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SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes load bearing formed steel stud exterior wall, interior wall, and framing; and formed steel joist, purlin, slotted channel, and framing and bridging.

B. Related Sections:
1. Section 05 12 00: Structural building framing.
2. Section 05 31 23 - Steel Roof Decking: Metal roof decking supported by wall stud metal framing.
3. Section 06 10 00 - Rough Carpentry.
4. Section 06 10 53 - Miscellaneous Rough Carpentry: Rough wood blocking.
5. Section 07 21 16 - Batt Insulation: Insulation within framing members.
6. Section 07 26 00 - Vapor Retarders.
7. Section 07 27 00 - Air Barriers.
8. Section 09 21 16 - Gypsum Board Assemblies: Light weight, non-load bearing metal stud framing.
9. Section 04 20 00 – Unit Masonry Assemblies: Veneer masonry supported by wall stud metal framing.

1.2 REFERENCES

A. American Iron and Steel Institute:
1. AISI General - Standard for Cold-Formed Steel Framing - General Provisions.
2. AISI Header - Standard for Cold-Formed Steel Framing - Header Design.
3. AISI NAS - North American Specification for Design of Cold-Formed Steel Structural Members.
4. AISI PM - Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings.

B. ASTM International:
1. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
2. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.

C. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.3 - Structural Welding Code - Sheet Steel.

D. Green Seal:
1. GC-03 - Anti-Corrosive Paints.

E. National Association of Architectural Metal Manufacturers:
    1. NAAMM ML/SFA 540 - Lightweight Steel Framing Systems Manual.

F. SSPC: The Society for Protective Coatings:
    1. SSPC Paint 15 - Steel Joist Shop Paint.
    2. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

G. Steel Stud Manufacturers Association:
    1. SSMA - Product Technical Information.

1.3 SYSTEM DESCRIPTION

A. Maximum Allowable Deflection:
    1. 1: 360 of span.
    2. 1: 600 of span at masonry veneers.

B. Wall System:
    1. Design to AISI NAS, AISC General, and AISC Header.
    2. Design to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
    3. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
    4. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable code.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Shop Drawings:
    1. Show layout, spacing, sizes, thickness, and type of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining Work.
        a. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Product Data: For each type of cold-formed metal framing product and accessory indicated.

D. Mill Certifications: Submit mill certifications for steel delivered to site. Certify steel bare metal thickness in 0.001 inch (0.025 mm), yield strength, tensile strength, total elongation in 2 inch (50 mm) or 8 inch (200 mm) gauge length, chemical analysis, and galvanized coating thickness.

1.5 QUALITY ASSURANCE

A. Calculate structural properties of framing members in accordance with AISI NAS.

B. Furnish framing materials in accordance with SSMA - Product Technical Information.

C. Perform Work in accordance with the following:
   1. Framing: AISI General and AISI NAS.
   2. Headers: AISI Header.
   3. Trusses: AISI Truss.
   4. Wall Studs: AISI WSD.
   5. Lateral Design: AISI Lateral.

D. Maintain one copy on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
   1. Current member of Steel Stud Manufacturers Association.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience and approved by manufacturer.

C. Design structural elements under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

D. Form, fabricate, provide, and connect components in accordance with NAAMM ML/SFA 540 - Lightweight Steel Framing Systems Manual.

1.7 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate placement of components within stud framing system specified in Division 9.

PART 2 PRODUCTS

2.1 COLD-FORMED METAL FRAMING

A. Manufacturers:
   1. Clark Steel Framing Systems.
   2. Consolidated Systems, Inc.
   3. Dietrich Industries, Inc.
   4. Marino\Ware.
   5. Unimast Incorporated

2.2 FRAMING COMPONENTS

A. Steel Sheet: ASTM A653, Structural Steel, zinc coated, grade as follows:
   1. Grade: 33 for studs and joists
   2. Grade: 33 for track runners and deflection tracks.

B. Studs: Steel sheet, formed to channel shape, punched web, knurled faces 16 gauge minimum thick, 1-1/2 inch face and 6 inch depth.

C. Joist, Purlins: Steel sheet, formed to channel shape, punched web, knurled faces, 1-1/2 inch face, minimum 6 inch depth, unless otherwise indicated.

D. Track: Steel sheet, formed to channel shape; same width as studs, tight fit; 16 gauge inch thick, solid web.

E. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain stud while allowing free vertical movement, with flange designed to support horizontal and lateral loads.
   1. Minimum uncoated – Steel thickness: Match stud gage.
   2. Flange width: A minimum of 2 inches.

F. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure.

2.3 ACCESSORIES

A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33 ksi.

B. Bracing, Furring, Bridging: Formed sheet steel, thickness determined by performance requirements specified.

C. Plates, Gussets, Clips: Formed sheet steel, thickness determined by performance requirements specified.

D. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic, zinc rich.

2.4 FASTENERS

A. Self-drilling, Self-tapping Screws, Bolts, Nuts, and Washers: Steel, hot dip galvanized.

B. Anchorage Devices: Power actuated, drilled expansion bolts, screws with sleeves, and pre-set anchor bolts.

C. Welding: In conformance with AWS D1.1 and AWS D1.3.

2.5 FABRICATION

A. Fabricate assemblies of formed sections of sizes and profiles required.

B. Fit, reinforce, and brace framing members to suit design requirements.

C. Fit and assemble in largest practical sections for delivery to site, ready for installation.

D. Fabrication Tolerances" Fabrication assemblies level, plumb, and true to line to a maximum allowable to tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minim fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

2.6 FINISHES

A. Studs: Galvanize to G90 coating class.

B. Tracks and Headers: Galvanize to G90 coating class.

C. Joist and Purlins: Galvanize to G90 coating class.

D. Bracing, Furring, and Bridging: Same finish as framing members.

E. Plates, Gussets, and Clips: Same finish as framing members.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to ASTM C 1007, unless more stringent requirements are indicated.

C. Install shop or field fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Bolt or weld wall panel at horizontal vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inches.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire typing of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
      c. Set tracks in sealant on exterior wall. Sealant shall create seal between track and foundation.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation in built-up exterior framing members such as headers, sills, boxed joists, and multiple studs at opening, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerance: Install cold-formed metal framing level, plumb and true to line to a maximum allowable tolerance variation of 1/8 inch 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous track sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to bottom track, unless otherwise indicated. Space stud as follows:
   1. Stud spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single deep-leg deflection tracks and anchor to building structure where required.
   2. Connect vertical deflection clips to bypassing studs and anchor to primary building structure where required.

E. Install horizontal bridging in curtain-wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. Top Bridging for Single Deflection Track. Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
      a. Install solid blocking at centers indicated.
   2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complex and stable curtain wall-framing system..

3.4 ERECTION OF JOISTS, PURLINS

A. Install perimeter joist track sized to match joist. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjusting to final position, brace, and reinforce. Fasten joist to both flanges of joist track.
   1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
   2. Reinforce end and bearing points of joist with web stiffeners, end clips joist hangers, steel clip angels, or steel-stud sections as indicated on Show Drawings.

C. Space joists not more than 2 inches from abutting walls, and as follows:
   1. Joist Spacing: As indicated.

D. Frame openings with build-up joists headers consisting of joist and joist track, nesting joists, or another combination of connected joist if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated.
   1. Install web stiffeners to transfer axial loads of wall above.

F. Install bridging at each end of joists and at intervals indicated. Fasten bridging at each joist intersections as follows:
   1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to bottom flange of joist.

2. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated, and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist framing assembly.

3.5 FIELD QUALITY CONTROL

A. Testing: Contractor will engage a qualified independent testing agency to perform field quality control testing.

B. Field and shop welds will be subject to inspection and testing.

C. Testing agency will report test results promptly and in writing to Contract and Architect.

D. Remove and replace Work that does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expenses, will be performed to determine compliance of corrected Work will specify requirements.

3.6 REPAIR AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair according to ASTM A 780 and manufacturer's written instruction.

B. Touchup Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on fabricated and installed prime-painted, cold-formed metal framing. Paint framing surfaces with same type of shop paint used on adjacent surfaces.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 10 51 13

METAL LOCKERS

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. Welded lockers.
2. Locker benches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of metal locker.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.

B. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Show locker trim and accessories.
3. Include locker identification system and numbering sequence.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 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. Full-size units of the following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:

    a. Identification plates.
    b. Hooks.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate sizes and locations of wood bases for metal lockers.

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures.
    b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for Welded Metal Lockers: Lifetime from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

2.2 WELDED LOCKERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. DeBourgh Mfg. Co; First Responder .
2. List Industries Inc; Task Force XP .
3. Penco Products, Inc; Patriot Duty LockersAll-Welded All-Welded Defiant Angle Iron Pro Tough Pro Tough Defiant.
4. Tiffin Metal Products Company

B. Expanded-Metal Doors: Fabricated from 0.090-inch nominal-thickness expanded metal; welded to 0.105-inch nominal-thickness steel angle frame; with 0.090-inch nominal-thickness, steel sheet lock panel backed by 0.060-inch nominal-thickness, steel sheet retainer welded to door frame.

1. Ventilation: 6inch wide by 3/4inch high horizontal louvers arranged in two groups of six.

C. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops and Bottoms: 0.060-inch nominal thickness, with single bend at edges.
2. Backs: 0.048-inch nominal thickness.
3. Shelves: 0.060-inch nominal thickness, with double bend at front and single bend at sides and back.

D. Unperforated Sides: Fabricated from 0.048-inch nominal-thickness steel sheet.

E. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet or 0.097-inch nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

F. Reinforced Bottoms: Structural channels, formed from nominal-thickness steel sheet; welded to front and rear of side-panel frames.

G. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

1. Continuous Hinges: Manufacturer's standard, steel; side or top mounted as required by locker configuration.

H. Projecting Turn-Handle and Latch: Steel handle welded to manufacturer's standard, three-point, cremone-type latching mechanism consisting of steel rods or bars that engage locker frame at top and bottom of door, and center latch that engages strike jamb; with steel padlock loop.

