable air volume boxes shall be by manufacturer's recommendations. The duct shall comply with the latest NFPA Bulletin 90A and be listed as Class 1 connector, UL Standard 181.

2.9 FLEXIBLE CONNECTIONS

- A. Where duct connections are made to fans and air handling units, install a non-combustible flexible connection of 29 ounce neoprene coated fiberglass fabric approximately six inches wide. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless steel or zinc-coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws two inches on center. Fabric shall not be stressed other than by air pressure. Allow at least one inch slack to ensure that no vibration is transmitted.

2.10 FABRIC DUCT SYSTEM

- A. Fabric duct system shall be Ductsox or equal. Ducts shall be Cylindrical Series, Sedona-Xm Fabric, horizontally-mounted, Comfort-Flow type. Ducts shall be 6.8 oz. per square

yard anti-microbial treated coated polyester, UL Classified (NFPA 90-A). Color shall be custom as selected by the Architect.

- B. Ducts shall be complete with inlet cover sleeve, zippered inlet connection and end cap, straight length and fitting zippers, interior seams, adjustable flow devices, launderable and 10-year warranty from project final completion. Orifice sizes and spacing shall be as indicated on the drawings.
- C. Ducts shall be supported by one (1) row suspension cables with snap clips spaced every 24 inches along the length to ensure proper support. Provide turnbuckles and securing hardware.

2.11 INSTRUMENT TEST FITTINGS

- A. Manufactured type with a minimum two-inch length for insulated duct, and a minimum one-inch length for duct not insulated. Test hole shall have a flat gasket for rectangular ducts and a concave gasket for round ducts at the base, and a screw cap to prevent air leakage.
- B. Provide instrument test holes at each duct or casing mounted temperature sensor or transmitter, and at entering and leaving side of each heating coil and cooling coil.

2.12 AIR OUTLETS AND INLETS

- A. Materials:
 - 1. Steel or aluminum as indicated. Provide manufacturer's standard gasket.
 - 2. Exposed Fastenings: The same material as the respective inlet or outlet. Fasteners for aluminum may be stainless steel. Provide concealed method of fastening where available.
- B. Performance Test Data: In accordance with Air Diffusion Council Code 1062R4.
- C. Finish: White baked enamel for ceiling mounted units. Wall-mounted units shall be primed.
- D. Air Supply Outlets and Inlets: Manufacturer shall be Tuttle and Bailey, Price, Titus or Metal-Aire. Tuttle and Bailey model numbers are listed.
 - 1. Square ceiling diffusers shall be Model 1300ALT 24" x 24" adjustable pattern full louver face for lay-in mount for inverted T-bar ceiling without panel extensions or Model 1300ASF surface mount, as applicable for ceiling type. Provide opposed blade manual damper and equalizing deflectors. Construction shall be steel with mitered blade joints.

2. Supply registers shall be Type A54 aluminum double deflection and shall have free area of not less than 75%. Register dampers shall be aluminum opposed blade type, face operated. Sponge rubber gasket shall be provided on frame.
3. Return and exhaust registers and grilles shall be Model A70 fixed blade aluminum construction with 40 degree deflecting vanes on ¾" centers. Units shall have free area not less than 75%. Register dampers shall be aluminum opposed-blade face-operated type. Units on watertight ducts shall be all aluminum including damper, linkage, core, and frame. Sponge rubber gasket shall be provided on frame. Wall-mounted units shall be provided with horizontal face blades.
4. Return air lay-in filter grilles shall be Model A70DFB aluminum construction for nominal 24 x 24 lay-in inverted Tee Bar ceiling. Blades shall be 40 degrees deflection. Grilles shall have hinged frame with MERV 8 filters of standard size.
5. Linear floor grilles shall be Model LFG-HC with core 16A supply grilles. The grille face shall have a 1" extruded aluminum border and an overall dimension of 16-5/8" x 7-5/8" or 17-5/8" x 9-5/8". The grille face and border shall fully cover all inlets and actuators of the plenum unit and be capable of a straight drop installation. The grille shall be fastened using screw mounting/spring-clip mounting. The plenum shall be constructed of minimum 24 ga. steel and finished in black. The plenum shall have a finished height of 10-3/8"/11-1/4" and be able to install above conduit in a 12" raised floor. Grilles shall have a fixed 15 degree blades spaced 1/4" on center. The outlet core shall have extruded aluminum receiving bar. Blades shall run parallel to the long dimension of the grille. The grille border shall be heavy-duty extruded aluminum construction with precise factory mitered corners and reinforcing support bars for extra support for the core receiving bar. The support and receiving bars shall not exceed 8" on center. The core shall be held into the border with removable core clips allowing the removal of the core without special tools. The grille shall be finished in B17 Black Powder Coat. The LFG shall be constructed with the HC configuration. The cooling inlet shall be 11" x 6"/12" x 6" with a gasketed modulating damper for VAV control and a nominal 6"/8" heating inlet. The LFG-HC shall be supplied complete with a 24 VAC floating point actuator furnished with two modular jacks for system connections and one 25 foot plenum rated modular plug-in control cable.
6. Round floor turbulent flow diffusers shall be RFTD-DB/RFBHC/DBV round floor turbulent flow diffusers of the sizes, configurations and capacities indicated on the drawings. Each diffuser shall produce a high induction turbulent vertical flow resulting in rapid temperature equalization within the occupied zone. The diffuser core shall consist of multiple radial slots with an incline angle of 30 degrees. The 8" core shall be constructed of UL 2043 Fire Rated Polyamide with permeating color able to withstand maximum mechanical loading of 1300 lbs. The 6" core shall be constructed of UL 2043 Fire Rated Polyamide with permeating color able to withstand maximum mechanical loading of 1750 lbs. Round floor diffusers shall be installed with Ring Nut/Ring Press Fit/Ring Claw fasteners and shall include tamper protection to prevent unauthorized removal of the round diffuser. Assembly shall include black polyamide Standard Distributor Basket with Damper device. Diffuser Model RFTD-DBV is for use in non-ducted VAV applications. Diffuser Model

RFTD-RFBHC is for use in ducted VAV cooling/constant volume heating ducted applications.

7. Linear diffusers and shall be extruded aluminum adjustable pattern, recessed type complete with volume control, mounting frames, mounting yokes, mounting strips and accessories.
8. Return air grilles for Gymnasium shall be Series 91 heavy gauge steel, 45 degree deflection complete with frame and reinforcing mullions for duct mount and heavy duty service.
9. Return air grilles for the auditorium shall be Series RCG, reversible core, architectural quality, all extruded aluminum construction. Core shall be mandrel tube construction and shall be removable.
10. Linear slot diffusers for the Auditorium shall be extruded aluminum Series SDS adjustable pattern type complete with volume control, mounting frames, acoustically-lined duct plenum, and accessories.

- E. Ceiling Radiation Damper: Provide where indicated. UL approved complete with insulating blanket.

2.13 DUCT SILENCERS

- A. Duct silencers shall be factory fabricated tubular or rectangular type of size, model number, performance, and quantity indicated on the plans. Acoustical performance shall be rated and tested in accordance with ASTM E477.
- B. Outer casing for rectangular and tubular type silencers (12-36 inches in diameter) shall be constructed of 22 gauge, G-90 galvanized steel Tubular silencers 38" in diameter and larger shall be 18 gauge, G-90 galvanized steel. Interior partition shall be minimum 26 gauge, G-90 galvanized perforated steel. Casing shall be constructed with lock formed or welded seams capable of withstanding 8" W.C. air pressure differential.
- C. Silencer acoustic filler shall be inert, vermin, and moisture proof inorganic glass fiber with Flame Spread Classification less than 20 and Smoke Developed Rating less than 20 when tested in accordance with ASTM E 84, NFPA Standard 255, or UL No. 723.

2.14 DUCT-MOUNTED FILTERS

- A. Duct-mounted filters shall be Camfil Farr or equal 30% efficiency consisting of glass media, a galvanized steel header, galvanized steel pocket retainers, and bonding agents to prevent air bypass and ensure leak free performance.
- B. Filter media shall consist of high-density air laid lofted microfine glass media that is chemically bonded to a permeable media support backing forming a lofted filter blanket.

- C. Individual pockets shall contain a minimum of 40 stitching support points per square foot of media area. All stitching centers shall be sealed through the use of a foam based sealant that shall remain pliable throughout the life of the filter. The sides and ends of each pocket shall be sewn with a chain-link over lock stitch.
- D. Pockets shall be formed into tapered pleats, supported by controlled media space stitching, to promote uniform airflow across the surface of the media. At any point, the sizes of the upstream and downstream passages shall be proportional to the volume of filtered air.
- E. Support members shall include a galvanized steel header and galvanized steel pocket retainers. The header shall be bonded to the media to prevent air bypass. Individual pocket retainers shall be fastened with a mechanical crimp to lock individual pockets together. The media pockets shall be bonded to the pocket retainers to prevent air bypass. The frame shall form a rigid and durable support assembly.
- F. A filter-to-filter sealing gasket shall be installed on one of the vertical members of the filter header.
- G. Provide factory housing with access doors and ductwork flanges.

2.15 LOUVERS

- A. Wall Louvers (4" Aluminum): Louvers shall be Greenheck Model ESD-403, Louvers and Dampers Inc. Model IL-23, or equal stationary drainable blade with 4" deep frame and 0.08" thick extruded aluminum construction. Blades shall be positioned at approximately 37 degree angle and spaced not to exceed 4 inches on center. A channel in each blade shall drain water to downspouts in jambs and mullions to prevent water cascade from blade to blade. Provide complete with 1/2" mesh matching bird screen in removable frame and extended sill. Louver shall be AMCA certified for air performance and water penetration. Water penetration shall not occur while the free area velocity is maintained less than 1,000 feet per minute. Louvers are basically sized at 400 cfm per square feet of louver face area, with a static pressure drop not to exceed 0.10 inches water column for a 48" x 48" louver. Finish shall be (prime coat) (mill finish) (baked enamel) (anodized) (as selected by the Architect).
- B. Wall Louvers (2" Aluminum): Louvers shall be Greenheck Model ESJ-202 or equal stationary with 2" deep frame and 0.063" thick extruded aluminum construction. Blades shall be positioned at approximately 45 degree angle and spaced not to exceed 3 inches on center. Provide complete with 1/2" mesh matching bird screen in removable frame and extended sill. Louver shall be AMCA certified for air performance and water penetration. Water penetration shall not occur while the free area velocity is maintained less than 490 feet per minute. Finish shall be (prime coat) (mill finish) (baked enamel) (anodized) (as selected by the Architect).

- C. Wall Louvers (Galvanized): Louvers shall be Louvers and Dampers Inc. Model IF-23, or equal stationary drainable blade with 4" frame and formed 18 gauge galvanized steel construction. Blades shall be positioned at approximately 37 degree angle and spaced not to exceed 4 inches on center. A channel in each blade shall drain water to downspouts in jambs and mullions to prevent water cascade from blade to blade. Provide complete with 1/2" mesh matching bird screen in removable frame and extended sill. Louver shall be AMCA certified for air performance and water penetration. Water penetration shall not occur while the free area velocity is maintained at less than 1,000 feet per minute. Louvers are basically sized at 400 cfm per square feet of louver face area, with a static pressure drop not to exceed 0.10 inches water column for a 48" x 48" louver. Finish shall be (prime coat) (mill finish) (baked enamel) (as selected by the Architect).
- D. Wall cap for 4" round ducts shall be Greenheck WCSP-6.
- E. Eave cap for 10" x 3-1/4" ducts shall be Greenheck ELSP.
- F. Roof jack shall be Greenheck RJSP-5/6.

2.16 FIRE DAMPERS

- A. General - Fire dampers shall be dynamic type. Dampers shall meet local codes and the standards of the National Fire Protection Association contained in Bulletin 90A. Dampers in ductwork shall be sized so that the free air space is not less than the connected duct free air space. (Damper installed behind grilles or registers shall be the same size as the grille or register with blades in the air stream.) Location shall be as shown on drawings or as required by local code. Dampers shall possess a 1-1/2 hour standard fire protection rating in accordance with NFPA No. 555.
- B. Material - The frame shall be constructed so as to be unaffected by corrosion or high heat. Mechanical parts shall have bronze non-corrosive pins. Vertical and horizontal dampers shall feature closure spring operation suitable for closure against the installed system air stream. When closed, the dampers shall be held closed by a catch arrangement. Blades installed in regular ductwork will not be accepted.
- C. Fuse Links - Fire curtains shall be arranged to close automatically and remain tightly closed upon the operation of an approved fusible link or other approved heat-actuated device, located where readily affected by an abnormal rise of temperature in the duct. Fusible links shall have a temperature rating approximately 50 Deg. F above the maximum temperature that would normally be encountered when the system is in operation or shut down.
- D. Access doors shall be provided in accordance with NFPA 90A. Suitable openings shall be provided to make fire dampers accessible for inspection and maintenance.

2.17 SMOKE DAMPERS

- A. General - Dampers shall meet local codes and the standards of the National Fire Protection Association contained in Bulletin 90A. Locations shall be as shown on the drawings.
- B. Performance - Each damper shall be classified by Underwriter's Laboratories as a leakage rated damper for use in smoke control systems under the latest version of UL 555S, and shall bear U.L. Label attesting to same. The leakage rating under UL 555S shall be Leakage Class II (10 CFM Sq. Ft. at 1" W.G.). As part of the U.L. qualification, dampers shall have demonstrated a capacity to operate under HVAC system operating conditions, with pressures of at least 4" W.G. in the closed position, and 2000 FPM air velocity in the open position. The dampers and their actuators shall be qualified under UL 555S to an elevated temperature of at least 250 Deg. F.
- C. Materials - Damper frames shall be a minimum of 16 gage galvanized steel formed into a structural hat channel shape with tapped corners for reinforcement. The blades shall be single skin 16 gage minimum galvanized with three longitudinal grooves for reinforcement. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Blade edge seals shall be silicone rubber designed to withstand 450 Deg. F and jamb seal shall be silicone impregnated fiberglass with stainless steel flexible metal compression type cover. Appropriate electric (120V-1PH) actuators shall be furnished and installed by the damper manufacturer at time of damper fabrication. Damper and actuator shall be supplied as a single entity which meets all applicable UL 555S qualifications for both dampers and actuators. Factory supplied caulked sleeve shall be 20 gage. (.91) for dampers through 84" (2134) wide and 18 gage (1.21) above 84" (2134) wide. Damper and actuator assembly shall be factory cycled 10 times to assure operation. All wiring or piping material required to interconnect the actuator with detection and/or alarm or other systems shall be furnished by others as detailed elsewhere in the specification. Dampers shall be Ruskin Model SD36 or approved equal.
- D. Access holes - Suitable hand hole openings with tightly fitted covers shall be provided to make them accessible for inspection and maintenance.
- E. Operation - Damper motor shall de-energize to allow spring-loaded damper to close when smoke is detected by a space-mounted smoke detector. Smoke detectors will be provided under the Electrical Specifications.

2.18 FIRE/SMOKE DAMPERS

- A. Fire/smoke dampers shall conform to the requirements of Underwriters' Laboratories standard for smoke dampers UL 555S and for fire dampers UL 555 for 1-1/2 hour rating. Operator shall be 120 VAC/60 Hz, normally closed type.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with provisions of Section 23 00 00, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC), particularly regarding coordination with other trades.
- B. Fabricate and install ductwork and accessories in accordance with SMACNA Standards:
 - 1. Duct clearance and lengths shall be established from measurements taken at the job site before any ducts are fabricated. The Contractor will not be allowed any extra costs for ducts fabricated and then found not to fit into the space intended. Duct sizes on the drawings are actual sheet metal dimensions which shall be altered by the Contractor to other dimensions producing the same air handling characteristics where necessary to avoid interferences and clearance difficulties. Acoustically lined duct has been sized to include the lining.
 - 2. Fire damper openings shall be established from measurements taken at the job site before any fire damper is fabricated. The Contractor will not be allowed any extra costs for dampers fabricated and then found not to fit into the space intended. The Contractor shall coordinate clearances for locating the damper blades out of the air stream as required.
 - 3. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA. Weld sheet metal in accordance with SMACNA, Guidelines for Welding Sheet Metal. Repair damaged galvanized areas with galvanizing repair compound.
 - 4. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA.
 - 5. Construct casings and pipe penetrations in accordance with SMACNA. Design casing access doors to swing against air pressure so the pressure helps to maintain a tight seal.
- C. Install duct hangers and supports in accordance with SMACNA. Duct supports shall consist of not less than 1" x 16 ga. galvanized steel strap hangers spaced not over 8'-0" on center for ducts with up to 240" perimeter.
- D. Duct floor and wall openings - Rectangular and square ducts shall have openings 1" larger than the overall duct dimensions framed in place when the wall is constructed and 1/4" larger when floors are poured. Space between duct and structure shall be filled with duct insulation, except in fire partitions or floors they shall be packed tight with non-combustible fiber rope. Flanges constructed of 22-gauge galvanized sheet metal, not less than 3" wide, shall be installed at each opening in finished areas.
- E. Install underfloor ducts in accordance with SMACNA. Sheet steel ducts shall be anchored with wire and stakes located at least 4" away from duct. Bricks and blocks wired to bottom of duct are not acceptable anchors. Ducts shall be sloped as indicated.