I. Identification Plates: Manufacturer's standard, etched, embossed, or stamped plates, with numbers and letters at least 3/8 inch high.

J. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

K. Coat Rods: Manufacturer's standard.

L. Coat Rods: diameter steel, .

M. Filler Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.

N. Materials:

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

O. Finish: Baked enamel or powder coat.

1. Color: As selected by Architect from manufacturer's full range.

2.3 LOCKER BENCHES

A. Provide bench units with overall assembly height of 17-1/2 inches.

B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

1. Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick except provide minimum 20-inch- wide tops where accessible benches are indicated.
2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.

C. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:

1. Tubular Steel: 1-1/2-inch- diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.

a. Color: Match metal lockers.

2.4 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.

C. Locker Configuration: As indicated on Drawings.

D. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.

E. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.

F. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

G. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.5 ACCESSORIES

A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

B. Anchors: Material, type, and size required for secure anchorage to each substrate.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.
2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
3. Anchor back-to-back metal lockers to floor.

B. Welded Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.

C. Equipment:

1. Attach hooks with at least two fasteners.
2. Attach door locks on doors using security-type fasteners.
3. Identification Plates: Identify metal lockers with identification indicated on Drawings.

a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach recess trim to recessed metal lockers with concealed clips.
2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
3. Attach sloping-top units to metal lockers, with closures at exposed ends.
4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.

5. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

E. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

F. Freestanding Locker Benches: Place benches in locations indicated on Drawings.

3.3 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

3.4 PROTECTION

A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

SECTION 11 19 00

DETENTION EQUIPMENT CONTRACTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Provide materials, labor, equipment, and services necessary to furnish, deliver and install all work of this section and/or as required by job conditions.

1. Scope and Responsibility:

a. A single Detention Equipment Manufacturer (DEM) shall assume complete accountability for furnishing locks and sliding devices to the Detention Equipment Contractor (DEC).
b. The DEC shall be responsible for the interfacing and integration of all products and systems with the General Trades Contractor to ensure that all parts of the work will come together with his.

2. The DEC shall complete the submittal package of all items listed below within 3 weeks of written notice to proceed.

a. Hardware Schedule – including wiring diagram and templates.
b. Detention Security Hollow Metal – door/frames shop drawings.
c. Correctional and Institutional Furnishings – shop drawings.
d. Steel Detention Cells – shop drawings.

3. After all approvals, the submitted manufactures must commit in writing to the following schedule. The Construction Manager maintains the right to make adjustments to the schedule prior to contract execution.
a. Maximum of six weeks for the complete shipment of detention door frames to represent at least 75% of those required with the balance to be delivered to the site at a maximum of 10 weeks.
b. Maximum of six weeks for the complete shipment of all required embeds.
c. Maximum of ten weeks for the complete shipment of all detention door hardware.
d. Deliver all other materials in manner as not to negatively effect the construction schedule.

4. The above (2-3) required letters of commitment for drawings and product shipment must be submitted at the time of the bid.

1.3 DETENTION EQUIPMENT CONTRACTORS

A. Qualifications of Detention Equipment Contractor:

1. Any Non-Prequalified Detention Equipment Contractor who intends to submit a bid on this section of the Specifications shall submit the following data to the Architect in writing fourteen (14) days prior to bid date and shall be approved by addendum seven (7) days prior to bid date. Verbal approval will not satisfy this requirement. Grounds for disqualification shall exist if it is proven that the information submitted is inaccurate or, in the opinion of the Architect, does not satisfy the requirements.
   a. Provide a narrative and historical description of the firm from inception, including history of ownership, partnership, incorporation, and/or other organizational information. Include information on the growth of the firm over time to include the number of employees, relocation(s) of the firm, major production equipment purchases and replacements.
   b. List the firm's business volume (dollar amount) for the last five (5) fiscal years.
   c. Provide a statement that the firm has been in business for a minimum of ten (10) continuous years, and the principals and key personnel that have been engaged in successfully providing procurement, management, installation and commissioning of security detention projects.
   d. Provide a list of all employees in a super vision capacity, stating their area of responsibility and their years of experience in that capacity.
   e. Submit a list of all projects completed in the last ten (10) years.
   f. Submit a list of five (5) projects that this corporation, under its current name, has built in the last five (5) years comparable in size and construction. Include in this list:
      1. Project Name, Owner, Contract Name, Address and Phone Number.
      2. Project Manager Name, Address and Phone Number.
      3. Using Agency Name, Address and Phone Number.
      4. Architect and Engineer of Record Name, Address and Phone Number.
      5. General Contractor and/or Construction Manager Name, Address and Telephone Number.

      For each project listed provide the following:
      1. Name and location of project.
      2. Type of project (state or federal prison, county, or city jail)
      3. Project delivery method (traditional, design/bid/build, design/build, design/build/manage, general construction, construction manager, etc.)
      4. Scope of the Project including total number of cells, total project square footage, type of product and service provided on that project, and the total quantity of the contract.
      5. Date of final completion and occupancy.
   g. Submit a list of five (5) projects that this corporation, under its current

name, has built in the last ten (10) years comparable in size and construction that have been in continuous operation for a minimum of five (5) years. Include in this list:

1. Project Name, Owner, Contact Name, Address, and phone number.
2. Project Manager Name, Address and Phone Number.
3. Using Agency Name, Address and Phone Number.
4. Architect and Engineer of Record Name, Address and Phone Number.
5. General Contractor and/or Construction Manager Name, Address and Telephone Number.

For each project listed provide the following:

1. Name and location of project.
2. Type of project (state or federal prison, county, or city jail)
3. Project delivery method (traditional, design/bid/build, design/build, design/build/manage, general construction, construction manager, etc.)

h. Provide a list of ten (10) prefabricated steel modular cell projects, jails and prisons, of 20 or more cells with at least three (3) projects over 50 cells that are complete and have been operational within the last five (5) years. Include in this list.

1. Project Name, Owner, Contact Name, Address, and phone number.
2. Project Manager Name, Address and Phone Number.
3. Using Agency Name, Address and Phone Number.
4. Architect and Engineer of Record Name, Address and Phone Number.
5. General Contractor and/or Construction Manager Name, Address and Telephone Number.

For each project listed provide the following:

1. Name and Location of project.
2. Type of project (state or federal prison, county, or city jail)
3. Project delivery method (traditional, design/bid/build, design/build, design/build/manage, general construction, construction manager, etc.)
4. Scope of the Project including total number of cells, total project square footage, type of product and service provided on that project, and the total quantity of the contract.
5. Date of final completion and occupancy.

i. Provide an audited financial statement from a recognized accounting firm for the most recent fiscal year. The format of the financial statement must be acceptable to surety for purpose of obtaining performance and payment bonds in an amount equal to at least $2 million dollars.

j. Provide a financial statement for the current fiscal year. The format of the financial statement must be acceptable to surety for purpose of obtaining performance and payment bonds in an amount equal to at least $2 million dollars.

k. Provide a letter from a qualified surety company that your firm will be able to provide 100% performance/payment bond for this project if awarded the project.

l. Submit a listing of all projects in which the detention equipment contractor

is presently or has been involved in litigation and the status thereof. In addition to this statement, please respond to the following questions A through G. For any "YES" answer to the following questions, please attach a separate sheet, which provides a brief explanation of the facts, names of the parties involved, dollar amount being claimed from your firm, and the present status of the case. Attach explanations of any lawsuit alleging negligent of defective work, or breach of contract on part of the firm. Do not include lien matters, automobile accident cases, or workman's compensation cases:

1. Has a court issued a judgment of $50,000.00 of more against the firm or its predecessors in the past five (5) years?

_____ YES _____ NO

2. Has the firm or its predecessors been party to the settlement of a lawsuit with a potential value of $50,000.00 or more?

_____ YES _____ NO

3. Is the firm or its predecessors currently a party to a pending lawsuit with a potential value of $50,000.00 or more?

_____ YES _____ NO

4. In the past five years, has any key person, the firm or its predecessors defaulted on a loan?

_____ YES _____ NO

5. Has the firm of its predecessors or any person of the firm or its predecessors ever been suspended or debarred by a state, federal or municipal agency?

_____ YES _____ NO

6. In the past five (5) years, has the firm or its predecessors been terminated on or failed to complete any contract?

_____ YES _____ NO

m. Submit for approval the names of the detention equipment manufacturers that you intend to purchase materials from. The manufacturers must be chosen from these specifications.

1. Submit a current letter from the detention hardware manufacturer stating that the erector is trained, fully authorized distributor and installer of their complete line of products.
2. Submit a current letter from the hollow metal door and frame manufacturer stating that you are a factory-trained, fully authorized distributor and installer for their complete line of products.
3. Submit a current letter from the prefabricated cell manufacturer stating that you are a factor-trained, fully authorized distributor and installer for their complete line of products.

n. Submit a statement that you will conform with the following regarding project coordination, procurement, schedules, and delivery of materials necessary to complete your scope of work.

1. The detention equipment contractor must complete the submittal package of all items listed below within three weeks of written notice to proceed.
    a. Hardware Schedule – including wiring diagram and templates.
    b. Detention Security Hollow Metal – doors and frames shop

drawings.

c. Correctional and Institutional Furnishings – shop drawings.

d. Prefabricated Steel Cells – shop drawings.

2. The detention equipment contractor is required to review the entire submittal of shop drawings with the Architect/Engineer in the office of the Architect/Engineer. In most cases, this review can be accomplished in a single day. This procedure has proven to be very effective in the past.

3. The submitted manufacturers must commit in writing to the following schedule. The Architect or Construction Manager maintains the right to make adjustments to the schedule prior to contract execution.

a. Maximum of **six** weeks for the complete shipment of detention door frames to represent at least 75% of those required with the balance to be delivered to the site at a maximum of 10 weeks.

b. Maximum of **six** weeks for the complete shipment of all required embeds.

c. Maximum of **ten** weeks for the complete shipment of all detention door hardware.

d. Delivery of all other materials in manner as to not negatively affect the construction schedule.

e. Delivery of pre-manufactured steel modular cells in a maximum of twelve (12) weeks to the job site completely outfitted with all specified equipment.

o. A letter from an approved and A-15 rated bonding company that your firm can be bonded for this project (complete) if awarded this contract.

p. Are you signatory to a Union Labor Agreement? If so, provide a letter from the International Ironworkers Union that your firm employs union iron workers to install the specified security products on this project.

2. All materials in this section may be provided by any of the approved detention equipment manufacturers. The DEC shall take the furnished material and assume complete responsibility for the detailing, coordinating, erecting, installation and performance and warranty of such work.

3. Prequalified Detention Equipment Contractors

a. Pauly Jail Building Company, Noblesville, Indiana

b. U.S. Security Systems, Inc.; Montgomery, Alabama

1.4 SUBMITTALS

A. The DEC shall submit a list of subcontractors and suppliers with his bid.

B. The DEC shall submit to the Architect a written letter of commitment from all major subcontractors and suppliers to provide materials to the job site on the date required by the project schedule. This letter of commitment shall be received by the Architect within two (2) days of Notice to Proceed.

C. All detention equipment shop drawings shall be submitted to the Architect within sixty (60) days of Notice to Proceed.

D. All detention equipment determined to be on the critical path of the project schedule shall be reviewed in person between the DEC and the Architect. These submittals shall be reviewed in the office of the Architect.

1.5 PERFORMANCE, LABOR AND MATERIALS PAYMENT BOND

A. The DEC shall be required to provide a bond in the amount of one hundred (100) percent of the contract sum.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 11 19 00

SECTION 23 21 13

HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pipe and fittings for hydronic piping.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of the following:

a. Pipe.
b. Fittings.
c. Joining materials.
d. Bypass chemical feeder.

2. Delegated-Design Submittal:

a. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
b. Locations of pipe anchors and alignment guides and expansion joints and loops.
c. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
d. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

B. Informational Submittals:

1. Qualification Data: For Installer.
2. Welding certificates.
3. Field quality-control reports.
4. Preconstruction Test Reports:

a. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.3 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on water quality.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 100 psig at 180 deg F.
2. Chilled-Water Piping: 150 psig at 73 deg F.
3. Condenser-Water Piping: 150 psig at 73 deg F.
4. Glycol Cooling-Water Piping: 150 psig at 150 deg F.
5. Makeup-Water Piping: 80 psig at 73 deg F.
6. Condensate-Drain Piping: 150 deg F.
7. Blowdown-Drain Piping: 180 deg F.
8. Air-Vent Piping: 180 deg F.
9. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. Anvil International.
    b. Victaulic.
    c. or Engineered/Owner Approved Equal.

2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
3. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
    a. Grooved-End Tube Couplings, 2" and up: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves. Gasket shall be Grade "EHP" EPDM compound designed for temperatures from -30 deg F to +250 deg F. Victaulic Style 607 or Engineered/owner approved equal

E. Copper or Bronze Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. NIBCO Inc.
    b. Viega, LLC.

2. Housing: Copper.
3. O-Rings and Pipe Stops: EPDM.
4. Tools: Manufacturer's special tools.
5. Minimum 200-psig working-pressure rating at 250 deg F.

F. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. T-Drill Industries Inc.

G. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. Anvil International.
    b. Victaulic.
    c. or Engineered/Owner Approved Equal.

2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
    a. Rigid Couplings: Victaulic Styles 107V/W07 or Owner/Engineered approved Equal. Gaskets shall be grade “EHP” EDPM designed for operating temperatures from -30 deg F to +250 deg F.
    a. Flexible Couplings: Use in locations where vibration attenuation and stress relief are required. Three flexible couplings may be used in lieu of flexible connectors at equipment connections and shall be placed in close proximity to the vibration source. Victaulic Style 177, W77 or Owner/Engineered approved equal. Equipment may be dressed with Style 380, 381 and 385 assemblies in conjunction with Victaulic headers
    b. Victaulic 300-Series/WVic-300 Butterfly Valve and 716/W716 Check Valve may be used with grooved piping system. Utilization of “Tri-Service” Assembly is acceptable
    c. Victaulic Style 730/W730 Strainers are acceptable. Contractor may utilize Victaulic Style 731D Suction Diffuser with grooved end piping system.

d. Victaulic Y-Patterson Globe Style Balance Valve may be utilized on coil connections
e. Victaulic Installation-Ready™ fittings for all schedules plain end carbon steel piping in HVAC and mechanical applications sizes ½" through 2".
f. All grooved components must be of one manufacturer.
g. Contractor may elect to utilize prefabrication services.

I. Steel Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

a. Apollo.
b. Viega.
c. Victaulic Company.

2. Housing: Steel.
3. O-Rings and Pipe Stop: EPDM.
4. Tools: Manufacturer's special tool.
5. Minimum 300-psig working-pressure rating at 230 deg F.

J. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, with wall thickness as indicated in "Piping Applications" Article.

1. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.

B. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.

1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.5 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

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

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for CPVC Piping: ASTM F 493. Solvent cement VOC content 490 g/L or less. Adhesive primer VOC content 550 g/L or less.

H. Solvent Cements for PVC Piping: ASTM D 2564. Primer ASTM F 656. Solvent cement VOC content 510 g/l or less. Adhesive primer VOC content 550 g/L or less.

2.6 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. Charlotte Pipe and Foundry Company.
    b. IPEX Inc.
    c. KBI (King Bros. Industries).

2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. NIBCO Inc.; Model T/S-1710.
    b. Charlotte Pipe and Foundry Company.
    c. IPEX Inc.
    d. KBI (King Bros. Industries).

2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. A.Y. McDonald Mfg. Co.
    b. Capitol Manufacturing Company.
    c. Central Plastics Company.
    d. Hart Industries International, Inc.
    e. Jomar International, Ltd.
    f. Matco-Norca.
    g. Watts Regulator Co.
    h. Zurn Industries, LLC; AquaSpec Commercial Faucet Products.
    i. Victaulic 647

2. Description:

    a. Standard: ASSE 1079.
    b. Pressure Rating: 125 psig minimum at 180 deg F.
    c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Matco-Norca.
    d. Watts Regulator Co.
    e. Zurn Industries, LLC; AquaSpec Commercial Faucet Products.

2. Description:

    a. Standard: ASSE 1079.
    b. Factory-fabricated, bolted, companion-flange assembly.
    c. Pressure Rating: 125 psig minimum at 180 deg F.
    d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.

2. Description:

    a. Nonconducting materials for field assembly of companion flanges.
    b. Pressure Rating: 150 psig.
    c. Gasket: Neoprene or phenolic.
    d. Bolt Sleeves: Phenolic or polyethylene.
    e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

    a. Elster-Perfection.
    b. Grinnell Mechanical Products.
    c. Matco-Norca.
    d. Precision Plumbing Products, Inc.
    e. Victaulic Company.

2. Description:

    a. Standard: IAPMO PS 66.
    b. Electroplated steel nipple, complying with ASTM F 1545.
    c. Pressure Rating: 300 psig at 225 deg F.
    d. End Connections: Male threaded or grooved.
    e. Lining: Inert and noncorrosive, propylene.

2.8 BYPASS CHEMICAL FEEDER

A. Description: Welded steel construction; 125-psig working pressure; 5-gallon capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, soldered and brazed joints.
2. Schedule 40, Grade B steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; Victaulic Installation-Ready™ fittings and threaded joints.
3. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Hot-water heating piping installed belowground and within slabs shall be the following:

1. Type K, annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.
2. Rovanco Pre-Insulated Piping Systems – Rhinoflex.
3. Perma-Pipe Pre-Insulated Piping Systems.

D. Chilled-water piping, aboveground, NPS 2 and smaller shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed, or pressure-seal joints.
2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; Victaulic Installation-Ready™ fittings and threaded joints.
3. Schedule 5 steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.

E. Chilled-water piping, aboveground, NPS 2-1/2 and larger shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

F. Chilled-water piping installed belowground and within slabs shall be the following:

1. Type K, annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.
2. Rovanco Pre-Insulated Piping Systems – Rhinoflex.
3. Perma-Pipe Pre-Insulated Piping Systems.

G. Condenser-water piping, aboveground, NPS 2 and smaller shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
2. Schedule 80 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; Victaulic Installation-Ready™ fittings and threaded joints.
3. Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.

H. Condenser-water piping, aboveground, NPS 2-1/2 and larger shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
2. Schedule 80 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 80 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
4. Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.

I. Condenser-water piping installed belowground and within slabs shall be the following:

1. Type K, annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.

J. Glycol cooling-water piping, aboveground, NPS 2 and smaller shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed, or pressure-seal joints.
2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; Victaulic Installation-Ready™ fittings and threaded joints.

K. Glycol cooling-water piping, aboveground, NPS 2-1/2 and larger shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

L. Glycol cooling-water piping installed belowground and within slabs shall be the following:

1. Type K, annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.

M. Makeup-water piping installed aboveground shall be either of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
2. Schedule 80 CPVC plastic pipe and fittings, and solvent-welded joints.

N. Makeup-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.

O. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

P. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

Q. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

R. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit equipment and valve servicing.

F. Install horizontal piping at a uniform grade of 0.2 percent upward in direction of flow. Install vertical piping plumb.

G. Install piping free of sags and bends.

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

I. Install piping to allow application of insulation.

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

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install air vents, consisting of a tee fitting, NPS 3/4 ball valve, short NPS 3/4 threaded nipple, reducer, and air vent, at high points in piping. Use automatic air vents in mechanical rooms and run copper tubing from vent discharges to floor drains. Use manual air vents in other locations unless indicated otherwise.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the top or side of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to the valve specifications.

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in other Division 23 Sections for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in other Division 23 Sections for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in other Division 23 Sections.

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in other Division 23 Sections.

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in other Division 23 Sections.

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2-and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in other Division 23 Sections for hanger, support, seismic restraint, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.