- F. Flexible Duct Installation: Continuous, single pieces not over fourteen feet long (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with adhesive and clamps or screws as recommended by the duct manufacturer. Flexible ducts shall not penetrate any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hours.
- G. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.
- H. Control Damper Installation:
 - 1. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
 - 2. Assemble multiple section dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
 - 3. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
- I. Duct Liner: Install in accordance with SMACNA and NAIMA (North American Insulation Manufacturers Assoc.) Apply in cut-to-size pieces to the entire interior of the duct with approved adhesive and secured with fasteners. Fasteners shall be metal washer type and mechanically secured or welded to the duct. Adhesive type fasteners are not acceptable. Edges, joints, and penetrations shall be coated with adhesive meeting ASTM C916.
- J. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.
- K. Installation of Diffusers, Registers, and Grilles: Ducts shall be fastened securely to the building construction at each side of opening. Diffuser, register, or grille shall be securely fastened thereto, snug against the wall.
- L. Installation of Fire and Smoke Dampers and Fire/Smoke Dampers: Dampers shall be installed so as to provide the positive barrier to passage of air when in a closed position. Dampers shall be located and installed so that destruction of the duct on either side of the damper will not allow the damper to fall away from the opening to be protected. Dampers shall be located in the wall or ceiling, or as close thereto as possible, and securely fastened thereto. Where it is not possible to locate the damper directly adjacent to the wall or ceiling, it shall be located as close as possible and all ductwork between the damper and wall or ceiling shall be fireproofed with plaster or other approved methods to give a rating equal to the rating of the damper. Access doors in the duct and wall or ceiling where applicable shall be sized and located as required for inspection and maintenance of the

damper. Damper installation shall be as recommended by the manufacturer for UL compliance and shall meet all requirements of NFPA Standard 90A. Dampers shall be installed with sufficient tension to prevent rattling or vibration. The installation of the dampers shall conform to the requirements of SMACNA.

- M. Breeching shall be installed per manufacturer's installation instructions and comply with NFPA 211.
- N. Smoke Detectors shall be provided and installed by the Electrical Contractor, as specified in Division 26.
- O. All grease exhaust ductwork shall be sloped downward to the hood or an approved receptacle at not less than 1/4 inch per foot.
- P. Connection of horizontal ducts to rooftop exhaust fans shall be made using radiused elbows or mitered elbows with turning vanes. Duct transitions shall be as hereinbefore specified.
- Q. Ductwork associated with clothes dryer exhaust shall have smooth interior finish with joints running in the direction of airflow.

3.2 DUCT LEAKAGE TESTS AND REPAIR

- A. Low Pressure Ducts: Seal visible openings and seal air leaks audible at operating conditions.
- B. High Pressure Duct Leakage Testing (greater than 3 in. w.g.):
 - 1. Perform testing in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Ductwork shall have a rate of air leakage (CL) less than or equal to 4.0 as determined in accordance with the equation:

$$CL = F/P^{0.65}$$

Where F = the measured leakage rate in CFM per 100 square feet of duct surface and P = the static pressure of the test.

Documentation shall be furnished demonstrating that representative sections totaling at least 25 percent of the duct area have been tested and that all tested sections comply with the requirements of this section.

- 2. Audible Leaks: Test at two inches wg above design operating pressure, up to rated pressure classification of ductwork. Repair significant or noisy leaks.
- C. Breeching and chimney shall be tested as recommended by the system manufacturer.

END OF SECTION 233000

SECTION 238100 - DECENTRALIZED UNITARY HVAC EQUIPMENT

PART 1 - GENERAL

1.1 CONDITIONS

- A. The applicable provisions of Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC), are hereby made a part of this section and the Contractor is cautioned to read Section 230000 carefully as items of work applicable to this section are included in Section 230000.

1.2 DESCRIPTION OF WORK

- A. Computer Room Air Conditioner
- B. Definitions:
 - 1. Energy Efficiency Ratio (EER): A ratio calculated by dividing the cooling capacity in Btuh by the power input in watts at any given set of rating conditions, expressed in Btuh per watt (Btuh/watt).
 - 2. Unitary (ARI): Consists of one or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function.

1.3 RELATED WORK

- A. Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).
- B. Section 230900, INSTRUMENTATION AND CONTROLS FOR HVAC.
- C. Section 232133, VARIABLE SPEED DRIVES.
- D. Section 233000, HVAC AIR DISTRIBUTION.

1.4 QUALITY ASSURANCE

- A. Safety Standards:
 - 1. Design, manufacture and installation of mechanical refrigeration equipment: ANSI B9.1.

2. Machinery Guards: Provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears, and other moving parts regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory fabricated unit casings.

- B. Unit Capacities: When providing a substitution to the basis of design manufacturer for the Variable Refrigerant System, the Contractor shall ensure the system meets the heating and cooling capacities specified in the equipment schedules and is responsible for any additional materials that include, but are not limited to higher capacity outdoor an indoor units, refrigerant piping, and accessories required for proper operation.

1.5 SUBMITTALS

- A. In accordance with Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC), furnish the following:
 1. Manufacturer's Literature and Data:
 - a. Computer Room Air Conditioner
 2. Submit proof of specified ARI Certification.
 3. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required EER, COP, etc.
 4. Operating and Maintenance Manuals: Submit in accordance with paragraph, INSTRUCTIONS, in Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).

1.6 EXTRA MATERIALS

- A. Furnish one set of air filters for each unit.

PART 2 - PRODUCTS

2.1 COMPUTER ROOM AIR CONDITIONER

- A. General - Equipment and material specified under this heading shall be furnished and installed by a certified representative of the unit manufacturer. System shall consist of Trane or equal condensing unit, air unit, refrigerant piping, and system controls. Each system shall be fitted and rated in accordance with ARI Standard 210.
- B. Condensing (outdoor) unit shall be complete with compressor-motor unit, direct expansion condenser coil, condenser fans, starters, controls, and piping enclosed in a sheet steel

enclosure recommended for outside installation. Three phase units shall be provided with phase loss relay package in accordance with Section 26 29 13 LOW VOLTAGE MOTOR CONTROLLERS. Condenser fans shall be vertical discharge. Provide guards for intake and discharge to protect coil and fan. Provide compressor anti-short cycling control and low ambient control for cooling operation to (55) (40) (30) Deg. F. Crankcase heater shall be provided in compressor body.

- C. Fan-coil (indoor) unit shall be modular type complete with cooling coil, heating coil, fans, fan motor and drive, combination filter mixing box, drain pan, starters, controls, and refrigerant piping enclosed in an insulated casing. Cooling coil shall be non-ferrous direct-expansion type. Fan motor shall be direct drive. Filters shall be 2-inch thick throwaway type. Provide thermal expansion valve for each cooling coil circuit and liquid solenoid as required for compressor capacity control. Provide rubber-in-shear vibration isolators. Provide a trap in the condensate drain piping from the evaporator coil drain pan of sufficient depth to prevent blowout or siphoning of water.
- D. Refrigerant lines shall be hard drawn, dehydrated, and sealed copper tubing, sized and connected as recommended by the unit manufacturer. Suction line shall be insulated and effectively vapor sealed. Refrigerant circuit access ports shall be fitted with locking type tamper resistant caps in strict accordance with the IMC.
- E. Controls - The large bezel touch screen user interface display panel features a high resolution backlit liquid-crystal graphical display equipped with contrast adjustment and LED illuminated function keys. The screens that appear on the user interface display panel present data that originates from the controller I/O module. The controller is operated via a round membrane type keypad and offers an alarm log plus four different interface menu levels to the operator: Information, Control, Service, and Factory. The controller shall incorporate a communication interface port to be field connected to BAS.
- F. The system shall be completely charged with refrigerant and oil and shall be guaranteed to be free of leakage for one (1) year.
- G. The system shall be tested and checked out for safe, controlled operation. One week before final inspection, a letter from the unit manufacturer's representative shall be submitted to the Engineer certifying that the system is performing safely and satisfactorily. Compressors shall be guaranteed to be free from defective materials or workmanship for five (5) years after final acceptance of the project.
- H. Steam Generating Humidifier: The humidifier shall be of a self-contained steam generating electrode type, utilizing a plastic disposable cylinder with full probes, connected to electric power via cylinder plugs that slide onto the electrode pins. The electrode pins shall be constructed from expanded low carbon steel, zinc plated, and dynamically formed for precise current control. The humidifier assembly shall include integral fill cup, fill and drain valves and associated piping. The canister shall be designed to collect the mineral deposits in the water and provide clean particle free steam to the air stream, thereby reducing maintenance cost. The microprocessor control shall maintain humidifier operation

through fill and drain cycles based on the water conductivity. Overflow and loss of flow protection shall be provided along with a manual drain switch. A high water alarm with built-in time delay shall provide an indication to change canister. The humidification system shall require no cleaning maintenance during the cylinder life. The humidifier shall discharge steam at atmospheric pressure. It shall be capable of operating with water in the range of 200 to 1500 micromhos. The steam shall be introduced into the air stream, after the evaporator, by a calibrated discharge tube designed to equally distribute the steam to the air stream without condensation. The humidifier shall have a capacity of 4-15 lb/hr Lbs./hr. Proportional (0-10 Vdc) microprocessor controls shall be provided with the Steam Generating Humidifier option.

- I. Dehumidification Cycle: The floor-mounted air conditioning system shall be provided with a refrigeration-based dehumidification mode. Moisture is condensed on the cooling coil and discharged through the condensate drain. Reheat (electric) shall be provided to offset sensible cooling during the dehumidification cycle.
- J. Condensate pump: A condensate pump shall be factory installed for automatic removal of condensate and humidifier flush water. The condensate pump shall include an internal overflow safety float which shall open the control circuit, thereby shutting the unit down in the event of a condensate overflow. The condensate pump shall be specifically designed to operate with the higher condensate temperatures caused by the flush and drain cycle of the electrode canister humidifiers.
- K. Sequence of Operation: The controller shall receive inputs for measurable control conditions (temperature, relative humidity, and dew point) via return air or room mounted sensors. The internal logic will then determine if the conditions require cooling, humidification or dehumidification. Control setpoints shall be established to maintain design conditions of the installation. The controller will respond accordingly to changes in these conditions and control the output/demand for the appropriate mode of operation until user defined conditions are achieved.
- L. Safety: Upon activation of the clean agent system the units shall shutdown.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Handle and install units and accessories in accordance with ARI 260 and the manufacturer's printed instructions.
- B. Coordinate indoor unit location with lighting and ceiling system.
- C. Coordinate roof openings and locations with structural framing.

3.2 TESTS

- A. Perform tests and make reports in accordance with Section 230000, HEATING, VENTILATING AND AIR-CONDITIONING (HVAC), and Section 230593, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

END OF SECTION 238100

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SECTION 260100 - BASIC REQUIREMENTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies the basic requirements of electrical installations and includes requirements common to all sections of Divisions 26, 27 and 28. It expands and supplements the requirements specified in sections of Division 1.
- B. Division 26 shall provide the electrical equipment, electrical wire, raceways and cable work and connections as required for complete and operable electrical systems as indicated in Division 26 Contract Documents. Refer to all other portions of these Contract Documents and apply to those portions of work relating to Electrical Work the same as if the Electrical Work was repeated herein in its entirety.
- C. Other Divisions of these Contract Documents will provide equipment that will require electrical connections - Division 26 shall coordinate with other Divisions and shall provide all necessary items and equipment for complete and code-compliant connections.

1.2 RELATED DOCUMENTS

- A. The Drawings and general provisions of the Contract, including the General and Supplementary Conditions, Instructions to Bidders and sections of Division 1, apply to the work specified in this section.

1.3 SCOPE OF THE WORK

- A. Work included under this section shall include complete electrical systems as shown on the Contract Documents, which includes all of the specifications, drawings, addendums, accepted change orders and the Authority Having Jurisdiction (AHJ) compliances. Provide supervision, labor, material, equipment, machinery, plant, and other items necessary to complete the systems. Items of equipment may be specified in the singular; however, provide the number of items of equipment indicated in the Contract Documents and as required for complete systems.
- B. It is the intention of these Contract Documents to call for finished work, tested and ready for operation. Wherever the word "provide" is used, it shall mean "furnish and install complete and ready for use."
- C. Minor details necessary for the complete installation and operation of the systems shall be included.

- D. Any item that is shown on the drawings but not mentioned in the specifications, or mentioned in the specifications but not shown on the drawings, shall be considered as being both shown on the drawings and mentioned in the specifications and shall be provided.
- E. The entire work provided for in the specifications and indicated on the drawings is to be accomplished even though every item and minor detail for the proper installation and successful operation of the entire work may not be mentioned in the specifications or shown on the drawings.
- F. All materials and equipment shall be new and listed by Underwriters Laboratories, Inc.

1.4 PERMITS AND FEE

- A. The Contractor shall obtain and pay for all permits, bonds, licenses, and inspection certificates, and shall pay inspection fees and taxes, but permanent electrical utility fees shall be paid by the Owner.
- B. The Contractor shall file plans and prepare documents required to obtain approvals of the Authorities Having Jurisdiction (AHJ).

1.5 DRAWINGS

- A. Electrical drawings are diagrammatic and indicate general arrangement of systems and work included. Consult Architectural and Structural drawings for building construction details.
- B. Should there be any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and specifications, notify the Architect/Engineer and make modifications as directed.
- C. Where variances occur between drawings and specifications or within either document itself, include in the contract price the item or arrangement of better quality, greater quantity, or higher cost.

1.6 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Refer to equipment specifications in Divisions 2 through 23 for rough-in requirements.
- B. Rough-in openings shall align vertically and horizontally with the building structure and shall be plumb.
- C. Verify door swings before roughing-in switch outlets.

1.7 ELECTRICAL INSTALLATIONS

- A. In addition to the requirements of the General Conditions, examine areas and conditions for compliance with installation tolerances and other conditions affecting performance of electrical work. Do not proceed with installation until unsatisfactory conditions have been corrected. Verify all dimensions by field measurements.
- B. Install material and equipment in accordance with manufacturer's written installation instructions, applicable requirements of the National Electrical Contractors Association (NECA) "Standard of Installation" and applicable requirements of National Electrical Code (NEC).
- C. Coordinate electrical equipment and materials installation with other building components.
- D. Arrange for chases, slots and openings in other building components to allow for electrical installations.
- E. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components as they are constructed.
- F. Sequence, coordinate and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building. Where housekeeping pads are required, they shall be minimum 4" tall and shall meet Division 3 specifications.
- G. Where mounting heights are not indicated, detailed or dimensioned, bring to the attention of the Architect immediately for resolution.
- H. Install electrical equipment with National Electrical Code (NEC) required clearances to facilitate maintenance and repair or replacement of equipment components. Connect equipment in such a way as to facilitate future maintenance, with minimum of interference with other items in the vicinity. Do not run any conduits across any designated rooftop walkways – if this is unavoidable, provide a removable platform or stairs to safely walk over the conduits.
- I. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components. Do not block mechanical equipment access with raceways.
- J. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.

- K. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A.
- L. All wiring connectors and terminals (including but not limited to wiring devices, breakers, disconnects, fuses, starters, etc.) shall be rated for not less than 75 deg. C. If connectors and terminals are provided that are rated for less than 75 deg. C., the electrical contractor shall incur all costs associated with upsizing conductors and conduits as required by the NEC for lower-temperature conductors.
- M. All damages incurred to new or existing electrical installations shall be immediately reported to the general contractor project manager and repaired by the contractor at no cost to Owner.
- N. Site-Applied Interior Paints and Coatings: Comply with low-emitting requirements in Division 01 Section "Indoor Air Quality Requirements."

1.8 PROTECTION

- A. Protect work against theft, injury, or damage. Carefully store material and equipment off the ground and under cover. Close open ends of work or equipment with temporary covers or plugs during storage and construction to prevent entry of obstructing material.

1.9 EXCAVATION AND BACKFILLING

- A. Excavate to the depths required for the installation of electrical work. The Contractor shall be responsible for obtaining core drill sample information prior to receipt of bids to determine presence or absence of rock. After receipts of bids, no extras will be allowed for excavation of rock. Remove and properly dispose of excavated materials not required or suitable for backfill. Provide shoring as necessary to protect existing facilities, new work, and the safety of personnel. Make open cut excavation, except for short sections of trench which may be tunneled if conduit or duct can be properly installed and supported.
- B. Grade the bottom of trenches to provide uniform bearing and support for each section of conduit on undisturbed soil at every point along its entire length. Backfill trench over depths with sand, fine gravel, or loose, granular, moist earth and thoroughly tamp. Unstable soil that is incapable of properly supporting conduit shall be removed to stable soil and the trench treated as over depth.
- C. Do not backfill until all tests have been performed and the utility systems installed conform to the requirements of the Contract Documents. Carefully backfill trenches with clean earth, sand, and gravel or soft shale in 6-inch layers and thoroughly tamp until the conduit has a cover of not less than 2 feet. Place the remainder of the backfill in the trench in 1-foot layers and tamp. Grade surface to reasonable uniformity and mound over trenches. Use

compacted backfill for excavation under slabs on grade, building structures, concrete or asphalt paving, and driveway or parking areas.

- D. Check elevations of utilities entering and leaving building. When such elevations require excavations lower than footing levels, notify Architect and proceed as directed by him. Make excavations at minimum required depths in order not to undercut footings.

1.10 ACCESSIBILITY

- A. Furnish, for installation by others, access doors in every location necessary and as required by Code or equipment manufacturer recommendation, whether indicated or not, to allow working access to concealed electrical items which may require operation, inspection, maintenance, or adjustment. Access doors are not required in lay-in panel systems. See Division 8 for specification and installation requirements.
- B. Coordinate the final location of concealed equipment and devices requiring access with final location of access doors. Access unit shall be of adequate size and shall match the wall, floor and ceiling rating and construction type. Allow ample space for removal of all parts that will likely require replacement or servicing during the normal life of equipment.
- C. Prior to installation of equipment and materials requiring access doors, prepare, for review by the architect in ample time for proper coordination, one (1) set of architectural prints marked with size and approximate location of all access doors.