4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing:

1. NPS 3/4: Maximum span, 7 feet.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/2: Maximum span, 9 feet.
4. NPS 2: Maximum span, 10 feet.
5. NPS 2-1/2: Maximum span, 11 feet.
6. NPS 3 and Larger: Maximum span, 12 feet.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions and local codes. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

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

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

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

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

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

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

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

I. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

J. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

K. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

3.7 CHEMICAL TREATMENT

A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:

1. pH: 9.0 to 10.5.
2. "P" Alkalinity: 100 to 500 ppm.
3. Boron: 100 to 200 ppm.

4. Chemical Oxygen Demand: Maximum of 100 ppm. Revise this value if closed system contains glycol.
5. Corrosion Inhibitor:

    a. Sodium Nitrate: 1000 to 1500 ppm.
    b. Molybdate: 200 to 300 ppm.
    c. Chromate: 200 to 300 ppm.
    d. Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
    e. Chromate Plus Molybdate: 50 to 100 ppm each.

6. Soluble Copper: Maximum of 0.20 ppm.
7. Tolyiriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum of 10 ppm.
8. Total Suspended Solids: Maximum of 10 ppm.
9. Ammonia: Maximum of 20 ppm.
10. Free Caustic Alkalinity: Maximum of 20 ppm.
11. Microbiological Limits:

    a. Total Aerobic Plate Count: Maximum of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maximum of 100 organisms/mL.
    c. Nitrate Reducers: 100 organisms/mL.
    d. Sulfate Reducers: Maximum of zero organisms/mL.
    e. Iron Bacteria: Maximum of zero organisms/mL.

B. Install bypass chemical feeders in each hydronic system where indicated. Install in upright position with top of funnel not more than 48 inches above the floor.

C. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

D. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

E. Fill systems that have antifreeze or glycol solutions with concentrations indicated on the Drawings.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual isolation valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 28 51 23

IP AUDIO COMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01, and Division 28 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the requirements for an IP audio communication system. The IP audio communication system shall be integrated with the overall Electronic Security System. The system shall be configured to support all intercom stations, speakers and touchscreen master modules shown on the security electronics plans.

B. New head-end equipment and field devices shall be provided for Buildings #1 and #2. The new head-end equipment for Building #1 shall be connected to and integrated with the existing Harding Instruments head-end equipment. The intent of the specifications is to provide a seamless control system of all audio communication devices for Building #1.

C. The SSI shall provide an integrated IP audio communication system as specified herein. The system shall include all equipment, installation materials, set up, and testing to form a complete operating system. Independent system functions and integrated system functions to be fully verified as part of system testing and commissioning.

D. The Graphic User Interface (GUI) software (specified in section 284620) shall be the primary interface for the control and monitoring of the IP audio communication system (reference section 284620 for software functional requirements).

E. The SSI shall provide a digital interface between the PLC system and the Digital Communication Controllers for control by the PLC.

F. Digital Communication Controllers and Digital Communication Expanders shall be interconnected to form intercom exchanges. Each Digital Communication Controller (DCC) shall be capable of supporting up to four Digital Communication Expanders (DCEs). The SSI shall provide and install the required number of DCCs and DCEs to support the total number of intercom stations, ceiling speakers and touchscreen master modules in the system. All DCCs shall be connected to each other over a 10/100/1000Base-T network. This network shall provide data communications for the system. Reference section 282300 for network switch requirements.

G. The system shall include station audio level alarm detection (for ceiling speakers requiring this feature, as indicated on the plans) with adjustable detection settings for each individual station. SSI shall include with their bid the head-end equipment required to support this feature. The SSI shall adjust the audio level alarm detection settings for each station, with input from the Owner.

H. The SSI shall provide an audio recording system to digitally record all the audio conversations between each audio master station and intercom stations, ceiling speakers, paging speakers and paging horns. The existing audio recording system at the Jail shall be replaced with the equipment specified herein. A separate audio recording system shall be provided for Building #2.

I. The SSI shall NOT provide PLC-controlled relay cards to control audio line switching at the security electronics head-end. All switching shall be provided by Harding digital communication controllers (DCCs) and digital communication expanders (DCEs).

J. The IP audio communication system shall include the following main components:

1. Digital Communication Controllers and Expanders

2. Administrator Software

3. Audio Master Stations

4. Intercom Stations & Loudspeakers

5. Accessories

6. Audio Recording System

1.3 DEFINITIONS

A. DCC: Digital Communication Controller

B. DCE: Digital Communication Expander

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, and accessories.

B. Shop Drawings: Detail equipment enclosure assemblies and indicate dimensions, loads, required clearances, components, and location of each field connection.

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

C. Operation and Maintenance Data: For IP audio communication system to include in operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Schedules detailing locations, titles, and termination locations of all intercom stations, ceiling speakers and touchscreen master modules in the system.

1.5 QUALITY ASSURANCE

A. All work shall conform to applicable National Electrical Codes (NEC). SSI shall adhere to applicable state and local ordinances and the requirements of the authority having jurisdiction.

B. Intercom system equipment is to be designed and manufactured in accordance with ISO-9001 2000 Quality System Standard.

C. Manufacturer's quality control program to be registered in accordance with the above noted standard.

1.6 WARRANTY

A. Warranty Period: 12 months from date of Substantial Completion. The manufacturer shall repair or replace software and hardware that fails in materials or workmanship within specified warranty period.

1.7 EXTRA MATERIALS

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

1. Intercom Station: For each building (Building #1 and #2), furnish 1 spare intercom station of each type provided.

2. Touchscreen Master Module: For each building (Building #1 and #2), furnish 1 spare touchscreen master module of each type provided.

PART 2 - PRODUCTS

2.1 DIGITAL COMMUNICATION CONTROLLERS

A. Manufacturer:

1. Harding Instrument Co. Ltd. - MicroComm DXL

B. Description: SSI shall provide required number of Digital Communication Controllers to form an intercom exchange capable of independent local operation. Each exchange capacity shall be increased as required by connecting additional Digital Communication Expanders (maximum of 4) to each DCC. The basis for the specification is Harding Instruments.

C. Digital Communication Controller (DCC):

1. Each DCC shall include the following:

a. Process Control Card (PCC)
b. Master Control Card (MCC)
c. Two Station Control Cards (SCC's)

d. Optional internal PCI card.
e. Front panel keypad/display for system setup and maintenance.
f. 110 VAC, 60 Hz power supply for internal functions.

D. Process Control Card (PCC):

1. Process Control Card shall contain system configuration and data, control exchange operations and switching, and provide exchange network ports.
2. PCC shall include the following:

a. USB network ports for exchange expansion.
b. Ethernet network ports for system expansion and external control by touch screen computers and graphic control panels.
c. Fiber optic or copper digital audio trunk ports.
d. Two serial ports.
e. Internal modem for transmitting and receiving data over a telephone line.

E. Master Control Card (MCC):

1. MCC shall include the following:

a. Include ports for any combination of two intercom or telephone set master stations.
b. Include two line-level audio inputs with status and control.
c. Include two line-level audio outputs with status and control.
d. Convert incoming audio signals to digital format and outgoing signals to analog format.
e. Intercom master station audio, press-to-talk and hook switch status transmitted over two single shielded pair cables with wiring supervision to detect open circuit and short circuit faults.
f. Telephone set master station functions all transmitted over a single wiring pair.

F. Station Control Card (SCC's):

1. SCC's shall include the following:

a. Each provides sixteen half-duplex intercom station ports which can be employed in adjacent pairs for full duplex devices.
b. Provide an interface for intercom stations. Units to convert incoming audio signals to digital format and outgoing signals to analog format. Each channel to monitor the status of up to two (2) switches associated with each intercom station.
c. Each card interfaces with 16 half-duplex channels. Each channel includes a separate audio power amplifier for non-blocking call operation and sixteen (16) independent software-controlled volume settings.
d. All station audio, switch, and power functions on 400 Series and 401 Series cards to be transmitted over a single shielded pair cable with supervision to detect open circuit and short circuit faults.
e. Audio and switch functions on 300 Series (Generic Intercom) station control cards to be transmitted on separate wiring pairs.

2.2 ADMINISTRATOR SOFTWARE

A. Manufacturer:

1. Harding Instrument Co. Ltd. - MicroComm DXL

B. Description: Administrator software shall be included with the IP audio communication system. SSI shall provide one licensed copy of the administrator software for Building #2 only to the Owner at final completion. The basis for the specification is Harding Instruments.

C. Administrator Software:

1. Harding Instruments model DXL-SOF-ADM.
2. Administrator Software to function on a standard PC to support system configuration, diagnostics, maintenance, and logging but not be required for system operation.
3. Administrator Software to employ Windows features including views of system tree structure, tables of devices, screens for system settings and adjustments, and tables of operational data.
4. Configuration features to include:

    a. Creation of overall system architecture.
    b. Creation of multiple device templates.
    c. Copy and paste functions with auto-numbering and auto-assignment to create device schedules.
    d. Configuration error detection and alerts.
    e. Device naming and call routing functions.
    f. Device setting and performance functions.

5. Diagnostic and Maintenance features to include:

    a. Verification of system configuration and installation.
    b. Verification of system networks.
    c. Verification of device connections.
    d. Verification of system operation.
    e. Diagnostics via modem or Ethernet ports.

6. Logging features to include:

    a. Display of system activity with filtering options.
    b. Search by time and date.
    c. Search by device.
    d. Search by parameter.

7. SSI shall install a licensed copy of the Administrator software on the Security Management Server.

2.3 AUDIO MASTER STATIONS

A. Manufacturer:

1. Harding Instrument Co. Ltd. - MicroComm DXL

B. Description: VoIP Touchscreen Master Modules shall be provided to interface with the IP audio communication system. One VoIP touchscreen master module shall be provided for each new GUI station location. The basis for the specification is Harding Instruments.