1.11 SEALANTS

- A. See Division 7 for fire-stopping sealants required around conduit and/or cable penetrations through fire-rated assemblies. Also, see Division 7 joint sealants required around conduit and/or cable penetrations through joints. See Division 7 for weatherproof sealants required around conduit and/or cable penetrations through water tight assemblies such as exterior walls and roof.
- B. Apply fire stop/sealant around all penetrations in and out of the new data center walls, ceiling, floor, cable tray system, etc...to ensure no leaks associated with the fire suppression system FM-200.
- C. Apply sealant around all exterior mounted electrical devices to provide weatherproofing and pest control.
- D. Apply Fire stopping at all required floor/decking penetrations to and from the Generator system, and the existing penthouse data room and to the new Data Center. Contractor shall provide the same for all penetrations required under this scope of work.

1.12 CUTTING AND PATCHING

- A. This Article supplements sections of Division 1 for general requirements for cutting and patching and specifies the cutting and patching for electrical equipment, components and materials, to include removal and legal disposal of selected materials, components, and equipment.
- B. Do not endanger or damage installed work through procedures and processes of cutting and patching.
- C. Arrange for repairs required to restore other work because of damage caused as a result of electrical installations.
- D. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.
- E. Perform cutting, fitting, and patching of electrical 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. Remove samples of installed work as specified for testing;
 - 5. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect/Engineer observation of concealed work.

1.13 SLEEVES

- A. Locate sleeves during normal course of work. Provide sleeves for conduit larger than 1" passing through concrete floor slabs and concrete, masonry, tile, and gypsum wall construction. Sleeves shall not be provided for conduit running embedded in concrete or slab on grade. Sleeves through structural members shall be only as directed by Architect.
- B. All conduits passing through fire-rated walls or floors or ceilings shall have sleeve assemblies to maintain the fire rating of the wall or floor or ceiling. Pack between sleeve and conduit with U.L. Listed material to maintain wall or floor or ceiling rating. See Architectural drawings for locations of fire-rated walls, floors and ceilings.
- C. Sleeves shall be constructed of 20 gauge galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. All other sleeves shall be constructed of galvanized steel pipe unless otherwise indicated.
- D. Fasten sleeves securely in floors or walls so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster, or other materials from being forced into the space between pipe and sleeve during construction.

1.14 MOTOR AND ELECTRICAL WIRING

- A. Temperature control wiring, equipment control wiring, and interlock wiring necessary for the proper sequence of operation of mechanical equipment will be provided as part of the Mechanical Work. See Division 23 for instrumentation and control for HVAC, and for the complete definition of control wiring.
- B. Power wiring from the power source to the motor or equipment junction box, including wiring through starters, VFD's and safety switches shall be provided as part of the Electrical Work under Division 26.
- C. Power wiring from the power source to electric heating equipment, including wiring through contactors, safety switches and line voltage control devices shall be provided as part of the Electrical Work under Division 26.

1.15 QUALITY ASSURANCE

- A. Manufacturers: Where a list of manufacturers or a proprietary item is not specified, use manufacturers whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Installer's Qualifications: Firms with at least three (3) years of successful installation experience on projects utilizing material similar to that required for this project.
- C. Codes and Standards: Comply with applicable requirements of the following codes and standards.
 - 1. National Electrical Manufacturers Association (NEMA) Standards.
 - 2. 2017 NFPA 70 - National Electrical Code (NEC)
 - 3. 2016 NFPA 72 – National Fire Alarm and Signaling Code
 - 4. 2018 VUSBC – Virginia Uniform Statewide Building Code (VCC – Virginia Construction Code)
 - 5. 2018 IBC - International Building Code as adopted and modified by the VUSBC (VCC)
 - 6. 2018 IFC – International Fire Code
 - 7. 2018 NFPA 101 – Life Safety Code
 - 8. 2018 VECC – Virginia Energy Conservation Code
 - 9. 2010 Americans with Disabilities Act Accessibility Guidelines (ADAAG)
 - 10. 2010 ADA Standards for Accessible Design
 - 11. Institute of Electrical and Electronics Engineers (IEEE) Standards
 - 12. National Electrical Safety Code (NESC)
 - 13. Other applicable ANSI/NFPA & UL Standards as required for the project

- D. Provide material and equipment which is listed by Underwriters Laboratories, Inc. (UL) and which bears the UL label. This applies to materials and equipment for which UL Standards have been established and for which label service is regularly furnished. Assemble materials and equipment, for which no UL Product Category exists for the completed unit, with UL-listed components.

1.16 ELECTRICAL SUBMITTALS

- A. Refer to the Conditions of the Contract (General and Supplementary) and Division 1 for submittal definitions, requirements and procedures.
- B. Submittal of shop drawings, product data and samples will be accepted only when submitted by the General Contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.
- C. Submittals that are not acceptable must be resubmitted until returned as approved by the engineer. If the third submittal is not approved, the contractor will be responsible for paying additional fees for subsequent reviews of submittals at a rate of \$200 per hour, and the specified item may be required to be provided at the engineer's discretion at no additional cost to the contract. Submittals will not be returned until payment is received.

1.17 BIDDING INSTRUCTIONS

- A. Products are generally specified by a performance specification and/or by manufacturer's name and model number or trade name.
 - 1. When specified only by a performance specification, the Contractor may use any manufacturer who meets the performance specification and applicable codes.
 - 2. When several products/manufacturers are specified together, then the Contractor has the option of using any product/manufacturer listed. The Contractor shall be subject to the requirements of paragraph 1.16 - ELECTRICAL SUBMITTALS. The Contractor's bid shall be compiled on the use of the listed products without exception. Substitutions will only be considered after the contract has been signed and shall be subject to the requirements of paragraph 1.18 - SUBSTITUTIONS.
 - 3. When several products/manufacturers are specified together and the system design is based on one of the listed products by specific model number(s) or catalog number(s), the Contractor has the option of using the one specific product or any product/manufacturer listed. However, when another listed product/manufacturer is used, the Contractor shall be responsible for determining that the product(s) are compatible with building design, electrical design, and mechanical design; are equal to the basis-of-design product in quality, appearance, construction and performance (including lamping and lenses for lighting fixtures); and will not necessitate design modifications by the Architect/Engineer. The Contractor's bid shall be compiled on the use of the listed products/manufacturers without exception. Substitutions will

- only be considered after the Contract has been signed and shall be subject to the requirements of paragraph 1.18 - SUBSTITUTIONS.
4. When only one manufacturer's name is listed with the catalog number, this shall be the basis of the bid. The Contractor's bid shall be compiled on the use of the listed product(s) only. Substitutions will only be considered after the Contract has been signed and shall be subject to the requirements of paragraph 1.18 - SUBSTITUTIONS.
 5. A request for substitution shall be made in writing from the General Contractor only. Requests by distributors, manufacturers, or manufacturer's representatives will not be considered. Oral requests will not be considered. Request for deviations from product specifications will not be considered.
 6. Request for substitutions will not be considered during bidding unless the specified product is discontinued.
 7. If approval for a substitution is granted, samples shall be submitted if and as requested by Engineer.
 8. Approval of substitutions prior to shop drawing submittal will not be granted.

1.18 SUBSTITUTIONS

- A. Any substitution to the basis of design light fixtures shall require complete photometric point-by-point calculations (at no additional cost to the contract) of all areas (rooms) the substitute light fixtures will be installed. The photometric calculations shall include substitute light fixture(s) and any non-substitute light fixture(s) where they are all in the same area (room). Architect/Engineer shall then review substitution cut sheets and photometric calculations to determine if the light fixtures are equal to the basis of design.
- B. Substitutions are understood to mean that the Contractor:
 1. Has personally investigated the proposed substitute and has determined that it is equal or superior in all respects, including appearance, to the item specified.
 2. Will provide the same guarantee for the substitution that he would for the equipment specified,
 3. Has coordinated the installation of the substitute, providing design modifications and changes as required for the work to be complete in all respects.
 4. Has coordinated the installation of the substitute with the General Contractor pertaining to changes required for the work to be complete with all trades (all changes shall be provided without additional cost to the contract).
 5. All required design modifications and/or changes shall be submitted with the shop drawings for the substitute equipment.
 6. Has coordinated with the light controls manufacturer to ensure substitution will work with specified light controls and sequence of operations.
 7. Has provided the amount of credit due the Owner if the substitution is accepted.
- C. The Architect/Engineer will indicate on which of these items the Contractor may submit shop drawings for review. The acceptance by the Architect/Engineer of any or all of those items listed by the Contractor for review shall not constitute an approval of the substitute

but shall mean that the Contractor may then submit detailed shop drawings for review. When a request for substitution is granted, the Architect/Engineer will review shop drawings as follows:

1. If shop drawings for the substitute equipment are marked "AMEND & RESUBMIT" on first submittal, the Contractor is allowed to resubmit for two additional reviews, unless the Architect/Engineer provides other instructions. If after the third review, the substitute equipment is not accepted, the specified equipment shall be provided without any additional cost to the contract.
2. If shop drawings for the substitute equipment are marked "REJECTED – SEE REMARKS" at any submittal level, the Contractor shall stop any further submittals of any substitute equipment. The Architect/Engineer will not review any additional substitute equipment and the Contractor shall submit and provide the specified equipment without any additional cost to the contract.

1.19 SIMILAR PRODUCTS

- A. When two or more items of same material or equipment are required, they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, conductors, conduit, fittings, sheet metal, steel bar stock, welding rods, solder, fasteners and similar items used in Work, except as otherwise indicated.
- B. Provide products which are compatible within systems and other connected items.

1.20 NAMEPLATE DATA

- A. Provide permanent operational data nameplate on each item of power-operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location. Provide the manufacturer's nearest authorized servicing agency, address and emergency telephone number.

1.21 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications. Products shall be adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.

- C. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.22 IDENTIFICATION

- A. Coordinate all room number designations with the final room numbers. Use final room numbers for all final documentation and display, including but not limited to, programming, alarm displays, annunciator displays, panelboard schedules, signage, labels, and engraved labels. The room numbers shall be as directed by the Owner and may not be the same as shown on Contract Drawings. Include final room numbers on the drawings for the Record Documents.

1.23 RECORD DOCUMENTS

- A. Refer to the sections of Division 1 for record document requirements. The following paragraphs supplement the requirements of Division 1.
- B. Mark Drawings to indicate revisions to lighting fixture and wiring device layout; conduit size and location both exterior and interior; actual equipment locations, dimensioned from column lines; concealed equipment, dimensioned from column lines; distribution and branch electrical circuitry; fuse and circuit breaker sizes and arrangements; support and hanger details; concealed control system devices; panel schedules.
- C. Mark Contract Documents to indicate accepted substitutions, Change Orders and actual equipment and material used on the project.
- D. Within 30 days after the date of system acceptance, as-built record drawings of the following shall be provided to the Owner in accordance with energy codes.
 - 1. Floor plans indicating the location and area served for all electrical distribution equipment.
- E. Within 90 days after the date of system acceptance, as-built record drawings of the actual lighting and associated controls installations shall be provided to the Owner, including the location, luminaire identifier, and control & circuiting for each piece of lighting equipment, in accordance with energy codes

1.24 OPERATING AND MAINTENANCE DATA

- A. Refer to the sections of Division 1 for procedures and requirements for preparation and submittal of maintenance manuals.

- B. In addition to the information required by Division 1 for Maintenance Data, include the following information:
1. Submittal data stating equipment rating and selected options for each piece of equipment requiring maintenance. Include description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts. Unless equipment is purchased and provided by the owner.
 2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
 3. Operations and maintenance manuals for each piece of equipment requiring maintenance. Include maintenance procedures for routine preventative maintenance and troubleshooting, disassembly, repair and reassembly, aligning and adjusting instructions. Required regular maintenance actions shall be clearly stated and incorporated on a readily accessible label; the label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product.
 4. Servicing instructions and lubrication charts and schedules.
 5. Names and addresses of at least one qualified service agency for each piece of equipment or system.
 6. A complete narrative of how each system is intended to operate.
- C. For compliance with energy codes, provide a lighting equipment and controls operations and maintenance manual to the Owner within 90 days after the date of system acceptance. These manuals shall include the following:
1. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
 2. Operation and maintenance manuals for each piece of lighting equipment and lighting controls with routine maintenance clearly identified, including a recommended re-lamping program and a schedule for inspecting and recalibrating all lighting controls.
 3. A complete narrative of how each lighting control system is intended to operate, including recommended settings.
- D. Compile and assemble the manuals for Divisions 26, 27 and 28 into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference. Only one copy of each manual needs to be submitted for engineer review.
- E. For the Owner's use, provide 2 copies of all O&M manuals, diagnostic tools, software and sufficient training for all electrical systems and their components (generator, fire alarm, lighting controls, digital meters, etc.).

1.25 WARRANTIES

- A. Refer to the sections of Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.
- B. Compile and assemble the warranties for Divisions 26, 27 and 28 into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- C. Provide complete warranty information for each product or piece of equipment, including date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services. Only one copy of each warranty needs to be submitted for engineer review.

1.26 CLEANING

- A. Refer to the sections of Division 1 for general requirements for cleaning.
- B. Clean all panelboards, lighting fixtures, and lenses prior to final acceptance. Replace all inoperative LED boards and LED drivers, if required on the new fixtures for the new data center required lighting fixtures.

1.27 SITE VISIT REPORTS

- A. Respond in writing to each item of discrepancy noted on all site visit reports.

1.28 ALTERATIONS TO EXISTING WORK

- A. Refer to the sections of Division 2 for requirements for selective demolition. The following paragraphs supplement the requirements of Division 1.
- B. Unless otherwise indicated, all existing electrical work shall be removed in all areas that are indicated to be renovated, unless required for the new installation.

END OF SECTION 260100

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of the low voltage power and lighting wiring. Extent of electrical wire and cable shall be as indicated and required for complete and operable electrical systems.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. The Drawings and general provisions of the Contract, including the General and Supplementary Conditions, Instructions to Bidders and sections of Division 1, apply to the work specified in this section.
- B. Refer to other Division 7, Division 26 and Division 31 sections for requirements for penetration firestopping, requirements for electrical installations, grounding and bonding, raceway and boxes and earthwork.

1.3 REFERENCES AND CODES

- A. NEMA WC 70 -- Standard for Non-shielded Power Cable 2000 volts or Less for the Distribution of Electrical Energy (2009).
- B. 2017 NFPA 70 -- National Electrical Code

1.4 SUBMITTALS

- A. In accordance with sections of Division 1, furnish the manufacturer's literature and data showing each conductor and cable type and rating. **All** provided conductor(s) shall be SimPul impregnated colored code insulation, or equal. No color tape will be accepted. This is noted throughout the contract documents for the same.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to Authorities Having Jurisdiction.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 Article 100 by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

- C. Comply with applicable requirements of NFPA 70 (NEC) pertaining to the construction and installation of electrical wires and cables.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver wire and cable properly packaged in factory fabricated containers or wound on NEMA-specified wire and cable reels. Each coil or reel shall contain only one continuous cable without splices.
- B. Handle wire and cable carefully to avoid abrading, puncturing or tearing wire and cable insulation and sheathing. Ensure the dielectric resistance integrity of the wire and cable is maintained.
- C. Store wire and cable in a clean, dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. General: Provide electrical conductors and cables of manufacturer's standard materials, as indicated by published product information, designed and constructed as recommended by manufacturer for a complete installation and for applications indicated. **All** provided conductor(s) shall be SimPul impregnated colored code insulation, or equal. No color tape will be accepted. This is noted throughout the contract documents for the same.
- B. Line Voltage (100 to 600 volts): Provide only copper conductors with conductivity of not less than 98% at 20 degrees C (68 degrees F). All indicated conductor sizes in construction documents are based on copper Provide color-coding of conductors. Use factory applied colored insulation for provide black for phase A, red for phase B, blue for phase C, and white for neutral. For 480Y/277 volt systems, provide brown for phase A, orange for phase B, yellow for phase C, and gray for neutral. Provide ground conductor color as required by the NEC.
 - 1. Provide factory-fabricated copper conductors of sizes, ampacity ratings, and materials for applications and services indicated. Provide conductors with Type XHHW or XHHW-2 or THHN or THWN-2 insulation with a minimum rating of 75 degrees C, which are the indicated conductors scheduled [except where specifically noted otherwise].
 - 2. Provide solid conductors for sizes #10 AWG and smaller. Provide stranded conductors for sizes #8 AWG and larger. Provide minimum conductor size of #12 AWG, larger where indicated.
 - 3. For 120-volt 15 amp and 20 amp branch circuits, use minimum 12 AWG up to 60 feet, 10 AWG for 61-95 feet, 8 AWG for 96-155 feet and 6 AWG for branch circuits longer than 155 feet. Conductors shall be same size for entire length of run, except if all outlets are in the same room (1200 square feet or less) the oversized conductors may be run only to the first outlet.

4. For 277-volt 15 amp and 20 amp branch circuits, use minimum 12 AWG up to 140 feet, 10 AWG for 141-220 feet and 8 AWG for branch circuits longer than 220 feet. Conductors shall be same size for entire length of run.
5. Cables: Provide UL-type factory-fabricated cables of materials and jacketing/sheathing as indicated below for services indicated. Re-size cable conductors based on equal to or greater equivalent 75 degree C rated copper conductors as scheduled if cables are used. Select cables with construction features which fulfill project requirements. At Contractor's option, the following cable types are acceptable where indicated:
6. Fire Alarm Circuits: Contractor shall match the existing used Fire Alarm wiring and devices to be compatible with existing Fire Alarm, which will be removed in its entire under another phase. Where required provide plenum rated or fire-protective signaling circuit cables/assemblies in accordance with the instructions by the manufacturer.

2.2 CONNECTORS

- A. General: Provide proper current-carrying material suitable for conductors used.
- B. Line Voltage (100 to 600 volts):
 1. Splices: Provide solderless, screw-on, reusable pressure cable type, 600 volt connectors for conductors #10 AWG and smaller constructed of corrosion-resistant steel or copper spring and a vinyl or plastic insulator which is temperature-rated 105 degree C and approved for copper conductors. Provide compression connectors for conductors #8 AWG and larger constructed of copper, copper alloy.
 2. Terminations: Provide compression-type terminations rated 600V and 105 degree C, constructed of tin-plated copper; serrated barrel; chamfered conductor entry. All compression terminations shall be applied using the manufacturer's recommended compression tool for the size of termination used. The terminations shall be of exact size to fit the conductors and shall be installed to bring uniform pressure on all sides of the joint and assure a permanent high-conductivity connection. Where terminations are supplied as standard material on equipment, contractor may elect to utilize such termination in lieu of those specified herein.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUCTORS, CABLES AND CONNECTORS

- A. Coordinate conductors/cable installation work, including electrical raceway and equipment installation work, as necessary to properly interface installation of conductors/cables with other work.
- B. Unless otherwise indicated, install individual conductors in raceways.
- C. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

- D. Support cables according to NEC and cable manufacturer's instructions.
- E. Cables penetrating fire-rated elements shall be sealed according to Division 7.
- F. Type AC, MC, NM, NMC, NMS, SE, USE, SO and UF cable may be used in areas where permitted by NEC and local codes, but only for branch circuits above accessible ceilings and in stud walls. Only cables with 75 degree C rated insulation are permitted. Where running into a panel where the ceiling space is inaccessible, conduit shall be run from the panel to a junction box above the nearest accessible ceiling. Cables shall be run neatly in straight parallel runs with proper support and limited sag.
- G. Provide cables in plenum spaces in metallic raceways or with cable jackets approved for use in plenum spaces.
- H. Provide listed bushing or grommets where non-metallic-sheathed cables pass through openings in metal studs and other metal members in accordance with NEC 300.4. Where cables are installed at roof decking, follow requirements of NEC 300.4(E).
- I. Pull conductors simultaneously where more than one is being installed in same raceway.
- J. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- K. Use pulling means, including fish tape, cable, rope and basket weave conductor/cable grips, which will not damage cables or raceway. Remove and replace all conductors/cables with damaged jacket or insulation.
- L. Install splices at accessible outlet or junction boxes. Keep splices in underground junction boxes, hand holes, and manholes to an absolute minimum. Where splices are necessary, arrange to minimize the effects of moisture.
- M. Install splices and tapes which possess equivalent-or-better mechanical strength and insulation ratings than conductors being spliced.
- N. Where ground conductors are required to be run in same raceway as phase conductors, the ground conductor shall be run continuous throughout each circuit and the ground conductor pigtailed to the device to ensure ground continuity.
- O. Do not install a shared neutral on any circuit. Install capped neutral conductors in switch boxes where required by NEC 404.2(C).
- P. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- Q. Wiring at Outlets: Install conductors at each outlet with at least 6 inches of slack.
- R. AC and MC cable are not allowed to be used.

- S. Comply with all emergency system wiring requirements in NEC 700.10.

3.2 INSTALLATION OF CONDUCTORS AND CABLES FOR POWER LIMITED CIRCUITS

- A. Wiring for signaling and power limited circuits may be run exposed in the following locations:
 - 1. Above accessible ceilings where not exposed to view.
- B. Provide signaling and wiring for power limited circuits in raceways in the following locations:
 - 1. In all locations not specifically listed above.
 - 2. Where concealed in inaccessible locations.
 - 3. In elevator equipment rooms and hoistways.
- C. Install exposed conductors or cable parallel and perpendicular to building surfaces, or exposed structural members, and follow surface contours where possible.
- D. Install conductors and cables in a neat and workmanlike manner.
- E. Support conductors and cables frequently to prevent excessive sag. Support a minimum of 6” above suspended ceilings. Do not support conductors or cables from conduit or other raceway.
- F. Parallel cable runs shall be installed adjacent to each other. Tie adjacent runs in neat bundles.
- G. Install conductors and cables without splices. Make connections at terminal strips in cabinets or at equipment terminals.
- H. Provide conductors and cables in accordance with requirements of manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Prior to energization of circuitry, check low voltage installed conductors and cables with megohm meter to determine insulation resistance levels to ensure requirements are fulfilled.
- B. Prior to energization, test low voltage conductors and cables for electrical continuity, short circuits and grounds. Also, test conductor phase-to-phase and phase-to-ground.

END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies general grounding and bonding requirements of electrical equipment operations for safety and to provide a low impedance path for possible ground fault currents. Extent of grounding and bonding work is indicated by drawings and schedules and as specified herein. Grounding and bonding work is defined to encompass systems, circuits and equipment.

1.2 RELATED DOCUMENTS

- A. The Drawings and general provisions of the Contract, including the General and Supplementary Conditions, Instructions to Bidders and sections of Division 1, apply to the work specified in this section.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Refer to other Division 26 sections for conductors/cables, electrical raceways, boxes and fittings which are required in conjunction with electrical grounding and bonding work.

1.4 REFERENCES AND CODES

- A. Electrical Code Compliances: Comply with applicable requirements of the 2017 NFPA-70 (NEC) pertaining to electrical grounding and bonding, pertaining to systems, circuits, and equipment. Particular attention is called to Article 250.
- B. U.L. Compliance: Comply with applicable requirements of UL Standards Nos. 467, "Electrical Grounding and Bonding Equipment", and 869, "Electrical Service Equipment", pertaining to grounding and bonding of systems, circuits, and equipment. In addition, comply with UL Std. 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products which are U.L. Listed and labeled for their intended usage.
- C. IEEE Compliance: Comply with applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141, and 142 pertaining to grounding and bonding of systems, circuits, and equipment.

1.5 SUBMITTALS

- A. Submit manufacturer's data on grounding and bonding products and associated accessories.

PART 2 - PRODUCTS

2.1 GROUNDING SYSTEMS

- A. General: Except as otherwise indicated, provide electrical grounding and bonding systems in accordance with the NEC, with assembly of materials including, but not limited to: conductors/cables, connectors, terminals (solderless lugs), compression connectors, mechanical connectors and/or exothermic process connections, grounding electrodes and bonding jumpers, and additional accessories needed for complete installation. Where more than one type unit meets indicated requirements, selection is Contractor's option. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE and established industry standards for applications indicated.
- B. Conductors: Unless otherwise indicated, provide electrical grounding conductors matching power supply wiring materials and sized according to NEC.

2.2 MISCELLANEOUS MATERIAL

- A. Bonding Jumper Braid: Copper braided tape constructed of 30 gauge bare copper wires and properly sized for indicated applications.
- B. Bonding Plates, Connectors, Terminals and Clamps: Provide electrical bonding plates, connectors, terminals and clamps for indicated applications.
- C. Ground Busbar: Provide ground busbar of 1/4" thick, tin-plated copper; 15 1/2"L x 4"W; tower mounting with nylon polyamide insulators and stainless steel brackets and bolts for a total stand-off height of 2"; predrilled with 19 pairs of 5/16" holes and 3 pairs of 7/16" holes.
- D. Grounding Electrodes (Rods): Steel with copper welded exterior, 3/4 inch diameter and 10 feet length.
- E. Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials and bonding jumpers, as recommended by accessories manufacturers for type services indicated.
- F. Compression Connectors: Compression connectors shall be manufactured from pure, wrought copper in compliance with ASTM B187.

- G. Mechanical Connectors: Mechanical cast connectors shall be manufactured from a copper alloy of minimum 80% copper, according to ASTM B30.
- H. Field Welding: Comply with AWS Code for procedures, appearance, quality of welds and methods used in correcting welding work. Provide welded connections where grounding conductors connect to underground grounding electrodes. Welds shall utilize the exothermic process.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which electrical grounding and bonding connections are to be made and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until satisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS

- A. General: Install electrical grounding and bonding systems required in accordance with manufacturer's instructions and applicable portions of the NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.
- B. Provide insulated equipment grounding conductors in the same raceway with phase conductors for all feeders (panelboards, control centers and distribution transformers), motor circuits, branch circuits and site lighting. Ground conductors shall be continuous from the equipment to the ground bus of the switchboard, panelboard or control center serving the equipment.
- C. Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system with other work.
- D. Drive each grounding electrode (ground rod) vertically in the soil such that a minimum 8'-0" of length is in contact with the soil with the upper end of the electrode a minimum 2'-0" below finished grade level, but below the permanent moisture level. Utilize an exothermic welding process to connect grounding conductors to the underground grounding electrodes and at other inaccessible or concealed locations.
- E. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity.

- F. Connect together system neutral, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, wiring device ground connectors and plumbing systems. Particular attention is called to NEC 250.92, 250.97 and 250.98 for metal raceway bonding requirements. Ground cord-and-plug connected equipment in accordance with NEC 250.114.
- G. Provide a ground bar in each communication room and electric room where indicated. Ground bars shall be mounted with long dimension horizontal and with bottom of bar 12” above the finished floor. Ground each bar as noted on drawings.
- H. Terminate feeder and branch circuit insulated equipment grounding conductors with grounding lug to ground bar or bus.
- I. Route grounding connections and conductors to ground and protective devices in shortest and straightest paths as possible to minimize transient voltage rises.
- J. Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.
- K. All ground connectors shall be designed for fault-duty loading and shall have the fault capacity of the maximum sized conductor for which it is designed.
- L. Bolt hole connectors and in-line splices shall accommodate only one conductor size. All other ground connectors shall be range taking.
- M. Structural steel and busbar ground connectors shall accommodate only one rigid member conductor.
- N. All ground connectors shall be provided with a corrosion-inhibiting compound preapplied to the contact surfaces. The compound shall be compatible with the conductors accommodated by the connector.
- O. All ground connectors shall be capable of being provided with tin plating, if required by the application.
- P. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.
- Q. Compression and Mechanical Connector Marking:

1. All connectors shall be clearly and permanently marked with the following information:
 - a. Manufacturer's inspection symbol
 - b. Catalog number
 - c. Conductor accommodation(s)
 - d. Installation die index or die catalog number (compression)
 - e. Underwriters Laboratories Listing Mark
 - f. The words "Suitable for Direct Burial," or "Direct Burial," or "Burial" as specified per ANSI/UL467.
 2. The smallest unit package shall contain the information listed under Y.1 and shall also include installation tooling.
- R. Ground Connector Installation Using Compression:
1. Installation of connectors shall be made in accordance with the manufacturer's recommendations. The instructions typically include conductor preparation (cleaning, pre-crimp), installation tool and die selection, and application of the proper number of crimps.
 2. Connectors shall be installable under all types of weather/field conditions without special safety precautions or procedures.
 3. Connectors shall be installable without using or producing hazardous materials or by-products.
- S. Provide labels on all ground electrode conductors and bonding conductors that indicate what they are connected to.
1. Main Service Ground Buss Bar:
 - a. Ground electrode conductor to Metal Underground Water Pipe ground electrode shall be labeled: "Water Main".
 - b. Ground electrode conductor to Metal Frame of Building or Structure ground electrode shall be labeled: "Building Steel".
 - c. Ground electrode conductor to Concrete-Encased ground electrode shall be labeled: "Concrete Encasement".
 - d. Ground electrode conductor to Ground Ring ground electrode shall be labeled: "Ground Ring".
 - e. Ground electrode conductor to Ground Rod Triad ground electrode shall be labeled: "Ground Rods".
 - f. Ground conductor to Lightning Protection System ground terminals shall be labeled: "Lightning Protection System".
 - g. Ground conductor to Telecommunication Systems ground buss bar (located at the telecommunication services) shall be labeled: "Telecommunication Systems".
 - h. Ground conductor to Interior Gas Metal Piping shall be labeled: "Gas Piping".

- i. Ground conductor to Interior Sprinkler Metal Piping shall be labeled: “Sprinkler Piping”.

3.3 FIELD QUALITY CONTROL

A. Ground Connector Inspection:

1. Compression dies shall provide embossment of the connector upon successful installation. The embossed index shall match the marking on the installed connector.
2. Connector marking information specified above shall be legible after installation for inspector cross-reference.
3. Closed barrel connectors shall have inspection holes at the appropriate location to verify proper cable insertion.

B. Performance: All system connectors shall be Listed by Underwriters Laboratories for direct burial in earth or embedment in concrete per ANSI/UL467 Standard for Grounding and Bonding Equipment.

C. Upon completion of installation of electrical grounding and bonding systems, test ground resistance of rod, pipe or plate electrodes with ground resistance tester. Where tests show resistance to ground is over 25 ohms, provide additional electrodes as listed by the NEC to reduce resistance to 25 ohms or less. Retest to demonstrate compliance. This test does not apply to supplementary grounding electrodes such as a ground rod provided for exterior lighting fixture poles.

3.4 O&M MANUAL

- A. Provide O&M Manual as specified in specification section 260100. Include both a paper copy and digital pdf copy of the O&M Manual.

END OF SECTION 260526

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of conduit, fittings and boxes to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise. Extent of raceway work is indicated by drawings and schedules and as required by the NEC.

1.2 RELATED DIVISIONS AND SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Instructions to Bidders and sections of Division 1, apply to the work specified in this section.
- B. Refer to other Division 7 and Division 26 sections for requirements for penetration firestopping, requirements for electrical installations, grounding and bonding and wiring devices and miscellaneous equipment.

1.3 REFERENCES AND CODES

- A. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publication pertaining to raceways.
- B. U.L. Compliance and Labeling: Comply with applicable requirements of U.L. Safety Standards pertaining to electrical raceway systems. Provide raceway products and components which have been U.L. Listed and labeled.
- C. Electrical Code Compliance: Comply with applicable requirements of the 2017 NFPA-70 (NEC) pertaining to the construction and installation of raceway systems.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on electrical boxes and fittings, raceways overhead metal raceways, junction boxes, pull boxes, hangers, seal-tite flexible conduit, red metallic conduit for fire alarm, compression fittings, NO screw type, FS boxes, thru-wall/floor firestop devices, plug-in flexible wiring system and cable tray with all required installation material, bonding jumper (green), all thread, beam camps, Unistrut with hardware, etc.

PART 2 - PRODUCTS

2.1 ALL RACEWAYS

- A. General: Provide complete assembly of all raceways, including but not limited to fittings, couplings, conduit bodies, underground raceway seals, service heads, expansion fittings, straps, hangers and other components and accessories as required to complete raceway system. Underground duct bank materials, schedule 80 pvc pipe.

2.2 METAL RACEWAYS

- A. Rigid Aluminum Conduit: Rigid aluminum 6063 Alloy, T41 temper, conforming to ANSI C80.5. Provide factory-applied, closed-end thread protectors.
- B. Rigid Steel Conduit: Rigid steel, zinc-coated, threaded type conforming to ANSI C80.1. Provide zinc coating fused to inside and outside walls.
- C. Intermediate Metal Conduit (IMC): Rigid intermediate grade steel, hot-dip galvanized conforming to ANSI C80.6.
- D. Electrical Metallic Tubing (EMT): ANSI C80.3. The Contractor has the option of using aluminum EMT where sizes 2" through 4" are required, except where UL firestop assemblies require steel.
- E. Flexible Metal Conduit: Formed from continuous length of spirally wound, interlocked zinc-coated strip steel conforming to UL 1.
- F. Liquid-Tight Flexible Metal Conduit: Constructed of single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC).
- G. Rigid Metal Conduit Fittings: Cast malleable iron, galvanized or cadmium plated, compatible with conduit materials conforming to NEMA FB-1.
- H. Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type.
 - 1. Straight Terminal Connectors: One piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
 - 2. 45° or 90° Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

- I. Liquid-Tight Flexible Metal Conduit Fittings: Cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated throat.
- J. EMT Fittings: Galvanized steel fittings, compression watertight type, except where aluminum EMT is used provide UL listed fittings for use with aluminum EMT.
- K. Conduit Bodies: Provide galvanized cast-metal conduit bodies of types, shapes and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded-conduit-entrance ends, removable covers, either cast or of aluminum or galvanized steel, and corrosion-resistant screws.

2.3 NON-METALLIC RACEWAYS

- A. Electrical Plastic Conduit--Extra Heavy Wall Conduit: Schedule 80, UL-rated, constructed of polyvinyl chloride compound C-200 PVC conforming to NEMA TC-2, and UL-listed in accordance with NEC Article 352 for direct burial, or above ground use.
- B. PVC Conduit and Tubing Fittings: NEMA TC 3, mate and match to conduit or tubing type and material.
- C. Conduit and Tubing Accessories: Provide conduit, tubing and duct accessories of types, sizes, and materials complying with manufacturer's published product information, which mate and match conduit and tubing.
- D. Conduit and Fitting Bonding: Use only manufacturer's recommended sealing compounds to produce watertight joints.