C. VoIP Touchscreen Master Module:

1. Harding Instruments model TMM-641-121-1.
2. The VoIP touchscreen master module shall include the following features:

a. Dimensions: 2.01” (H) x 5.35” (W) x 7.07” (D)
b. Operating Temperature: 32° to 122°F (0° to 50°C)
c. Humidity: 0 to 95% non-condensing
d. Field Connections: female RJ-45 connector
e. Power: 22.8Vdc – 37.8Vdc or EEE 802.3af compliant
f. Switch: 1 million operations
g. Speaker: 2.5” Mylar cone
h. Speaker level: 82 dB SPL max. @ 1 meter
i. Audio Output: 1V rms

2.4 INTERCOM STATIONS & LOUDSPEAKERS

A. Manufacturers:

1. Harding Instrument Co. Ltd. - MicroComm DXL
2. Quam-Nichols Co. (for loudspeaker only)
3. Lowell (for loudspeaker only)

B. Description: Intercom stations and loudspeakers shall be provided as shown on the plans. Intercom stations shall be the primary means of communication in the IP audio communication system between the GUI operator and the facility staff and offenders. All intercom stations shall include a call pushbutton switch. Ceiling speakers shown on the plans as designated with a “T” shall include audio threshold detection. The basis for the specification is Harding Instruments.

C. Intercom Stations:

1. Harding Instruments model ICE-420-217-000 for interior locations.
2. Harding Instruments model ICE-420-227-000 for exterior locations.
3. Harding Instruments model ICE-421-CUS-105 for interior locations with included “privacy switch” feature.
4. Harding Instruments model FDH-420-204-110 for interior stations with integral handset.
5. The intercom stations shall include the following features:

a. Intercom stations shall be designed for mounting on standard 2-gang outlet boxes. Faceplates shall be constructed of 11-gauge brushed stainless. Internal steel offset grille to restrict inserting objects through speaker grille. Stations shall be ruggedly constructed and resistant to damage from soil and sprays.
b. Each intercom station shall incorporate an internal loudspeaker, microphone preamplifier and functioning multiplexing circuitry. One pushbutton shall be

provided on each station. Pushbuttons shall be software assignable for placement of call requests or control of auxiliary functions.

c. Pushbuttons shall be single piece stainless steel construction and shall be backstopped to prevent excessive travel. Switch shall have positive tactile action with 1 million-operation lifetime.
d. Loudspeakers shall be waterproof Mylar cone type.
e. Stations shall be provided with MTA type insulation displacement connector that requires no wire stripping for installation.
f. Outdoor intercom stations shall be identical in all respects to standard intercom stations except that all metal plates and hardware shall be stainless steel, and internal circuitry and components shall be conformal coated.

D. Loudspeakers – Surface Mount:

1. Quam model SYSTEM 1VP, or equivalent by Lowell
2. The speaker assembly shall include the following components:

a. Loudspeaker: Quam model 8C5PAX
b. Transformer: Integral to unit, 5W, 25 and 70.7V, 5 taps
c. Enclosure: SE1WVP
d. Baffle: BS8W

3. The loudspeakers shall include the following audio features:

a. Average Sensitivity: 92 dB-SPL, 1W / 1M
b. Power rating: 12W-RMS, EIA 426A Standard
c. Calculated Output: 99dB-SPL, 5W/ 1M
d. Frequency Response: 65 Hz -17kHz EIA 426A Standard
e. Nominal Coverage Angle: 90° Included Angle, -6dB/2kHz, Half Space
f. Audio Connection: 7” long, color-coded tinned wires, pre-cut

E. Loudspeakers – Flush Mount:

1. Quam model SOLUTION 1, or equivalent by Lowell
2. The speaker assembly shall include the following components:

a. Loudspeaker: Quam model 8C10PAX
b. Transformer: Integral to unit, 5W, 25 and 70.7V, 5 taps
c. Back Box: ERD8U
d. Baffle: BR8WS
e. Mounting Device SSB-3

3. The loudspeakers shall include the following audio features:

a. Average Sensitivity: 95 dB-SPL, 1W / 1M
b. Power rating: 20W-RMS, EIA 426A Standard
c. Calculated Output: 102dB-SPL, 5W/ 1M
d. Frequency Response: 60 Hz -17kHz EIA 426A Standard
e. Nominal Coverage Angle: 90° Included Angle, -6dB/2kHz, Half Space
f. Audio Connection: 7” Color Coded Leads

2.5 ACCESSORIES

A. Manufacturer:

1. Harding Instrument Co. Ltd.

B. Quick Connect Boards and Interface Cables:

1. Harding Instruments model QCB-120-1 with model CBL-STN-XX-RR interface cable for audio.
2. Harding Instruments model QCB-120-2 with model CBL-SWT-XX-RR interface cable for switches.
3. The quick connect board shall include the following features:

    a. Dimensions: 3.25” x 4.28” x 1.5”
    b. Intercom station field connections: Screw clamp terminals
    c. Exchange field connections: double ended cable

4. The SSI shall provide the required number of quick connect boards and interface cables for all intercom stations and ceiling speakers in the system.

C. Page Zone Expander:

1. Harding Instruments model PZE-110-0
2. The page zone expander shall include the following features:

    a. Dimensions: 1.75” x 19” x 16.13”
    b. General Features: Three relay-controlled paging inputs with six relay-controlled page outputs for each input. Screw terminal connections for both page inputs and outputs. Sixteen supervised input lines. Three status LEDs for “run”, “install” and “fault”.
    c. Operating Temperature: 32 to 122° F
    d. Storage Temperature: -40 to 158° F
    e. Humidity: 0 to 95% non-condensing
    f. Power Requirements: 95-135 VAC, 47-63 Hz, 150mA MAX
    g. Paging Inputs: Maximum power; 100W max @ 25 Vrms per bank
    h. Paging Outputs: Maximum power; 50W max @ 25 Vrms per channel
    i. Standards: FCC Part 15, UL, CSA

3. The SSI shall provide the required number of PZE-110-0 units to support paging zones as shown on the plans.

2.6 AUDIO RECORDING SYSTEM

A. Manufacturer:

1. Eventide

B. Description: An audio recording system shall be provided to interface with the IP audio communication system. One channel of recording shall be provided for each audio master

station location (GUI touchscreen master modules, VoIP telephone masters, etc.) in the system. The basis for the specification is Eventide.

C. Audio Recording System:

1. Eventide model NexLog740DX.
2. Recording system shall passively receive IP streams from IP audio system.
3. System shall provide G.711 encoded audio for clear and intelligible recordings.
4. Called party, calling party, time and duration shall be provided for search, analysis and retrieval.
5. System shall include browser-based HTML5 interface for search, replay, incident reconstruction, incident export, live monitoring and instant recall functionality.
6. The audio recorder shall include the following features:

a. Form Factor: 3U rack-mountable
b. CPU: Core i5
c. RAM: 16GB DDR4
d. NIC: (2) 100/1000 ports
e. Drives: 2 x 1TB fixed-mount HDDs (configured RAID1)
f. OS: Embedded Linux
g. Software: NexLog DX-Series software & MediaWorks DX web-based configuration manager with licenses for 8 concurrent users.
h. Front Panel: Audio controls and amplified speaker
i. Power: Dual hot-swap 120-240VAC 50/60Hz
j. Recording Channels: Provide 1 recording channel per each audio master station location.

EXECUTION

2.7 EXAMINATION

A. Verify the accuracy of all dimensions, allowances, and clearances on site prior to commencing with any work that may be affected by those dimensions, allowances, and clearances.

B. Comply with manufacturer’s installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in the Contract Documents.

C. Precautions shall be taken to guard against electrostatic and electromagnetic susceptibility and interference.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

2.8 INSTALLATION

A. Provide complete IP audio communication system as specified herein.

B. All material furnished shall be new and conform to the applicable requirements of the Underwriters Laboratories and the National Standards Institute.

C. All system equipment to be contained within equipment racks or cabinets.

D. Provide adequate ventilation for all heat radiating equipment. SSI shall provide fan kits as required to maintain rated operating temperature of installed equipment.

E. All system equipment and field devices to be held securely in place. Fastenings and supports shall be selected to provide a safety factor of three.

F. All system equipment equipped with plug in power connectors to be connected to a dedicated receptacle. Do not use tap connectors for plugging in multiple plugs into a single receptacle.

G. All cable within equipment racks, and cabinets, or on backboards, to be neatly bundled and secured.

H. Wires shall not be nicked, have strands removed, or have frayed strands when removing insulation or terminating.

I. Wiring shall be executed in strict adherence to standard broadcast practices.

J. All field device cables terminating to quick connector boards shall be labeled for easy identification.

2.9 CONNECTIONS

A. All IP audio communication system equipment connections shall be completed per manufacturer's recommendations and per SSI shop drawings.

B. Ground equipment according to manufacturer's recommendations.

2.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust IP audio communication system components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare pass/fail reports:

1. Intercom station inspection: SSI shall perform an inspection of each intercom station to ensure that each station pushbutton works correctly and that the volume of the speaker is adjusted to the optimum level.
2. Audio master stations shall be tested for proper operation.
3. Ceiling speakers with audio threshold detection shall be tested for proper operation.

C. Remove and replace malfunctioning units and retest as specified above.

2.11 ADJUSTING

A. SSI shall provide IP audio communication system configuration and adjustments. All intercom stations, loudspeakers and audio master stations shall be adjusted for optimum performance.

B. Occupancy Adjustments: Refer to specifications 280500, 3.5B.

2.12 DEMONSTRATION

A. Provide qualified personnel to train Owner's maintenance personnel to adjust, operate, and maintain the IP audio communication system. Refer to Division 01 Section "Demonstration and Training."

B. Training shall be video recorded.

END OF SECTION 285123

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BID CATEGORY BP NO. 11 ASPHALT PAVING SCOPE OF WORK **ADDENDUM #02**

This Scope of Work is to include, but is not limited to, the following Specification Sections:

Section	Description
Division 00	Procurement and Contracting Requirements
Division 01	General Requirements
32 11 23	AGGREGATE BASE COURSE (FINE GRADING)
32 12 16	FLEXIBLE PAVEMENT
32 17 23	PAINTED PAVEMENT MARKINGS

This Bid Package Scope of Work describes and assigns Work to this Bid Package as designated by the Construction Manager. Each Contractor shall cooperate and coordinate with all other Bid Package Contractors for proper and expedient completion of the Work in this Project. This summary should in no way be construed as being all inclusive. It is issued as a guide to aid in the assignment of Work and is intended to clarify and/or further define the Scope of Work included in the Bid Documents. They shall not be construed as the entire Scope of Work for this Bid Package. All work described or indicated in the respective Specifications Sections or Divisions listed above shall be included, except as specifically excluded herein.