2.4 WIREWAYS

- A. General: Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, hold down straps, end caps, and other components and accessories as required for a complete system.
- B. Raintight Troughs: Construct in accordance with UL 870, with components UL-listed.
 - 1. Construction: 16-gauge galvanized sheet metal parts for 4" x 4" to 6" x 6" sections, and 14-gauge parts for 8" x 8" and larger sections. Provide knockouts only in bottom of troughs, with suitable adapters to facilitate attaching to other NEMA 3R enclosures. Do not use gasketing that can rip or tear during installation, or would compromise raintight capability of the trough. Do not use cover screws that protrude into the trough area and damage wire insulation.
 - 2. Finish: Provide 14-gauge and 16-gauge galvanized sheet metal parts with corrosion-resistant phosphate primer and baked enamel finish. Plate hardware to prevent corrosion.

2.5 CABLE TRAY

- A. Cable Tray: Shall be aluminum ladder type as noted on contract documents as follows:
1. Cable tray shall be nominal 4 inches high and 24 inches wide of lengths as required to provide a complete pathway as shown on the contract documents.
 2. Cable trays shall not have any sharp edges that can cut or damage cable jackets or conductors while being installed (pulled) over the cable tray assemblies.
 3. Provide cable tray splices, radius drops or rises, bends, supports, connectors, green grounding bonding at each connection plate, and fittings for a complete wireway system.
 4. Provide P& W or approved equal as noted on contract documents.

2.6 OUTLET BOXES

- A. Provide galvanized coated flat rolled sheet-steel non-gangable outlet boxes, of shapes, cubic inch capacities, and sizes suitable for installation at respective locations. Provide one piece multiple-gang boxes, not built-up. Construct outlet boxes with mounting holes and with cable and conduit-size knockout openings in bottom, ends and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover, and with grounding screws for fastening surface and device type box covers, and for equipment type grounding.
- B. Outlet Box Accessories:
1. Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Contractor's code-compliant option. Provide Erico #RBS16 or RBS24 box mounting plate in metal or wood stud partition walls as required where two or three devices are shown mounted side by side such as a receptacle, telecom or other device as indicated.
 2. Provide outlet box extension rings of the square-cut tile-type for use in GWB, tile, and wood-paneled walls. Provide standard plaster rings for use in plaster walls.
- C. Raintight Outlet Boxes: Provide corrosion-resistant cast-metal raintight outlet boxes, of types, shapes and sizes suitable for installation at respective locations, with threaded conduit holes for fastening electrical conduit, complete with NEMA 3R covers.

2.7 INTERIOR AND ABOVE-GRADE EXTERIOR JUNCTION AND PULL BOXES

- A. Provide galvanized code-gauge sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes to suit each respective location and installation. For exterior above-grade locations, provide NEMA 3R boxes with welded seams and equipped with stainless

steel nuts, bolts, screws and washers. If knockouts are provided on the sides of the box for conduit entry, use watertight conduit hubs. Large pullboxes with any dimension over 6 feet shall be complete with built-in wire support systems to prevent wire from pressing on connectors or other wire to prevent damage to insulation. Pullboxes in high-rise installations shall be complete with insulating wedge type connectors to provide proper support of conductors. The number and locations of pullboxes shall be as required by NEC to provide proper support of conductors, where required due to the number of bends in the raceway and where required due to length of raceway to not exceed the maximum pulling tension recommended by the cable manufacturer. Exterior exposed pullboxes shall be provided with screened raintight openings to allow heat to escape.

2.8 MISCELLANEOUS CABINETS

- A. Provide flat-rolled sheet-steel cabinets, flush or surface mounted as indicated, hinged door with flush latch and lock. Provide a framed directory with clear plastic protective cover on inside of door; trim clamps; gaskets where required by atmospheric conditions; single point latching for doors under 36"; 3 point latching for doors 36" and larger. Door and trim shall have factory applied finish to match panelboard cabinets.
- B. Manufacturers: Provide cabinets of one of the following:
 - 1. Anchor
 - 2. Austin
 - 3. Keystone
 - 4. Electromate
 - 5. Hoffman
 - 6. Westinghouse
 - 7. General Electric
 - 8. Square D

2.9 THRU-WALL/FLOOR FIRESTOP DEVICE

- A. The firestop device shall meet UL1479 (ASTM E 814) and bear the U.S. UL Classification Mark. The device shall be classified for use in one-, two-, three-, and four-hour rated gypsum, concrete and block walls. The device shall also have been tested by Underwriters Laboratories Inc. To UL2043 and determined to be suitable for use in air handling spaces. The firestop device shall stop or inhibit the spread of both fire and smoke as required by the IBC for fire and smoke rated partitions and barriers.
- B. Sizes: The firestop device shall be for 2" and 4" trade size EMT conduit.
- C. At each location where conduits and/or sleeves penetrate a fire or smoke rated partition or barrier for a pathway for I.T. cables, provide sufficient quantity of units to completely cover and properly seal all conduits and sleeves.

- D. Installation shall be in strict accordance with
 - 1. Manufacturer's installation instructions.
 - 2. All written and graphic requirements in the test assembly documentation published by the listing agency.

- E. The firestop device shall be the Wiremold FlameStopper. Other acceptable products are Hilti Speed Sleeve, STI EZ-Path and Metacaulk Pass-Thru.

2.10 BLANK FINISHED OUTLET COVERS

- A. Provide Arlington Industries, Inc. CP3540 blank covers on all future ceiling paddle fans and on any outlet or junction box that is for a future luminaire in finished space.

PART 3 - EXECUTION

3.1 INSTALLATION OF RACEWAYS

- A. Install raceways level and plumb and maintain manufacturer's recommended clearances.

- B. Coordinate with other work including wires/cables, boxes and panel work as necessary to interface installation of electrical raceways and components with other work.

3.2 INSTALLATION OF CONDUITS

- A. Conduit runs are not shown on floor plans unless specifically noted or indicated otherwise.

- B. Applications:
 - 1. Use rigid steel conduit in moist or damp locations, in hazardous or refrigerated areas, in poured concrete, underground, beneath slab-on-grade and were exposed outdoors.
 - 2. Steel IMC may be used in lieu of rigid steel conduit were permitted by the NEC, except IMC may not be used below-grade, below slab or in slab.
 - 3. EMT may be used for all installations not requiring rigid or IMC conduit. Aluminum EMT may be used at Contractor's option for size 2" through 4", except do not use aluminum EMT or aluminum products in cast-in-place concrete installation or where UL firestop assemblies require steel.
 - 4. Rigid conduit may be steel or aluminum at Contractor's option, except do not use aluminum conduit or aluminum products in cast-in-place concrete installations or where UL firestop assemblies require steel.
 - 5. Rigid PVC conduit may be used in lieu of rigid steel for conduits installed in poured concrete, underground or beneath slab-on-grade. Convert to metallic conduit at no more than 48" above ground or slab if concealed in wall; otherwise, convert to

metallic conduit before exiting ground or slab. Do not use PVC conduit above-grade unless specifically indicated otherwise.

6. Use PVC-coated rigid conduit and fittings in all highly corrosive atmospheres.
7. Use flexible conduit in movable partitions, from outlet boxes to recessed lighting fixtures, and in cells of precast concrete panels.
8. Use liquid-tight flexible conduit in exterior exposed locations; in moist or humid atmosphere where condensate can be expected to accumulate; in corrosive atmosphere; where subjected to water spray or dripping oil, water or grease; and for connection of motors, transformers and equipment subject to movement and vibration. Wherever liquid-tight flexible conduit is used, it may only be for the final 6 feet (maximum) of a connection to a motor, transformer or piece of equipment subject to movement or vibration.
9. Do not install any EMT conduit outside of the exterior walls within the exterior brick cavity. All EMT conduits shall be routed within exterior walls.

C. General:

1. Install conduits concealed in new construction work, either in walls, slabs or above hung ceiling, except in mechanical or electrical equipment rooms in which they may be exposed. Install conduits concealed in stairs, except in stairs without suspended ceilings a short horizontal section conduit to feed each light fixture mounted to underside of landing may be exposed. Run conduits concealed in existing work where practicable. Where conduits cannot be concealed in finished areas, notify the Architect for permission to use surface raceways. Where installed at roof decking, follow requirements of NEC 300.4(E).
2. Provide penetration firestopping in smoke barriers and fire-resistance-rated walls, floors and ceilings for electrical raceway penetrations in accordance with Division 7 and with requirements of this section.
3. Mechanically fasten together metal conduits, enclosures, and raceways for conductors to form continuous electrical conductor. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly.
4. Avoid use of dissimilar metals throughout systems to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.
5. Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install expansion/deflection fittings in raceways every 200' linear run or wherever structural expansion joints are crossed, per NEC 300.4(H).
6. Provide polypropylene or monofilament plastic or pull cord with not less than 200-lb tensile strength in empty conduits, tied off at both ends. Test conduits required to be installed, but left empty, with ball mandrel. Clear any conduit which rejects ball mandrel. Pay costs involved for restoration of conduit and surrounding surfaces to original condition.
7. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.
8. Use factory-made elbows or field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.

9. Size conduits to meet NEC, except no conduit smaller than 3/4 inch shall be used unless noted otherwise. Conduits below-grade and in-slab shall be minimum 3/4 inch.
10. Fasten conduit terminations in sheet metal enclosures by 2 locknuts and terminate with bushing. Install locknuts inside and outside enclosure.
11. Conduits shall not touch sprinkler pipes, or cross pipe shafts or ventilating duct openings.
12. Keep conduits a minimum distance of 6" from parallel runs of flues, hot water pipes and other sources of heat. Wherever possible, install raceway runs below hot water and steam piping where necessary to cross piping.
13. Use of running threads at conduit joints and terminations is prohibited. Where required, use 3-piece union or split coupling.
14. Complete installation of electrical raceways before starting installation of cables/wire within raceways.
15. Install conduits so as not to damage the integrity of the structural members. Avoid horizontal or cross runs in building partitions or side walls.
16. Install temporary closures to prevent foreign matter from entering raceways.
17. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
18. Provide bushings on all conduit stubs.

D. Concealed Conduits:

1. Metallic raceways installed underground, in floors, below-grade or outside shall have conduit threads painted with corrosion inhibiting compound before couplings are assembled. Draw up coupling and conduit sufficiently tight to ensure watertightness.
2. Install underground conduits minimum of 24" below finished grade, except where NEC or the Roanoke City requires deeper burial.
3. Mark Record Documents with conduit size and location.

E. Conduits in Concrete Slabs:

1. Install conduits in concrete slabs only under the following conditions:
 - a. In slab-on-grade.
 - b. In structural concrete deck.
 - c. In concrete-on-metal deck for short runs to isolated floor outlets.
2. Place conduits between bottom reinforcing steel and top reinforcing steel in middle 1/3 of slab thickness. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement. Separate conduits by not less than diameter of largest conduit to ensure proper concrete bond. Conduits crossing in slab must be reviewed for proper cover by Architect. Minimum finished cover of conduit in slabs shall not be less than one inch. Embedded conduit diameter is not to exceed 1/3 of slab thickness at cross-overs, if any. For locations where a large "swath" of conduits will be in or below slab, coordinate requirements with Structural Engineer before rough-in.
3. Mark Record Documents with conduit size and location.

F. Exposed Conduits:

1. Install exposed conduits and extensions from concealed conduit systems parallel with or at right angles to walls and floors of building. Conduits shall be run tight to the wall and ceiling or structure and as neatly and inconspicuously as possible. Contractor shall paint the entire raceway, fittings, etc. Color by Architect.
2. Exposed conduits may be used in finished spaces only when conduits cannot be concealed and surface raceway is not practical, and only with the specific approval of the Architect. The Contractor shall submit a detailed proposal for the area and the routing of the exposed conduit to the Architect before installation. Exposed conduits in finished areas shall be painted to match the surface on which they are installed.
3. Install exposed conduit work so as not to interfere with ceiling inserts, lights, ventilation ducts, HVAC unit clearances, or outlets.
4. Support exposed conduits by use of hangers, clamps, or clips. Support conduits on each side of bends and on spacing not to exceed the requirements of the NEC. Support multiple runs of conduit from trapeze hangers.
5. Set anchors in waterproof cement for the support of conduits where run on waterproof walls.
6. Above requirements for exposed conduits also apply to conduits installed in space above hung ceilings and in crawl spaces.

G. Non-metallic Conduits: Make solvent cemented joints in accordance with recommendations of manufacturer.

H. Conduit Fittings:

1. Use compression fitting only.
2. Bushings for terminating conduit smaller than 1-1/4" shall have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation.
3. Install insulated type bushings for terminating conduits 1-1/4" and larger. Bushings shall have flared bottom and ribbed sides. Upper edge shall have phenolic insulating ring molded into bushing.
4. Bushings of standard or insulated type shall have screw type grounding terminal where required by the NEC.
5. Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs shall be specifically designed for their particular application.
6. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with U.L. Listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - b. Where otherwise required by NFPA 70, such as in 225.27 and 300.5(G).

3.3 INSTALLATION OF WIREWAYS AND SURFACE METAL RACEWAYS

- A. Mechanically assemble metal enclosures and raceways for conductors to form continuous electrical conductor, and connect to electrical boxes, fittings and cabinets in order to provide effective electrical continuity and rigid mechanical assembly.
- B. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
- C. Install expansion fittings in all wireways and raceways wherever structural expansion joints are crossed.
- D. Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. No field bends of raceway sections will be permitted.
- E. Properly support and anchor raceways for their entire length by structural materials. Raceways shall not span any space unsupported.
- F. Use boxes as supplied by raceway manufacturer wherever junction, pull or devices boxes are required. Standard electrical "handy" boxes, etc. shall not be permitted for use with surface raceway installations.

3.4 INSTALLATION OF CABLE TRAYS

- A. Individual sections of cable trays shall be evenly aligned and secured together in a way to keep the hardware from damaging the jacket and conductors of the cable and to keep sections of cable trays from separating away from each other.
- B. Cable trays shall be supported uniformly from wall or structure overhead, capable of supporting the total weight of the cables and cable trays (approximately 40 to 50 pounds per foot) as detailed by the manufacturer of the cable tray.
- C. Cable trays shall be suspended above the drop ceiling and allow for the removal of acoustical ceiling tiles. Provide minimum 4" clearance above cable tray to piping, ductwork and other items to allow cables to be added to or removed from tray. Keep trays at least 6" away from lighting fixtures.
- D. The Contractor shall provide all materials, labor, and equipment and supervision necessary to install the cable trays of route and length as indicated on the contract drawings.
- E. Cable trays shall be run in a horizontal plane where possible. Provide all components and transition sections as required to offset cable trays horizontally and/or vertically to fully coordinate with all ceiling components.

- F. Provide penetration firestopping in smoke barriers and fire-resistance-rated walls, floors and ceilings for cable tray penetrations in accordance with Division 7 and this specification.
- G. Install expansion connectors where cable tray crosses building expansion joints and in cable tray runs that exceed 90 feet (27 m). Space connectors and set gaps according to NEMA VE 1.
- H. Ground cable trays according to manufacturer’s written instructions and referred to contract documents. (green insulated wire).
- I. Follow all requirements of NEC Article 392. Contractor shall refer to contract documents for other detail requirements for cable tray system.

3.5 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

- A. All wall-mounted wiring device boxes shall be mounted with long dimension vertically unless otherwise noted.
- B. Coordinate installation of electrical boxes and fittings with conductors/cable, wiring devices, raceway installation work, and equipment requiring electrical connections.
- C. Provide raintight outlets for interior and exterior locations exposed to weather or moisture.
- D. Provide surface mounted boxes only where recessed mounting is not possible.
- E. Provide knockout closures to cap unused knockout holes where blanks have been removed in new and existing boxes and fittings.
- F. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.
- G. Do not install boxes back-to-back in walls, unless “putty pads” are provided for sound attenuation. Back-to-back boxes may be used for switch outlets next to a cased wall opening (no door).
- H. Provide membrane protection for penetrations of fire rated walls as required by code:
 - 1. Provide not less than 24" separation between sides of boxes in opposite sides of fire rated walls, or
 - 2. Provide Wall Opening Protective Materials (fire putty sheet or similar code-compliant product such as FireBlock Fire Suppression Gasket) for outlet boxes in fire rated walls, or
 - 3. Provide solid fireblocking in accordance with code.

- I. Provide membrane protection for penetrations of fire rated ceilings as required by code:
 - 1. Provide Ceiling Opening Protective Materials (fire putty sheet) for outlet boxes in fire rated ceilings, or
 - 2. Provide solid fireblocking in accordance with code.
- J. Do not install aluminum products in concrete.
- K. Position recessed outlet boxes accurately in order that boxes will not be installed with front edge of box at a greater depth in wall than permitted by NEC. Provide extension rings for existing outlet boxes with new wall covering so face of box is flush with the finished wall surface and finished plate is tight to wall on all sides.
- L. Fasten electrical boxes firmly and rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Box support shall be independent of conduit.
- M. Subsequent to installation of boxes, protect boxes from construction debris and damage.

3.6 O&M MANUAL

- A. Provide O&M Manual as specified in specification section 260100. Include both a paper copy and digital pdf copy of the O&M Manual.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Extent of electrical identification work is as herein specified.
- B. Types of electrical identification work specified in this section include the following:
 - 1. Electrical power, control, fire alarm and communication conductors and/or conduits.
 - 2. Operational instructions and warnings.
 - 3. Danger signs.
 - 4. Equipment/system identification signs.

1.2 RELATED DOCUMENTS

- A. The Drawings and general provisions of the Contract, including the General and Supplementary Conditions, Instructions to Bidders and sections of Division 1, apply to the work specified in this section.