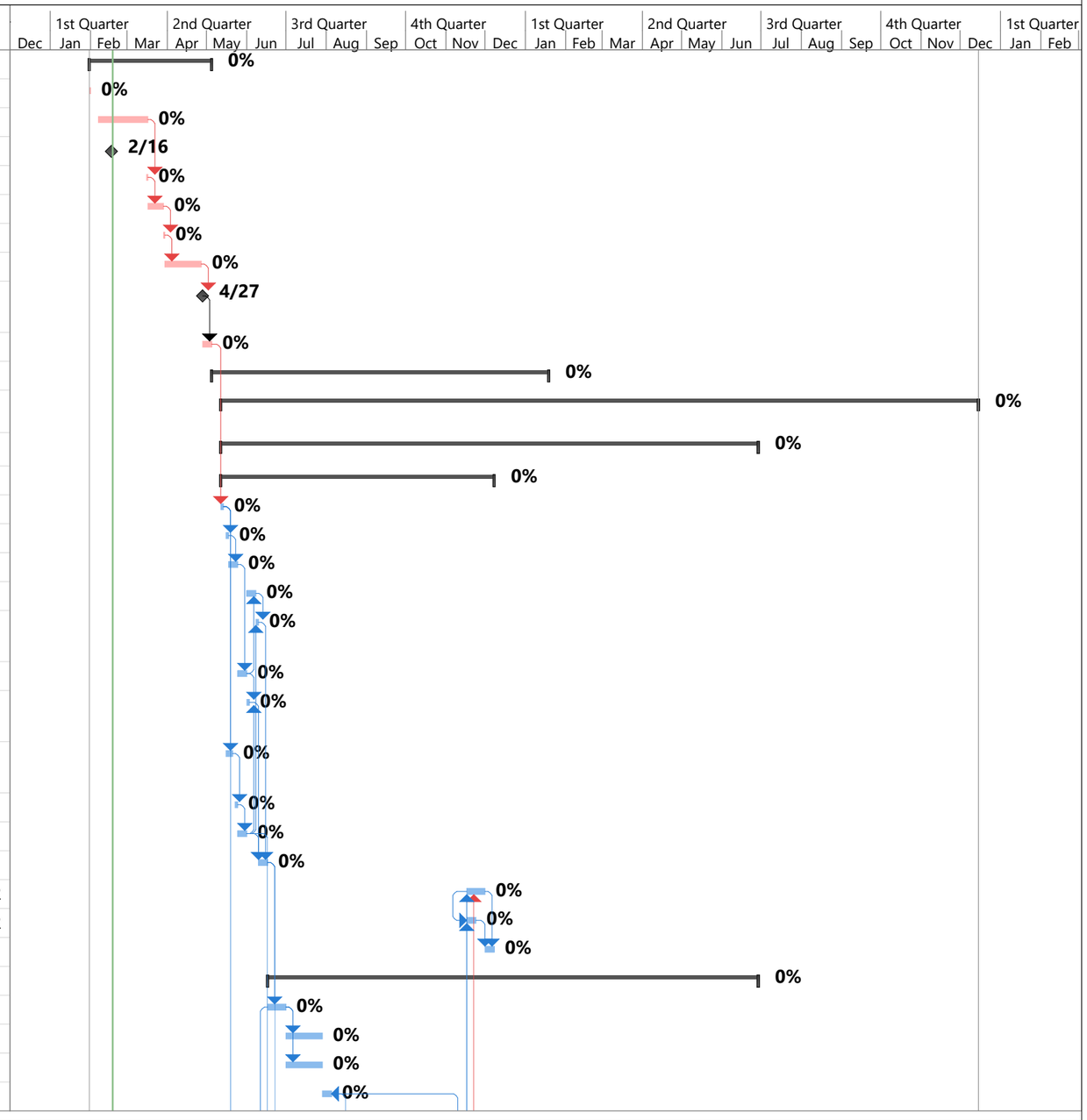
A. General Items
   1. Include in this scope of work a construction allowance of $15,000 to be utilized at the direction of the Construction Manager.
   2. Stone prep for asphalt paving shall be by Bid Package 2 – Site Development Contractor.
   3. Include fine grading of stone.
   4. Include milling and overlay of existing area indicated on Contract Documents.
   5. Provide and install all pavement marking and parking blocks / stops in accordance with the plans and specifications located on asphalt surface.
   6. Contractor is responsible to keep positive slope to drains.
   7. This contractor understands the construction of the Unit “F” Parking Lot will be expedited to provide for laydown/parking during construction.
      a) Site contractor will begin parking lot construction immediately upon mobilization to the site. Asphalt contractor agrees and understands, mobilization will be required to place binder, as soon as the stone subgrade is prepared.
      b) Include remobilization, sweeping/cleaning of binder, repair of soft or damaged areas of binder or subgrade, tack coat if required, and placing asphalt top at the conclusion of Unit “F”.
      c) Asphalt binder will be placed prior to concrete curbing.
      d) Include costs for additional asphalt materials as “over placed” beyond actual asphalt lot paving requirements.
      e) Saw cutting / Removal will be by Bid Package 1 - General Trades.

8. *This bid package includes providing and placing any / all asphalt paving and patching, including restripe as needed, at all areas of the existing pavement, which requires removal for completion of site utilities or other Bid Package scopes of work.*

END BID CATEGORY BP NO. 11 ASPHALT PAVING SCOPE OF WORK

KNOX County Detention Schedule 22-0218R.mpp

ID	Task Mode	WBS	Task Name	Duration	Start	Finish
1		**1**	**Pre-Construction**	**68 days**	**Mon 1/31/22**	**Wed 5/4/22**
2		1.1	Design Development	1 day	Mon 1/31/22	Mon 1/31/22
3		1.2	Project Bid Period (Feb 7st - Mar 16)	28 days	Mon 2/7/22	Wed 3/16/22
4		1.3	Pre-Bid Meeting	0 days	Wed 2/16/22	Wed 2/16/22
5		1.4	Receive Construction Bids	1 day	Wed 3/16/22	Wed 3/16/22
6		1.5	Garmong Bid / Scope / Budget Review	8 days	Thu 3/17/22	Mon 3/28/22
7		1.6	Budget Review With Commissioners	1 day	Tue 3/29/22	Tue 3/29/22
8		1.7	Sale Of Bonds	20 days	Wed 3/30/22	Tue 4/26/22
9		1.8	Board of Commissioners Awards Constuction Bids	0 days	Wed 4/27/22	Wed 4/27/22
10		1.9	Issue Prime Contracts	5 days	Thu 4/28/22	Wed 5/4/22
11		**2**	**Submittals & Procurement**	**185 days**	**Thu 5/5/22**	**Wed 1/18/23**
19		**3**	**Knox County Jail**	**416 days**	**Thu 5/12/22**	**Thu 12/14/23**
20		**3.1**	**Unit A**	**295 days**	**Thu 5/12/22**	**Wed 6/28/23**
21		**3.1.1**	**Site / Building Prep**	**150 days**	**Thu 5/12/22**	**Wed 12/7/22**
22		3.1.1.1	Mobilization	2 days	Thu 5/12/22	Fri 5/13/22
23		3.1.1.2	Site Layout	2 days	Mon 5/16/22	Tue 5/17/22
24		3.1.1.3	Erosion Control	5 days	Wed 5/18/22	Tue 5/24/22
25		3.1.1.4	Site Water Line Loop	5 days	Wed 6/1/22	Tue 6/7/22
26		3.1.1.5	Demo Existing Water Line - Bldg A Footprint	2 days	Wed 6/8/22	Thu 6/9/22
27		3.1.1.6	Site Sanitary Line - Reroute	5 days	Wed 5/25/22	Tue 5/31/22
28		3.1.1.7	Demo Existing Sanitary - Bldg A Footprint	2 days	Wed 6/1/22	Thu 6/2/22
29		3.1.1.8	Construct Temp Sheriff Access to Area B	5 days	Mon 5/16/22	Fri 5/20/22
30		3.1.1.9	Secure Area "A" / "B"	2 days	Mon 5/23/22	Tue 5/24/22
31		3.1.1.10	Demo. Existing Sally Port Structure	5 days	Wed 5/25/22	Tue 5/31/22
32		3.1.1.11	Bring Building Pad To Grade	5 days	Fri 6/10/22	Thu 6/16/22
33		3.1.1.12	Sidewalks	10 days	Thu 11/17/22	Wed 11/30/22
34		3.1.1.13	Concrete Curbing	5 days	Thu 11/17/22	Wed 11/23/22
35		3.1.1.14	Asphalt Paving	5 days	Thu 12/1/22	Wed 12/7/22
36		**3.1.2**	**Exterior Construction**	**269 days**	**Fri 6/17/22**	**Wed 6/28/23**
37		3.1.2.1	Concrete Footings	10 days	Fri 6/17/22	Thu 6/30/22
38		3.1.2.2	Electrical - Underslab	20 days	Fri 7/1/22	Thu 7/28/22
39		3.1.2.3	Plumbing - Underslab	20 days	Fri 7/1/22	Thu 7/28/22
40		3.1.2.4	Slab On Grade	5 days	Fri 7/29/22	Thu 8/4/22



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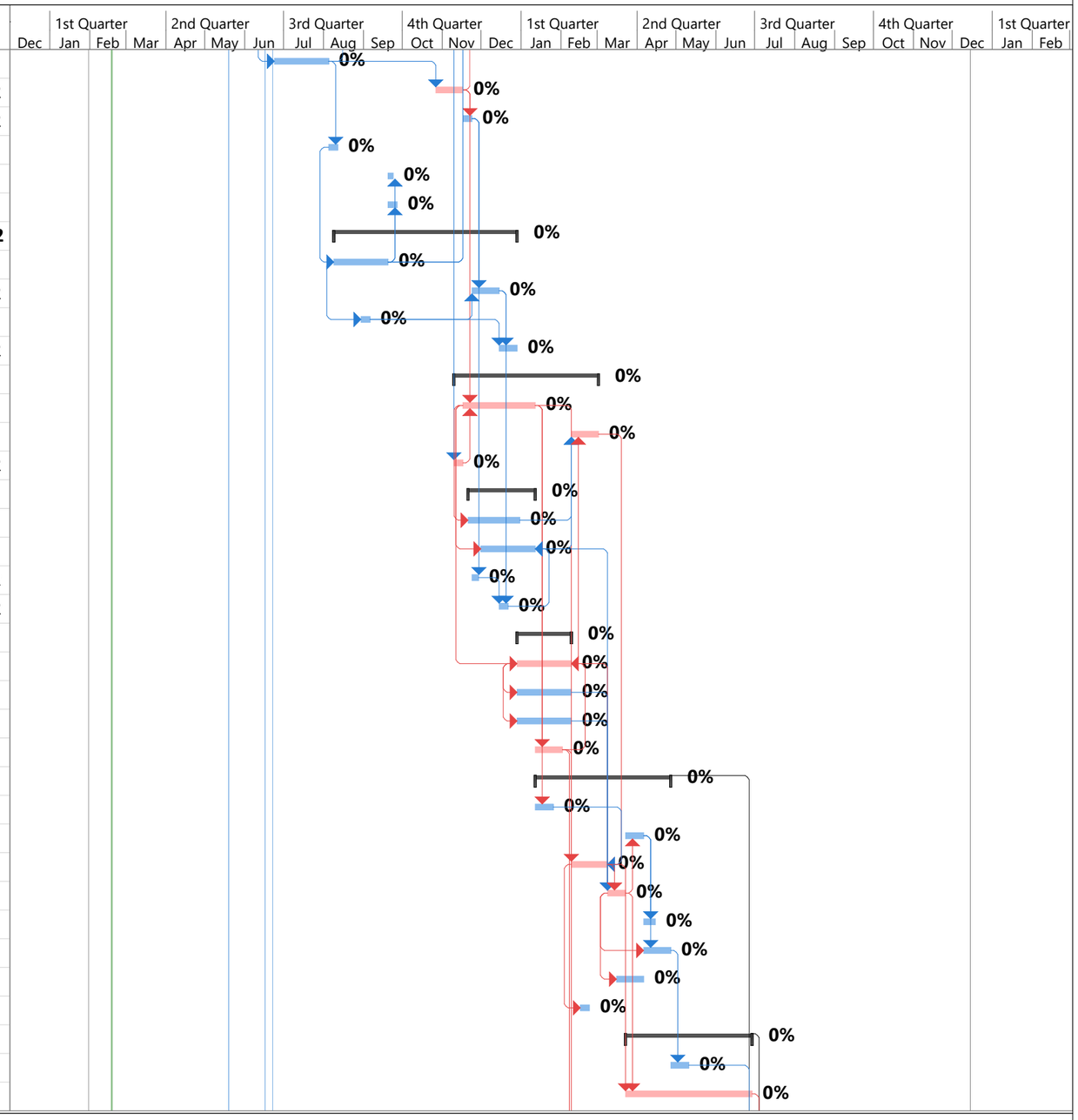
Critical Split	Task Progress	Duration-only	Milestone	Project Summary	Inactive Milestone
Critical Progress	Manual Task	Baseline	Summary Progress	External Tasks	Inactive Summary
Task	Start-only	Baseline Split	Summary	External Milestone	Deadline

ID	Task Mode	WBS	Task Name	Duration	Start	Finish
41		3.1.2.5	EXT Masonry Partitions	30 days	Fri 6/24/22	Thu 8/4/22
42		3.1.2.6	Structural Steel	15 days	Thu 10/27/22	Wed 11/16/22
43		3.1.2.7	Steel Decking	5 days	Thu 11/17/22	Wed 11/23/22
44		3.1.2.8	Rigid Insulation at Exterior Walls	5 days	Fri 8/5/22	Thu 8/11/22
45		3.1.2.9	Exterior HM Doors & Windows	4 days	Tue 9/20/22	Fri 9/23/22
46		3.1.2.10	OH Doors at Sallyport	5 days	Tue 9/20/22	Mon 9/26/22
47		**3.1.2.11**	**Exterior Finishes**	**102 days**	**Tue 8/9/22**	**Wed 12/28/22**
48		3.1.2.11	Exterior Brick	30 days	Tue 8/9/22	Mon 9/19/22
49		3.1.2.11	Roof Insulation / Membrane	15 days	Thu 11/24/22	Wed 12/14/22
50		3.1.2.11	Wood Blocking at CMU	5 days	Tue 8/30/22	Mon 9/5/22
51		3.1.2.11	Parapet Coping / Flashing	10 days	Thu 12/15/22	Wed 12/28/22
52		**3.1.2.12**	**Interior Construction**	**80 days**	**Thu 11/10/22**	**Wed 3/1/23**
53		3.1.2.12	Interior CMU Partitions	40 days	Thu 11/17/22	Wed 1/11/23
54		3.1.2.12	Construct Security Ceilings	15 days	Thu 2/9/23	Wed 3/1/23
55		3.1.2.12	HM Security Frames	5 days	Thu 11/10/22	Wed 11/16/22
56		**3.1.2.12**	**M&P Rough-Ins**	**38 days**	**Mon 11/21/22**	**Wed 1/11/23**
57		3.1.2.12	Piping Rough IN at Partitions	30 days	Mon 11/21/22	Fri 12/30/22
58		3.1.2.12	Ductwork	30 days	Thu 12/1/22	Wed 1/11/23
59		3.1.2.12	AHU Roof Curbs	3 days	Thu 11/24/22	Mon 11/28/22
60		3.1.2.12	Set AHU's	5 days	Thu 12/15/22	Wed 12/21/22
61		**3.1.2.12**	**Electrical Rough-Ins**	**30 days**	**Thu 12/29/22**	**Wed 2/8/23**
62		3.1.2.12	Power	30 days	Thu 12/29/22	Wed 2/8/23
63		3.1.2.12	Data	30 days	Thu 12/29/22	Wed 2/8/23
64		3.1.2.12	Security	30 days	Thu 12/29/22	Wed 2/8/23
65		3.1.2.12	Panels and Sub-Panels Installed	15 days	Thu 1/12/23	Wed 2/1/23
66		**3.1.2.13**	**Interior Finishes**	**75 days**	**Thu 1/12/23**	**Wed 4/26/23**
67		3.1.2.13	Doors / Hardware	10 days	Thu 1/12/23	Wed 1/25/23
68		3.1.2.13	Flooring	10 days	Thu 3/23/23	Wed 4/5/23
69		3.1.2.13	Paint	20 days	Thu 2/9/23	Wed 3/8/23
70		3.1.2.13	Acoustical Ceilings	10 days	Thu 3/9/23	Wed 3/22/23
71		3.1.2.13	Cabinets / Tops	7 days	Thu 4/6/23	Fri 4/14/23
72		3.1.2.13	Light Fixtures	15 days	Thu 4/6/23	Wed 4/26/23
73		3.1.2.13	HVAC Grilles / Diffusers	15 days	Thu 3/16/23	Wed 4/5/23
74		3.1.2.13	Electrical Devices / Trim	5 days	Thu 2/16/23	Wed 2/22/23
75		**3.1.2.14**	**Building Systems (Finish)**	**70 days**	**Thu 3/23/23**	**Wed 6/28/23**
76		3.1.2.14	Detention Devices	10 days	Thu 4/27/23	Wed 5/10/23
77		3.1.2.14	Security Access Controls	70 days	Thu 3/23/23	Wed 6/28/23