1.3 REFERENCES AND CODES

- A. Electrical Code Compliances: Comply with applicable requirements of the 2017 NFPA-70 (NEC) pertaining to installation of identifying labels and markers for wiring and equipment.
- B. U.L. Compliance: Comply with applicable requirements of UL Std. 969, "Marking and Labeling Systems", pertaining to electrical identification systems.
- C. NEMA Compliance: Comply with applicable requirements of NEMA Std. Nos. WC-1 and WC-2 pertaining to identification of power and control conductors.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams and the manuals, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before the installation of acoustical ceilings and similar concealment.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's data on electrical identification materials and products.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION MATERIALS

- A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Contractor's option, but provide single selection for each application.
- B. Color-Coded Conduit Markers: Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, plastic-sheet conduit markers, extending 360 degrees around conduits; designed for attachment to conduit by adhesives, adhesive lap joint or marker-matching adhesive plastic tape at each end of marker, or pre-tensioned snap-on. Except as otherwise indicated, provide lettering which indicates voltage of conductor(s) in conduit. Provide 8" minimum length for 2" and smaller conduit, 12" length for larger conduit. Unless otherwise indicated or required by governing regulations, provide white markers with black letters.
- C. Detectable Underground-Type Plastic Line Marker: Manufacturer's standard permanent, bright-colored, continuous-printed detectable plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried cable.
- D. Self-Adhesive Plastic Signs:
 - 1. General: Provide manufacturer's standard self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings, of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.
 - 2. Colors: Unless otherwise indicated, or required by governing regulations, provide black signs with white lettering. For Emergency provide Red face white cord

- E. Baked Enamel Danger Signs: Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20 gage steel with standard red, black and white graphics. Provide following minimum sizes: 20" x 14", 14" x 10", or 10" x 7", where signs are sized according to the largest size which can be applied where needed, or where a larger size is needed for adequate vision. Provide signs with recognized standard explanation wording, e.g., HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.
- F. Engraved Plastic-Laminate Signs:
 - 1. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thickness indicated, engraved with engraver's standard lettering style of sizes and wording indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate, and color codes as indicated below:
 - a. Normal Power Systems: Black face with White lettering.
 - b. Life Safety Power Systems: Yellow face with Black lettering.
 - c. Critical Power Systems: Orange face with White lettering.
 - d. Equipment Power Systems: Red face with White lettering.
 - 2. Thickness: 1/16", for units up to 20 sq. in. or 8" length; 1/8" for larger units.
 - 3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.2 LETTERING AND GRAPHICS

- A. Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operations/maintenance of electrical systems and equipment.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install electrical identification products as specified in accordance with the manufacturer's written instructions and the requirements of the NEC.
- B. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of finish work.
- C. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

- D. Identification: Coordinate all room number designations with the final room numbers. Use final room numbers for all final documentation and display, including but not limited to, programming, alarm displays, annunciator displays, panelboard schedules, signage, labels and engraved labels. The room numbers shall be as directed by the Owner and may not be the same as shown on Contract Drawings. Include final room numbers on the drawings for the Record Documents.

3.2 CONDUIT IDENTIFICATION

- A. Where conduit is concealed above accessible ceilings or exposed, apply color-coded identification at equipment termination, at outlet boxes, pull boxes and junction boxes, within each room, and at 20' on-center within an area.
 - 1. Color-code conduit using plastic tape with the following band colors between orange background bands.

SERVICE	COLOR BAND
240 or 208/120 Volt Normal Circuits	Black
240 or 208/120 Volt Life Safety Emergency Circuits	Black/Yellow
240 or 208/120 Volt Critical Emergency Circuits	Black/Orange
240 or 208/120 Volt Equipment Emergency Circuits	Black/Red
480/277 Volt Circuits	Blue
480/277 Volt Life Safety Emergency Circuits	Blue/Yellow
480/277 Volt Critical Emergency Circuits	Blue/Orange
480/277 Volt Equipment Emergency Circuits	Blue/Red
Grounding Electrode	Green
Fire Alarm	Red]
Security	White/Red

- 2. Fire Alarm conduit shall be red in color.

3.3 UNDERGROUND CABLE IDENTIFICATION

- A. During backfilling/top-soiling of each exterior underground electrical, signal or communication cable, install a continuous detectable underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker. Limit use of line markers to direct-burial cables.

3.4 CONDUCTOR/CABLE COLOR CODING

- A. See Division 26 for color-coding of line voltage conductors and cables. Provide means of identification per NEC 200.6(D).

3.5 IDENTIFICATION OF UNGROUNDED CONDUCTORS

- A. Where more than one nominal voltage system exists in a building, each ungrounded conductor of a multi-wire branch circuit, where accessible, shall be identified by phase and system. This means of identification shall be permitted to be by separate color coding, marking tape, tagging, or other approved means and shall be permanently posted at each panelboard and switchboard or readily available in accordance with NEC 210.5.

3.6 OPERATIONAL IDENTIFICATION AND WARNINGS

- A. Operational Identification and Warnings: Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets, and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

3.7 DANGER SIGNS

- A. General: In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations identified by Installer of electrical work as constituting similar dangers for persons in or about project.
- B. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110-120 volts.

3.8 EQUIPMENT/SYSTEM IDENTIFICATION

- A. Signs: Install engraved plastic-laminate sign on outside of each major unit of electrical equipment in building, including central or master unit of each electrical system, including communication/control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Provide three (3) lines of text, with 1/2" high lettering for first line and 1/4" high lettering for other lines; first line of text shall indicate name of unit, second line of text shall indicate voltage and phase and number of wires, and third line of text shall indicate origin of feeder. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
 - 1. Panelboards, control panels, relay panels, electrical cabinets, and enclosures.
 - 2. Access panel/doors for concealed electrical items.

3. Major electrical switchgear and switchboards (including individual breakers, i.e. main breakers, sub-breakers, etc.).
 4. Automatic transfer switches.
 5. Transformers.
 6. Push-button stations.
 7. Power generating units.
- B. Provide identification, labeling and signs for emergency and standby systems as required by 700.7, 700.10, 701.7 and 702.7 of NEC.
- C. Install signs at locations indicated and, where not otherwise indicated, at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- D. Provide labeling in accordance with all requirements in NEC 110.21 and 110.22.
- E. Provide enclosure type labeling as required in NEC 110.28.
- F. Provide labeling on all wiring devices (receptacles and lighting controls) with the panel and circuit number feeding them. Place the label on the cover plate. For all floor boxes, locate the label within the floor box next to the device, do not install on the top of the coverplate, they will get worn off.
- 3.9 O&M MANUAL
- A. Provide O&M Manual as specified in specification section 260100. Include both a paper copy and digital pdf copy of the O&M Manual.

END OF SECTION 260553

SECTION 260583 - WIRING CONNECTIONS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the basic requirements of electrical connections for equipment specified in Divisions associated with this scope of work sections and Division 26, 27 and 28 sections making reference to electrical connections for equipment specified herein.
- B. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

1.2 RELATED DOCUMENTS

- A. The Drawings and general provisions of the Contract, including the General and Supplementary Conditions, Instructions to Bidders and sections of Division 1, apply to the work specified in this section.

1.3 REFERENCES AND CODES

- A. Refer to other Division 26 sections for motor starters, controllers and disconnects not furnished as integral part of equipment.
- B. Refer to sections of other Divisions for motor starters, controllers, VFD's and disconnects furnished integrally with equipment and for specific individual equipment power requirements.
- C. Refer to other Division 26 sections for junction boxes, raceways and conductors/cables required for connecting motors and other electrical units of equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Refer to other Division 26 sections for manufacturers of electrical connection products.

2.2 MATERIALS AND COMPONENTS

- A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, junction boxes, raceways, conductors/cables, disconnect switches, starters, controllers, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wirenuts, and other items and accessories as needed to complete splices, terminations, and connections.
- B. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals as recommended by equipment manufacturer for intended applications.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. Connect electrical power supply conductors to equipment conductors or terminals in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- B. Cover splices with electrical insulating material equivalent to or greater than electrical insulation rating of those conductors being spliced.
- C. Prepare cables and conductors by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" conductors while stripping wire.
- D. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
- E. Tighten connectors and terminals, including screws and bolts, in accordance with the equipment manufacturer's published torque tightening values for equipment connectors.

- F. Fasten identification markers to each electrical power supply conductor/cable conductor which indicates their voltage, phase and feeder number in accordance with Division 26. Affix markers on each terminal conductor, as close as possible to the point of connection.

3.3 CONNECTIONS TO EQUIPMENT

- A. Final electrical connections to equipment furnished under other sections of these specifications or specified to be furnished by the Owner shall be provided as required for the individual item of equipment. Provide the conduit, outlet boxes, and power wiring from the power source to the motor or equipment junction box, wiring devices, transformers, relays, starters, VFD's, disconnect switches or circuit breakers, including wiring through starters, VFD's or safety switches, in accordance with the manufacturer's installation instructions. The presumed location of all presently envisioned equipment having electrical connections is shown or scheduled, but these locations are for estimating purposes only and the contractor shall prepare the bid to allow for any possible rearrangement of the equipment listed or as shown or scheduled. Prior to roughing in conduit, receptacles, or other outlets or equipment, verify the locations and characteristics of equipment and verify heights and locations of required connections from an approved shop drawing or roughing-in drawing. Use roughing-in dimensions of electrically operated units furnished by the supplier.
- B. Mechanical and Plumbing Equipment: See Divisions 21, 22 and 23 for any type or item of equipment requiring electrical connections. Provide all power wiring and control wiring of 110 volts and greater for controlling all equipment as described therein even though control wiring may not be shown on Electrical Drawings. See Mechanical Drawings for exact locations of equipment and Mechanical Specifications for control of equipment.

3.4 FIELD QUALITY CONTROL

- A. Final connections and proper operation of equipment connected under this contract shall be supervised by the equipment supplier. This Contractor shall certify in writing to the Architect that the connected equipment is properly connected and the equipment is operating properly in accordance with these contract specifications, the equipment manufacturer's wiring diagrams, and instructions of the equipment supplier or manufacturer.

END OF SECTION 260583

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SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of the low-voltage distribution transformers as indicated by drawings and schedules and as specified herein.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Instructions to Bidders and sections of Division 1, apply to the work specified in this section.

1.3 REFERENCES AND CODES

- A. Electrical Code Compliances: Comply with applicable requirements of the 2017 NFPA-70 (NEC) pertaining to low-voltage distribution transformers.
- B. NFPA Compliance: Comply with applicable requirements of NFPA 70E, "Standard for Electrical Safety Requirements for Employee Workplaces."
- C. NEMA Compliance: Comply with applicable portions of NEMA St. 1 and St. 20.
- D. ANSI Compliance: Comply with applicable requirements of ANSI Standards C57-Series pertaining to power/distribution transformers.
- E. NETA Compliance: Comply with ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment.
- F. U.L. Compliance: Comply with applicable requirements of ANSI/UL 506 and 1561.
- G. IEEE Compliance: 519

1.4 SUBMITTALS

- A. Submit manufacturer's technical product data including dimensions, wiring and connection diagrams, rated KVA, frequency, primary and secondary voltages, percent taps, polarity, X/R ratio and impedance. Furnish factory certification for each size transformer to be installed of the following:

1. Transformer performance efficiency at indicated loads
2. Percentage regulation at 100% and 80% power factor
3. No-load and full-load losses in watts
4. Percent impedance at 75 degrees C
5. Hot-spot and average temperature rise above 40 Deg. C ambient temperature
6. Sound level in decibels, including standard and low noise transformers

PART 2 - PRODUCT

2.1 MANUFACTURERS

- A. Transformers shall be manufactured by one of the following:
1. Square D/ Schneider Electric
 2. Eaton Corporation/Cutler-Hammer.
 3. Siemens Energy & Automation, Inc.
 4. Square D/Schneider Electric.

2.2 TRANSFORMERS

- A. General Distribution Dry Type: Provide factory-assembled, general-purpose, dry-type distribution transformers; of sizes, characteristics, and rated capacities indicated. Provide terminal board with crimp type connectors. Limit terminal compartment temperature to 75 degrees C when transformer is operating continuously at rated load with ambient temperature of 40 degrees C. Windings shall be copper. Provide wiring connections suitable for copper. Integrally mount vibration isolation supports between core and coil assembly and transformer enclosure; electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap. Do not exceed maximum sound-level ratings as determined in accordance with ANSI/NEMA standards. Provide transformers with fully-enclosed sheet steel enclosures and lifting lugs. Coat interior and exterior surfaces of transformer, including bolted joints, with manufacturer's standard color baked-on enamel. Efficiency shall meet US Department of Energy (DOE) 10 CRF 431.
- B. K-Factor Rated Dry Type Transformers: Transformers indicated to have 'K' factor ratings shall comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor. Windings shall be [aluminum] [copper]. Insulate with Class 220 insulation and limit temperature rise to 115 degrees C when operating in an ambient temperature of 40 degrees C. Efficiency shall meet DOE 10 CRF 431.
1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 2. Indicate value of K-factor on transformer nameplate.

3. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
 - a. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 - b. Include special terminal for grounding the shield.
 - c. Shield Effectiveness: Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1MHz. Common-Mode Noise Attenuation: Minus 120 dBA minimum at 0.5 to 1.5 kHz; minus 65 dBA minimum at 1.5 to 100 kHz. Normal-Mode Noise Attenuation: Minus 52 dBA minimum at 1.5 to 10 kHz.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide a concrete pad for each floor-mounted transformer that is 4" high and 4" larger than the respective transformer on all sides. Install each transformer on 1/2" thick rubber isolation pads between transformer and concrete pad. Transformers shall have minimum 6" clearance on back and sides and the NEC 110.26 required clearance on the front.
- B. Install wall-mounted transformers level and plumb with 1/4" thick rubber washers at each mounting bolt between transformer and wall or mounting frame. Provide wall mounted bracket from the same manufacturer as the transformer.
- C. Install pendant-mounted transformers level and plumb from anti-vibration hangers by Amber/Booth or Kinetics. Provide pendant mounted bracket from the same manufacturer as the transformer.
- D. Connect dry-type transformers to wiring system with liquid-tight flexible metal conduit in lengths not exceeding 6 feet.
- E. Provide equipment identification name plates complying with Division 26 for identification for electrical systems.

3.2 CLEANING

- A. Prior to energization:
 1. Upon completion of installation, inspect interior and exterior of transformer.
 2. Remove paint splatters and other spots inside and outside of the transformer enclosure. Repair exposed surfaces to match original finish.
 3. Remove all wrenches, packing materials, and construction debris from inside the transformer.

4. Use vacuum (with non-metallic attachments) to collect loose dust, dirt, and particles from inside the transformer enclosure and around the exterior of the transformer enclosure.
5. Do not use compressed air to assist in cleaning. Using compressed air is likely to spread contamination and damage insulation.
6. Accumulated dirt, oil, or grease might require a solvent to be removed. Solvents used for cleaning of electrical equipment shall be selected carefully to ensure compatibility with materials being cleaned. Do not use any liquid cleaners, include spray cleaners, unless specified by the transformer manufacturer, because of the risk of residues causing damage, interfering with electrical or mechanical functions, or compromising the integrity of the insulation surfaces. Allow sufficient time for drying after cleaning transformer with solvents. Wear the required PPE when working with potential hazardous solvents; refer to solvent material data sheets.

3.3 FIELD QUALITY CONTROL

A. Prior to energization:

1. Prior to energization of transformer, check all accessible connections to manufacturer's tightening torque specifications.
2. Prior to energization of transformer, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
3. Prior to energization of transformer, check for electrical continuity of circuits and for short-circuits.

B. Certification: This Contractor shall certify in writing to the Architect that the above checks were made, including date of the checks and results.

C. Upon completion of installation, energize transformer and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at project site, then retest to demonstrate compliance, otherwise remove and replace with new units and retest.

END OF SECTION 262213

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation and connection of the panelboards. Extent of panelboard work is indicated by drawings and schedules and as specified herein.

1.2 RELATED DOCUMENTS

- A. The Drawings and general provisions of the Contract, including the General and Supplementary Conditions, Instructions to Bidders and sections of Division 1, apply to the work specified in this section.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Refer to Division 26 for requirements of panelboards used as service entrance equipment.

1.4 REFERENCES AND CODES

- A. Electrical Code Compliances: Comply with applicable requirements of the 2017 NFPA-70 (NEC) pertaining to installation, and construction of electrical panelboards and enclosures.
- B. NFPA Compliance: Comply with applicable requirements of NFPA 70E, "Standard for Electrical Safety Requirements for Employee Workplaces."
- C. U.L Compliance: Comply with applicable requirements of UL 67, "Electrical Panelboards," and UL's 50, 869, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures. Provide units which are U.L. Listed and labeled.
- D. NEMA Compliance: Comply with NEMA Stds. Pub. No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)," Pub. No. PB 1, "Panelboards," and Pub. No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's data on panelboards.

- B. Shop Drawings: Submit manufacturer's drawings indicating the following:
1. Dimensional data, including gutter dimensions.
 2. Circuit protective device schedule indicating type, frame, trip, interrupting rating; circuit numbering and arrangement to match that indicated on contract drawings as much as possible.
 3. Bus rating and bracing.
 4. Lug location and capacity.
 5. Provisions for future, breakers or switches.
 6. Caution Label in Panelboards [and Load Centers] with Ground Fault and/or Arc Fault circuit breakers to read “DO NOT INSTALL SHARED NEUTRALS ON GROUND FAULT OR ARC FAULT CIRCUIT BREAKERS”.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with all requirements, panelboards shall be manufactured by one of the following:
1. Square D / Schneider Electric
 2. Eaton Corporation/Cutler-Hammer.
 3. Siemens Energy & Automation, Inc.
 4. Square D/Schneider Electric.

2.2 PANELBOARDS

- A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; designed and constructed in accordance with published product information; equipped with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated. Panelboards and circuit protective devices shall be marked to indicate that terminal provisions are based on the use of 75 degrees C rated, insulated conductors for all terminations.
- B. Panelboards: Provide dead-front safety type panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-turn solderless mechanical type lug connectors suitable for copper conductors. Provide copper phase bus bars and full-sized neutral bus bars, unless noted otherwise. Ground bus bars shall be un-insulated and bolted to the inside of the enclosure. All bus bars (phase, neutral and ground) shall be of the same material. Only a single neutral or ground conductor is permitted to be connected to a lug screw in the respective neutral or ground bus bar within

a panelboard. Provide additional or larger capacity neutral or ground bus bars for each panelboard where indicated. Provide spaces with all studs, bussing, and hardware for future circuit breakers without the necessity of installing additional parts or changing bussing.

- C. Panelboard Enclosures: Unless noted otherwise, provide galvanized sheet steel cabinet type enclosures, code-gauge, minimum 16-gauge thickness, minimum size 5-3/4" deep x 20" wide. Construct with multiple knockouts and wiring gutters. Provide front with hinged trim constructed of piano hinge down one side and adjustable trim clamps. Front shall have an integral door with keyed flush lock/latch and concealed hinges to provide access to the dead front portion of the circuit breakers and screws to release entire trim. Removing screws shall allow entire front to open along with integral door to provide full access to all wiring gutters without removing front. All panelboard enclosures shall be keyed alike. Equip with interior circuit-directory frames and cards with clear plastic covering. Fronts for flush mounted panelboards shall overlap cabinet by 3/4" all around; fronts for surface mounted panels shall be the same size as the cabinet. Provide baked gray enamel finish over rust inhibitor covering, except panels in all finished areas shall have a prime finish, ready for paint finish to match adjacent surface. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate properly with panelboards to be enclosed.
- D. Circuit Protective Devices:
1. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
 - a. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 - a. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
- E. Short Circuit Current Ratings: This Contractor shall contact the local utility company to determine the available fault current at the pad mounted transformer. Utilize components which are individually rated not less than the short circuit current rating as determined from data received from the local utility company and from the short circuit/coordination study. Series rating is not acceptable. Short circuit current rating shall be as required above and shall be a minimum of 10,000 amps on 208/120 or 240 panels and 14,000 amps on 480/277 panels unless noted otherwise.

- F. Circuit Breaker Lock: Provide approved circuit breaker lock-on device for the following equipment:
 - 1. All Fire Alarm System equipment, including but not limited to Fire Alarm Control Panel and remote (NAC) panels. Breakers shall be red and identified as “FIRE ALARM CIRCUIT”. FM-200 SYSTEM
 - 2. Sprinkler System: Dry-pipe air compressor.
 - 3. Exit signs.
 - 4. Egress lighting fixtures.
 - 5. Other equipment as shown on the Drawings or as required.

- G. Panelboard Surge Protective Device (SPD): See specification section 26 43 13 SURGE PROTECTIVE DEVICES (SPD) for SPD requirements.

PART 3 – EXECUTION

3.1 INSTALLATION OF PANELBOARDS

- A. Coordinate installation of panelboards and enclosures with cable and raceway installation work.
- B. Provide double neutral conductors for panelboards where indicated on the drawings.
- C. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure and plumb. Mount recessed panelboards with front uniformly flush with wall finish.
- D. Provide properly wired electrical connections within enclosures.
- E. Type panelboard's circuit directory card upon completion of installation work. Indicate panel designation, phase, voltage, and (for each circuit) type of load and location on the directory. Use Owner's room numbers, not those on the construction documents.
- F. Install fuses, of ratings indicated, in fusible panelboards.
- G. Unless noted otherwise on the drawings [or in the coordination study], all adjustable trip breakers shall have their long-time pick-up set to 100%. For breakers that have long-time pick-up set to less than 100%, provide label indicating what the setting is and that the wiring has been sized for this; also provide restricted access per NEC 240.6(C). A factory-authorized representative shall perform field adjustment of protective devices as required to place the equipment in final operating condition. Contractor shall notify Design Engineer once all breakers have been adjusted for field verification approval.
- H. Install filler plates in unused, open circuit breaker spaces.

- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- J. Apply sealant around all exterior mounted panelboards to provide weatherproofing and pest control; refer to sections of Division 7.
- K. Provide equipment/system identification nameplates complying with Division 26 in accordance with panelboard schedules on drawings. Inside each panelboard, the voltage, system, amperage and AIC ratings must be clearly labeled.
- L. Provide field marking to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing or maintenance of the equipment. Provide arc flash warning label [made of high performance polyester, 3-1/2”H X 5”W, Brady Cat. No. 94913 or approved equal] [per the arc flash hazard analysis]. [A warning label is not required for loadcenters in dwelling units.]

3.2 ADJUSTING AND CLEANING

- A. Adjust operating mechanisms for free mechanical movement.
- B. Prior to energization:
 - 1. Upon completion of installation, inspect interior and exterior of panelboard.
 - 2. Remove paint splatters and other spots inside and outside of the panelboard enclosure. Repair exposed surfaces to match original finish.
 - 3. Remove all wrenches, packing materials, and construction debris from inside the panelboard.
 - 4. Use vacuum (with non-metallic attachments) to collect loose dust, dirt, and particles from inside the panelboard enclosure and around the exterior of the panelboard enclosure.
 - 5. Do not use compressed air to assist in cleaning. Using compressed air is likely to spread contamination and damage insulation.
 - 6. Accumulated dirt, oil, or grease might require a solvent to be removed. Solvents used for cleaning of electrical equipment shall be selected carefully to ensure compatibility with materials being cleaned. Do not use any liquid cleaners, include spray cleaners, unless specified by the panelboard manufacturer, because of the risk of residues causing damage, interfering with electrical or mechanical functions, or compromising the integrity of the insulation surfaces. Allow sufficient time for drying after cleaning panelboard with solvents. Wear the required PPE when working with potential hazardous solvents; refer to solvent material data sheets.

3.3 FIELD QUALITY CONTROL

- A. Prior to energization:
 - 1. Prior to energization of panelboard, check all accessible connections to manufacturer's tightening torque specifications.
 - 2. Prior to energization of panelboard, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
 - 3. Prior to energization of panelboard, check for electrical continuity of circuits and for short-circuits.

- B. Certification: This Contractor shall certify in writing to the Architect that the above checks were made, including date of the checks and results.

- C. Upon completion of installation, energize panelboard and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at project site, then retest to demonstrate compliance, otherwise remove and replace with new units and retest.

END OF SECTION 262416

SECTION 264313 - SURGE PROTECTIVE DEVICES (SPD)

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section specifies the requirements of surge protection devices (SPD) for low voltage power systems. SPDs intended for Service Entrance equipment installation shall apply to IEEE C62.41, Category C3 waveforms. Extent of surge protective devices work is indicated by drawings and as specified herein.

1.2 RELATED DOCUMENTS

- A. The Drawings and general provisions of the Contract, including the General and Supplementary Conditions, Instructions to Bidders and sections of Division 1, apply to the work specified in this section.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Refer to other Division 26 sections for conductors/cables, electrical raceways, boxes and fittings which are required in conjunction with installation of SPD units.

1.4 REFERENCES AND CODES

- A. Source Limitations: Obtain surge protective devices and accessories through one source from a single manufacturer.
- B. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100 by a testing agency acceptable to authorities having jurisdiction and marked for the intended use.
- C. Comply with applicable requirements of the 2017 NFPA-70 (NEC), Article 285 pertaining to surge protective devices.
- D. Comply with applicable requirements of the 2017 NFPA-780 – Standards for the Installation of Lightning Protection Systems, Section 4.20 pertaining to surge protective devices.
- E. NFPA Compliance: Comply with applicable requirements of NFPA 70E, "Standard for Electrical Safety Requirements for Employee Workplaces."

- F. Comply with IEEE C62.41, "IEEE Guide for surge voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."
- G. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449 4th Edition, "UL Standard for Surge Protective Devices."

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated, include physical characteristics, rated capacities, peak-surge current ratings per mode and per phase, operating characteristics, MCOV and any furnished specialties and accessories.
- B. Product Certificates: Certificate from manufacturer certifying products furnished comply with UL 1283 and UL 1449 listing and classification.
- C. Furnish independent certified test reports.
- D. Furnish operational and maintenance data.

1.6 SURGE PROTECTIVE DEVICE LOCATIONS

- A. Provide surge protective devices within Distribution panel "EHVDC-2A"

1.7 MANUFACTURER QUALIFICATIONS

- A. All surge protective devices shall be manufactured by an ISO 9001-2001 certified company normally engaged in the design, development, and manufacture of such equipment. The certified company shall have been engaged in the commercial design and manufacture of SPD units for a minimum of ten (10) years. The manufacturer shall be represented by a firm that is located within 250 miles of the jobsite and has represented the manufacturer of the SPD units for a minimum of five (5) years.
- B. The surge protective device manufacturer shall provide unlimited free replacement of the entire SPD for all inoperable SPD units during the warranty period.

1.8 WARRANTY

- A. The manufacturer of the SPD units shall provide a ten year limited warranty from the date of substantial completion against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation, and maintenance instructions. The warranty shall cover events that damaged the SPD, when

they should not have damaged it. The warranty shall cover all parts, labor, and material to return the unit to serviceable condition. A factory trained local representative located within 250 miles of the jobsite shall provide on-site labor and system testing, if required, during the warranty period. The local representative shall own and operate test equipment capable of determining the clamping voltages of the systems provided on the project as well as ground measurement test equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Square D; Schneider Electric.
 2. DITECK Surge Protection
 3. General Electric Co.
 4. Cutler-Hammer, Inc.; Eaton Corporation.
 5. Current Technology, Inc.
 6. Liebert Corporation; a division of Emerson.

2.2 SURGE PROTECTIVE DEVICES

- A. Integral Surge Protection Device with the following features and accessories or as noted on contract documents.
1. 20kA nominal discharge current.
 2. 100kA short circuit current rating (SCCR).
 3. AC Sine wave True Tracking Filter with EMI/RFI Filtering.
 4. Phase Loss Monitoring with visual status indicators.
 5. Thermal protective MOVs.
 6. Audible Alarm, Silencing Switch and Form C Dry Contacts.
 7. 10 Protection Modes: (3) line-to-line (L-L), (3) line-to-neutral (L-N), (3) line-to-ground (L-G), and neutral-to-ground (N-G).
 8. Surge Counter with reset button.
 9. Fuses rated at 200-kA interrupting capacity.
 10. Nominal Discharge Current and Measured Limiting Voltage Tests.
 11. Connection Means: Permanently wired.

B. Required Ratings:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
CATEGORY	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, Main Entrance)	300 kA	150 kA
B	Exterior Locations, Distribution Panelboards, MCCs, Large Mechanical Equipment Panelboards, Panelboards Serving Exterior Equipment	200 kA	100 kA
A	Branch Locations (Panelboards, Busway)	100 kA	50 kA

C. 2017 NFPA 780 Table 4.20.4 Maximum Allowed Voltage Protection Rating (VPR) of Mode of Protection Provided for Different Power Distribution Systems to Which SPD Can Be Connected. The maximum VPR for the device shall not exceed the following:

MODES	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700V	1200V	1800V
L-L	1200V	1800V	4000V

D. The listed Maximum Continuous Operating Voltage (MCOV) must be a tested value (minimum 115% of nominal for 480Y/277V, and minimum 125% of nominal for 208Y/120V).

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Surge protective device units shall be installed in strict accordance with the manufacturer’s recommendations.
- B. Electrical Service, Distribution Panels and Panelboards:
 - 1. Provide SPD units at each building service entrance switchgear or switchboards and at other primary or secondary panelboard locations as indicated on the drawings or schedules. When provided, the SPD units shall be located integrally Distribution panel being protected.
 - 2. SPD units (except those in switchboards) shall be served with a dedicated 3-pole 60-amp circuit breaker in the gear being served and (5) #6 AWG minimum stranded low impedance connection cable to the breaker, unless the manufacturer recommends differently. The conductors serving SPD units shall be twisted together to reduce the SPD system input impedance, and shall be kept at the minimum length. SPD units shall be installed in strict accordance with the manufacturer’s recommended

practices and in compliance with NEC requirements. Measured impedance shall not be higher than 5 ohms on the ground for the service entrance SPD device. Where external, close nipple the SPD to the respective gear being protected.

3.2 GROUNDING CONNECTORS

- A. Connectors, splicers, and other fittings used to interconnect ground conductors, bond to equipment or grounding bars, shall be in accordance with NEC and U.L. requirements.
- B. All connectors and fittings shall be of the press crimp or compression set screw type.
- C. Special treatment to fittings, lugs, or other connectors of dissimilar material shall be applied to prevent electro-galvanic action.

3.3 FINAL INSPECTION

- A. Each SPD installation shall be inspected by a licensed electrician to verify proper installation and operation in accordance with all applicable codes. Any deficiencies shall be corrected by the contractor. Provide written documentation of this inspection as part of the closeout documents/manual.

3.4 PLACING SYSTEM INTO SERVICE

- A. Do not energize or connect [service entrance equipment,] [panelboards,] [control terminals,] or [data terminals] to their sources until surge protective devices are installed and connected.

END OF SECTION 264313

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APPENDIX - A

**OWNER FURNISHED ITEMS AND INSTALLATION
RESPONSIBILITIES**

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APPENDIX - A

OWNER FURNISHED ITEMS AND INSTALLATION RESPONSIBILITIES

The following is a consolidated list of equipment that will be furnished directly by the Owner for use on the Roanoke City Public Schools Administration Building on Campbell Avenue - Phase One (Data Center) Project. Cost for purchase of this equipment shall not be included in the Contractor's Base Bid.

Parties responsible for installation varies per item and is listed below. OFCI refers to Owner Furnished Contractor Installed items, OFVI refers to Owner Furnished Vendor Installed items. Contractor shall coordinate its efforts and schedule with that of applicable installers as to not unnecessarily delay the project. Contractor shall refer to the Drawings and Specifications for additional work related to these items that shall be included in Contractor's Base Bid. Refer to "Section 011000 Summary" for additional information related to OFCI and OFVI items.

Applicable products include but may not be limited to:

Materials Lift - OFVI

Manufacturer: PFlow Industries

Model: Series 21 Hydraulic Materials Lift

Quantity: 1

Installer: TK Elevator Corporation

Generator and Enclosure - OFVI

Manufacturer: KOHLER Power Systems

Model: 350REZXD – with sound attenuated outdoor weather housing

Quantity: 1 Generator (1) Enclosure

Installer: Fidelity Power Systems

Automatic Transfer Switch (ATS-EHVMEZZ-1A) - OFCI

Manufacturer: ASCO

Model: 7000 SERIES – 800A, 3 Phase, 4 wire, 600V - Opening transition

Quantity: 1

Installer: General Contractor

Automatic Transfer Switch (ATS-EHVDC-2A) - OFCI

Manufacturer: ASCO

Model: 7000 SERIES – 400A, 3 Phase, 4 wire, 600V - Opening transition

Quantity: 1

Installer: General Contractor

Manual Transfer Switch (ATS-GEN) - OFCI

Manufacturer: PSI Control Solutions, Inc.

Model: 3WMTS-800-B-N3R-3P-4W – 600V, NEMA 3R

Quantity: 1

Installer: General Contractor

Indoor CRAC Units - OFCI

Manufacturer: Trane

Model: TR-CFU-070

Quantity: 2

Installer: General Contractor

Outdoor CRAC UNITS - OFCI

Manufacturer: Trane

Model: RT-SCS-312

Quantity: 2

Installer: General Contractor

Data / UPS Racks (Including switches, cabling, equipment and devices within racks) – both OFCI / OFVI

Manufacturer: Varies

Model: Varies

Quantity: Varies

Installer: General Contractor is responsible for setting rack enclosures, providing power, and grounding requirements. RCPS IT Department will install equipment and make connections within the racks.

(See Electrical Drawings for additional information, Consult w/ Owner's IT Representative for questions)

APPENDIX - B

HAZARDOUS MATERIALS REPORT

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ROCKBRIDGE ENVIRONMENTAL
CONSULTING, INC.

Mr. Jeff Shawver
Chief of Physical Plants
Roanoke City Schools
3601 Ferncliff Avenue
Roanoke, VA 24017

May 27, 2022

Mr. Shawver,

This letter shall serve as the Certification of Completion for the limited Asbestos sampling for the scheduled renovation of the New Data Center located in the Admin Center on Campbell Avenue, formerly known as the Roanoke Times Building in Roanoke, Virginia.

Bulk samples were forwarded to San Air Technologies in Powhatan, Virginia, and were further divided to meet laboratory regulatory compliance and analyzed via Polarized Light Microscopy using the EPA Interim Method for the Determination of Asbestos in Bulk Samples (EPA-600/R-93/116).

This testing identified ACM that was generally accessible through non-destructive methods. If any additional materials not identified in this report are discovered during renovation/demolition, they should be assumed to contain asbestos until sampling proves otherwise. Please see the attached detailed Chain Of Custody supplied to San Air and subsequent results for materials sampled, descriptions, and sample locations.

VA DPOR defines Asbestos-Containing Materials (ACM) as materials containing more than 1% asbestos. OSHA Regulations apply to material containing any percentage of asbestos. The following materials tested positive:

- **Fire Doors - Friable, the damaged 3F fire door tested positive for 65% chrysotile asbestos.**

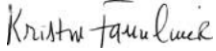
The following previously identified asbestos containing materials may have impact on the New Data Center Renovation Project as outlined by RRMM Architects, PC:

- **Intact HVAC duct insulation**
- **Thermal System Insulation, mudded joint plaster and straight run pipe insulations on drain and supply pipe, domestic service, conditioned system & storm drain**

- **Vinyl composite floor tiles and mastic sampled and identified in the 3F telephone switch room**
- **Transite Cementitious Panels, structured wall, cementitious sheets**

We recommend removal of these materials where slated for renovation or demolition in order to prevent them from releasing asbestos fibers. Qualified personnel should complete all removal, decontamination, and transportation of asbestos containing materials and asbestos contaminated materials. An Asbestos Abatement Project Design is recommended to outline the removal of ACM prior to the renovation/demolition phase. Asbestos Project Monitoring and Final Clearance Air sampling should be conducted for the work areas.

Respectfully,



Kristin Famuliner

Senior Biologist

VA Asbestos Inspector # 3303 002602

VA Asbestos Project Designer # 3305 000989

VA Asbestos Project Monitor # 3309 001040

VA Asbestos Management Planner # 3304 001422



The Identification Specialists

Analysis Report
prepared for
Rockbridge Environmental Consulting, Inc.

Report Date: 5/26/2022

Project Name: RCPS New Data Center

SanAir ID#: 22025581



NVLAP LAB CODE 200870-0

10501 Trade Court | North Chesterfield, Virginia 23236
888.895.1177 | 804.897.1177 | fax: 804.897.0070 | IAQ@SanAir.com | SanAir.com



SanAir ID Number

22025581

FINAL REPORT

5/26/2022 4:26:50 PM

Name: Rockbridge Environmental Consulting, Inc.
Address: 22 S Main St
Suite B01
Lexington, VA 24450
Phone: 540-463-3336

Project Number:
P.O. Number:
Project Name: RCPS New Data Center
Collected Date: 5/23/2022
Received Date: 5/25/2022 10:10:00 AM

Dear CF & TF,

We at SanAir would like to thank you for the work you recently submitted. The 19 sample(s) were received on Wednesday, May 25, 2022 via UPS. The final report(s) is enclosed for the following sample(s): DC-1, DC-2, DC-3, DC-4, DC-5, DC-6, DC-7, DC-8, DC-9, DC-10, DC-11, DC-12, DC-13, DC-14, DC-15, DC-16, DC-17, DC-18, DC-19.

These results only pertain to this job and should not be used in the interpretation of any other job. This report is only complete in its entirety. Refer to the listing below of the pages included in a complete final report.

Sincerely,

A handwritten signature in cursive script that reads "Sandra Sobrino".

Sandra Sobrino
Asbestos & Materials Laboratory Manager
SanAir Technologies Laboratory

Final Report Includes:

- Cover Letter
- Analysis Pages
- Disclaimers and Additional Information

Sample conditions:

- 19 samples in Good condition.



SanAir ID Number
22025581
 FINAL REPORT
 5/26/2022 4:26:50 PM

Name: Rockbridge Environmental Consulting, Inc.
Address: 22 S Main St
 Suite B01
 Lexington, VA 24450
Phone: 540-463-3336

Project Number:
P.O. Number:
Project Name: RCPS New Data Center
Collected Date: 5/23/2022
Received Date: 5/25/2022 10:10:00 AM

Analyst: Drakes, Renaldo

Asbestos Bulk PLM EPA 600/R-93/116

SanAir ID / Description	Stereoscopic		Components		Asbestos Fibers
	Appearance	% Fibrous	% Non-fibrous		
DC-1 / 22025581-001 Penthouse Mechanical Area, Ceiling Plaster	White Non-Fibrous Homogeneous		100% Other		None Detected
DC-2 / 22025581-002 1x1 ACT, 2F Data Center, Painted	Grey Fibrous Homogeneous	65% Glass	35% Other		None Detected
DC-3 / 22025581-003 ACT Adhesive	Brown Non-Fibrous Homogeneous		100% Other		None Detected
DC-4 / 22025581-004 1x1 ACT, 2F Data Center, Painted	Grey Fibrous Homogeneous	65% Glass	35% Other		None Detected
DC-5 / 22025581-005 ACT Adhesive	Brown Non-Fibrous Homogeneous	< 1% Other	100% Other		None Detected
DC-6 / 22025581-006 2x2 ACT Current Data Storage	Grey Fibrous Homogeneous	45% Cellulose 35% Glass	20% Other		None Detected
DC-7 / 22025581-007 2x2 ACT 2F Office	Grey Fibrous Homogeneous	45% Cellulose 35% Glass	20% Other		None Detected
DC-8 / 22025581-008 Gypboard W/ Joint Compound, 2F Offices, Drywall	White Non-Fibrous Homogeneous	12% Cellulose	88% Other		None Detected
DC-8 / 22025581-008 Gypboard W/ Joint Compound, 2F Offices, Joint Compound	White Non-Fibrous Homogeneous		100% Other		None Detected
DC-9 / 22025581-009 Gypboard W/ Joint Compound, 2F Offices, Drywall	White Non-Fibrous Homogeneous	12% Cellulose	88% Other		None Detected

Analyst:

Approved Signatory:

Analysis Date: 5/26/2022

Date: 5/26/2022



SanAir ID Number
22025581
 FINAL REPORT
 5/26/2022 4:26:50 PM

Name: Rockbridge Environmental Consulting, Inc.
Address: 22 S Main St
 Suite B01
 Lexington, VA 24450
Phone: 540-463-3336

Project Number:
P.O. Number:
Project Name: RCPS New Data Center
Collected Date: 5/23/2022
Received Date: 5/25/2022 10:10:00 AM

Analyst: Drakes, Renaldo

Asbestos Bulk PLM EPA 600/R-93/116

SanAir ID / Description	Stereoscopic		Components		Asbestos Fibers
	Appearance	% Fibrous	% Non-fibrous		
DC-9 / 22025581-009 Gypboard W/ Joint Compound, 2F Offices, Joint Compound	White Non-Fibrous Homogeneous		100% Other		None Detected
DC-10 / 22025581-010 Concrete Slab, 2F	Grey Non-Fibrous Homogeneous		100% Other		None Detected
DC-11 / 22025581-011 Concrete Slab, 2F	Grey Non-Fibrous Homogeneous		100% Other		None Detected
DC-12 / 22025581-012 12x12 VCT, Below Carpet, 2F Cust Office, VCT	Beige Non-Fibrous Homogeneous		100% Other		None Detected
DC-12 / 22025581-012 12x12 VCT, Below Carpet, 2F Cust Office, Adhesive	Yellow Non-Fibrous Homogeneous		100% Other		None Detected
DC-13 / 22025581-013 12x12 VCT W/ Mastic, 2F Office, VCT	Green Non-Fibrous Homogeneous		100% Other		None Detected
DC-13 / 22025581-013 12x12 VCT W/ Mastic, 2F Office, Mastic	Yellow Non-Fibrous Homogeneous		100% Other		None Detected
DC-14 / 22025581-014 VCT Remaining/Damaged Below Baseboard, 2F DC, VCT	Green Non-Fibrous Homogeneous		100% Other		None Detected
DC-14 / 22025581-014 VCT Remaining/Damaged Below Baseboard, 2F DC, Mastic	Yellow Non-Fibrous Homogeneous		100% Other		None Detected
DC-15 / 22025581-015 VCT Remaining/Damaged Below Baseboard, 2F DC, VCT	Green Non-Fibrous Homogeneous		100% Other		None Detected

Analyst:

Approved Signatory:

Analysis Date:

5/26/2022

Date:

5/26/2022



SanAir ID Number
22025581
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Received Date: 5/25/2022 10:10:00 AM

Analyst: Drakes, Renaldo

Asbestos Bulk PLM EPA 600/R-93/116

SanAir ID / Description	Stereoscopic	Components		Asbestos Fibers
	Appearance	% Fibrous	% Non-fibrous	
DC-15 / 22025581-015 VCT Remaining/Damaged Below Baseboard, 2F DC, Mastic	Yellow Non-Fibrous Homogeneous		100% Other	None Detected
DC-16 / 22025581-016 Vinyl Baseboard Mastic, 2F DC	Brown Non-Fibrous Homogeneous		100% Other	None Detected
DC-17 / 22025581-017 12x12 VCT, Paper Shredder, VCT	Red Non-Fibrous Homogeneous		100% Other	None Detected
DC-17 / 22025581-017 12x12 VCT, Paper Shredder, Mastic	Black Non-Fibrous Homogeneous	3% Cellulose	97% Other	None Detected
DC-18 / 22025581-018 3F Fire Door Contents, Damaged	Grey Fibrous Homogeneous		35% Other	65% Chrysotile
DC-19 / 22025581-019 12x12 VCT W/ Mastic, 2F Mens, VCT	Blue Non-Fibrous Homogeneous		100% Other	None Detected
DC-19 / 22025581-019 12x12 VCT W/ Mastic, 2F Mens, Mastic	Yellow Non-Fibrous Homogeneous		100% Other	None Detected

Analyst:

Approved Signatory:

Analysis Date: 5/26/2022

Date: 5/26/2022

Disclaimer

This report is the sole property of the client named on the SanAir Technologies Laboratory chain-of-custody (COC). Results in the report are confidential information intended only for the use by the customer listed on the COC. Neither results nor reports will be discussed with or released to any third party without our client's written permission. The final report shall not be reproduced except in full without written approval of the laboratory to assure that parts of the report are not taken out of context. The information provided in this report applies only to the samples submitted and is relevant only for the date, time, and location of sampling. The accuracy of the results is dependent upon the client's sampling procedure and information provided to the laboratory by the client. SanAir assumes no responsibility for the sampling procedure and will provide evaluation reports based solely on the sample(s) in the condition in which they arrived at the laboratory and information provided by the client on the COC, such as: project number, project name, collection dates, po number, special instructions, samples collected by, sample numbers, sample identifications, sample type, selected analysis type, flow rate, total volume or area, and start stop times that may affect the validity of the results in this report. Samples were received in good condition unless otherwise noted on the report. SanAir assumes no responsibility or liability for the manner in which the results are used or interpreted. This report does not constitute and shall not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any other U.S. governmental agencies and may not be certified by every local, state, and federal regulatory agencies.

Samples are held for a period of 60 days. Fibers smaller than 5 microns cannot be seen with this method due to scope limitations.

For NY state samples, method EPA 600/M4-82-020 is performed.

NYELAP Disclaimer:

Polarized- light microscopy is not consistently reliable in detecting asbestos in floor covering and similar non-friable organically bound materials. Quantitative transmission electron microscopy is currently the only method that can be used to determine if this material can be considered or treated as non-asbestos containing.

Asbestos Certifications

NVLAP lab code 200870-0

City of Philadelphia: ALL-460

PA Department of Environmental Protection Number: 68-05397

California License Number: 2915

Colorado License Number: AL-23143

Connecticut License Number: PH-0105

Massachusetts License Number: AA000222

Maine License Number: LB-0075, LA-0084

New York ELAP lab ID: 11983

Rhode Island License Number: PCM00126, PLM00126, TEM00126

Texas Department of State Health Services License Number: 300440

Commonwealth of Virginia 3333000323

Washington State License Number: C989

West Virginia License Number: LT000616

Vermont License: AL166318

Louisiana Department of Environmental Quality: 212253, Cert 05088

Revision Date: 8/14/2020



10501 Trade Ct., Suite 100
 N. Chesterfield, VA 23236
 804.897.1177 / 888.895.1177
 Fax 804.897.0070
sanair.com

Asbestos
Chain of Custody
 Form 140, Rev 6, 1/26/2022

SanAir ID Number

72025581

Company: REC, Inc	Project #:	Collected by: CF & TF
Address: 22 S Main St Suite B01	Project Name: RCPS New Data Center	Phone #: 540.463.3336
City, St., Zip: Lexington, VA 24450	Date Collected: 5.23.22	Fax #:
State of Collection: VA	Account#:	P.O. Number:
		Email: Kristin, Chance, Judy

Bulk			Air			Soil		
ABB	PLM EPA 600/R-93/116	<input checked="" type="checkbox"/>	ABA	PCM NIOSH 7400	<input type="checkbox"/>	ABSE	PLM EPA 600/R-93/116 (Qual.)	<input type="checkbox"/>
	Positive Stop	<input type="checkbox"/>	ABA-2	OSHA w/ TWA*	<input type="checkbox"/>	Soil		
ABEPA	PLM EPA 400 Point Count	<input type="checkbox"/>	ABTEM	TEM AHERA	<input type="checkbox"/>	ABSP	PLM CARB 435 (LOD <1%)	<input type="checkbox"/>
ABB1K	PLM EPA 1000 Point Count	<input type="checkbox"/>	ABATN	TEM NIOSH 7402	<input type="checkbox"/>	ABSP1	PLM CARB 435 (LOD 0.25%)	<input type="checkbox"/>
ABBEN	PLM EPA NOB**	<input type="checkbox"/>	ABT2	TEM Level II	<input type="checkbox"/>	ABSP2	PLM CARB 435 (LOD 0.1%)	<input type="checkbox"/>
ABBCH	TEM Chatfield**	<input type="checkbox"/>	Other:		<input type="checkbox"/>	Dust		
ABBTM	TEM EPA NOB**	<input type="checkbox"/>	New York ELAP			ABWA	TEM Wipe ASTM D-6480	<input type="checkbox"/>
ABQ	PLM Qualitative	<input type="checkbox"/>	ABEPA2	NY ELAP 198.1	<input type="checkbox"/>	ABDMV	TEM Microvac ASTM D-5755	<input type="checkbox"/>
** Available on 24-hr. to 5-day TAT			ABENY	NY ELAP 198.6 PLM NOB	<input type="checkbox"/>	Matrix Other		
			ABBNY	NY ELAP 198.4 TEM NOB	<input type="checkbox"/>			<input type="checkbox"/>
Water								
ABHE	EPA 100.2	<input type="checkbox"/>						

Turn Around Times	3 HR (4 HR TEM) <input type="checkbox"/>	6 HR (8HR TEM) <input type="checkbox"/>	12 HR <input type="checkbox"/>	1 Day <input checked="" type="checkbox"/>
	<input type="checkbox"/> 2 Days	<input type="checkbox"/> 3 Days	<input type="checkbox"/> 4 Days	<input type="checkbox"/> 5 Days

Special Instructions

Sample #	Sample Identification/Location	Volume or Area	Sample Date	Flow Rate*	Start - Stop Time*
dc-1	Penthouse Mechanical Area, Ceiling Plaster				
dc-2	1'x1' ACT, 2F Data Center, Painted Grey				
dc-3	ACT Adhesive, Brown				
dc-4	1'x1' ACT, 2F Data Center, Painted Grey				
dc-5	ACT Adhesive, Brown				
dc-6	2'x2' ACT Current Data Storage				
dc-7	2'x2' ACT 2F Office				
dc-8	Gypboard w/ Joint Compound, 2F Offices				
dc-9	Gypboard w/ Joint Compound, 2F Offices				
dc-10	Concrete Slab, 2F				
dc-11	Concrete Slab, 2F				
dc-12	12x12 VCT Beige, Below Carpet, 2F Cust. Office				

Relinquished by	Date	Time	Received by	Date	Time
C Famuliner	5.24.22		JAD	5/25/22	10:00a

If no technician is provided, then the primary contact for your account will be selected. Unless scheduled, the turnaround time for all samples received after 3 pm EST will be logged in the next business day. Weekend or holiday work must be scheduled ahead of time and is charged at 150% of the 3hr TAT or a minimum charge of \$150. A courier charge will be applied for same day and one-day turnaround times for offsite work. SanAir covers Ground and Next Day Air shipping. Shipments billed to SanAir with a faster shipping rate will result in additional charges.

COMMONWEALTH of VIRGINIA

Department of Professional and Occupational Regulation

9960 Mayland Drive, Suite 400, Richmond, VA 23233

Telephone: (804) 367-8500

EXPIRES ON

05-31-2022

NUMBER

3303002229

BOARD FOR ASBESTOS, LEAD, AND HOME INSPECTORS
ASBESTOS INSPECTOR LICENSE



CHARLES CHANCE FAMLINER
493 UNEXPECTED ROAD
LEXINGTON, VA 24450-0000



Charles Chance Famliner
By: Charles Chance Famliner, Licensee

Status can be verified at <http://www.dpor.virginia.gov>

(SEE REVERSE SIDE FOR PRIVILEGES AND INSTRUCTIONS)

DPOR-LIC (02/2017)

(DETACH HERE)



COMMONWEALTH of VIRGINIA
Department of Professional and Occupational Regulation

BOARD FOR ASBESTOS, LEAD, AND HOME INSPECTORS
ASBESTOS INSPECTOR LICENSE
NUMBER: 3303002229 EXPIRES: 05-31-2022

CHARLES CHANCE FAMLINER
493 UNEXPECTED ROAD
LEXINGTON, VA 24450-0000



VOID

VOID

Status can be verified at <http://www.dpor.virginia.gov>

DPOR-PC (02/2017)

END OF PROJECT MANUAL