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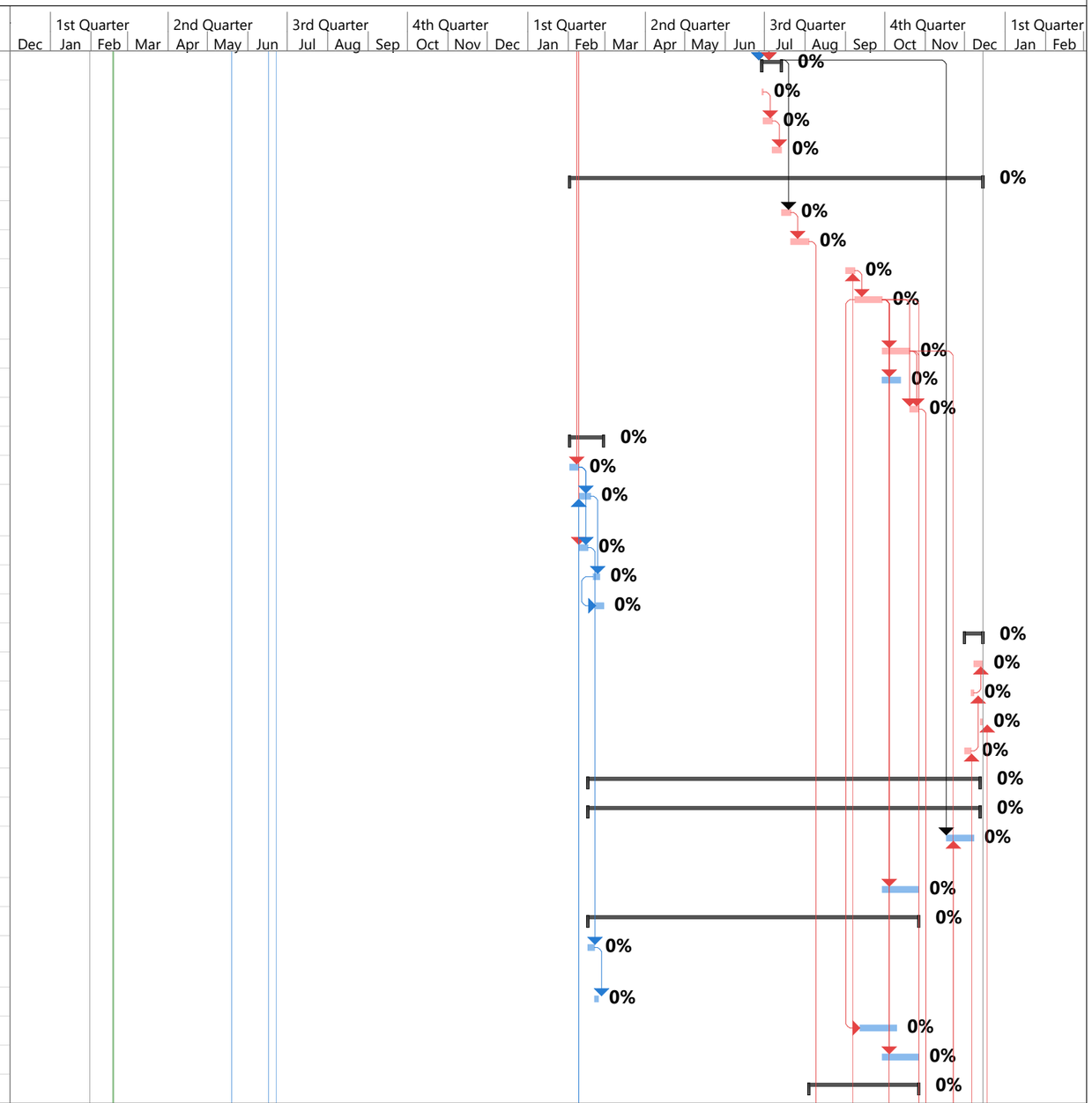
78		**3.2**	**Substantial Completion Unit "A"**	**11 days**	**Thu 6/29/23**	**Thu 7/13/23**
79		3.2.1	Punchlist Review	1 day	Thu 6/29/23	Thu 6/29/23
80		3.2.2	Punchlist Item Correction	5 days	Fri 6/30/23	Thu 7/6/23
81		3.2.3	Owner Move In	5 days	Fri 7/7/23	Thu 7/13/23
82		**3.3**	**Unit B**	**226 days**	**Thu 2/2/23**	**Thu 12/14/23**
83		3.3.1	Temp Construction Partitions	5 days	Fri 7/14/23	Thu 7/20/23
84		3.3.2	Selective Demolition	10 days	Fri 7/21/23	Thu 8/3/23
85		3.3.3	Concrete Floor Infill	5 days	Fri 9/1/23	Thu 9/7/23
86		3.3.4	Masonry Partitions (INCL Openings / Infills)	15 days	Fri 9/8/23	Thu 9/28/23
87		3.3.5	Secure Ceiling Construction	15 days	Fri 9/29/23	Thu 10/19/23
88		3.3.6	Interior Storefront / Glazing	10 days	Fri 9/29/23	Thu 10/12/23
89		3.3.7	Security Doors& Windows	5 days	Fri 10/20/23	Thu 10/26/23
90		**3.3.8**	**Secure Corridor**	**18 days**	**Thu 2/2/23**	**Mon 2/27/23**
91		3.3.8.1	Demo Existing Ceiling	5 days	Thu 2/2/23	Wed 2/8/23
92		3.3.8.2	Heating / Cooling Piping from Mech Rm Area "C"	7 days	Thu 2/9/23	Fri 2/17/23
93		3.3.8.3	Electrical Power from Bldg "C"	5 days	Thu 2/9/23	Wed 2/15/23
94		3.3.8.4	Install Acoustic Ceiling	5 days	Mon 2/20/23	Fri 2/24/23
95		3.3.8.5	New Lay In Light Fixtures	4 days	Wed 2/22/23	Mon 2/27/23
96		**3.3.9**	**Kitchen Upgrades**	**10 days**	**Fri 12/1/23**	**Thu 12/14/23**
97		3.3.9.1	Kitchen Equipment	5 days	Fri 12/8/23	Thu 12/14/23
98		3.3.9.2	Plumbing Fixtures	2 days	Wed 12/6/23	Thu 12/7/23
99		3.3.9.3	Light Fixtures	2 days	Wed 12/13/23	Thu 12/14/23
100		3.3.9.4	Acoustical Ceilings	3 days	Fri 12/1/23	Tue 12/5/23
101		**3.3.10**	**MEP Demo / Build Back**	**214 days**	**Thu 2/16/23**	**Tue 12/12/23**
102		**3.3.10.1**	**Mechanical Rough-Ins**	**214 days**	**Thu 2/16/23**	**Tue 12/12/23**
103		3.3.10.1	Remove / Replace Lighting Fixtures (Exist Ceiling)	15 days	Fri 11/17/23	Thu 12/7/23
104		3.3.10.1	Ductwork	20 days	Fri 9/29/23	Thu 10/26/23
105		**3.3.10.1**	**Power**	**181 days**	**Thu 2/16/23**	**Thu 10/26/23**
106		3.3.10.1	Tranformer at Property Storage #1125	3 days	Thu 2/16/23	Mon 2/20/23
107		3.3.10.1	Sub Panels	3 days	Tue 2/21/23	Thu 2/23/23
108		3.3.10.1	Data	20 days	Tue 9/12/23	Mon 10/9/23
109		3.3.10.1	Security	20 days	Fri 9/29/23	Thu 10/26/23
110		**3.3.10.1**	**Plumbing Rough-Ins**	**60 days**	**Fri 8/4/23**	**Thu 10/26/23**



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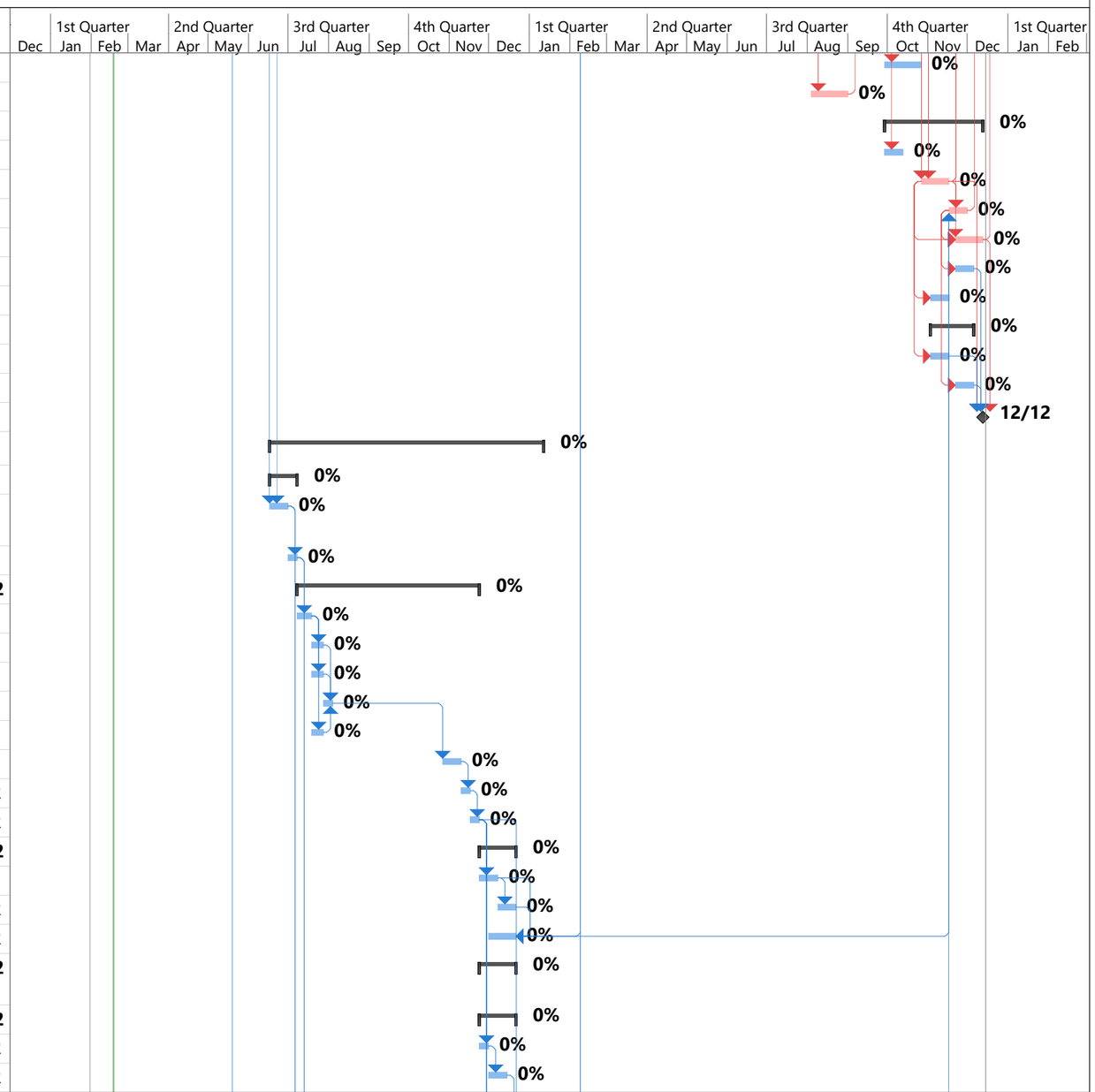
111		3.3.10.1	Water	20 days	Fri 9/29/23	Thu 10/26/23
112		3.3.10.1	Sanitary	20 days	Fri 8/4/23	Thu 8/31/23
113		**3.3.10.1**	**Interior Finishes**	**53 days**	**Fri 9/29/23**	**Tue 12/12/23**
114		3.3.10.1	Flooring	10 days	Fri 9/29/23	Thu 10/12/23
115		3.3.10.1	Paint	15 days	Fri 10/27/23	Thu 11/16/23
116		3.3.10.1	Acoustical Ceilings	10 days	Fri 11/17/23	Thu 11/30/23
117		3.3.10.1	Light Fixtures (New Ceilings)	15 days	Wed 11/22/23	Tue 12/12/23
118		3.3.10.1	HVAC Grilles / Diffusers	10 days	Wed 11/22/23	Tue 12/5/23
119		3.3.10.1	Electrical Devices / Trim	10 days	Fri 11/3/23	Thu 11/16/23
120		**3.3.10.1**	**Building Systems (Finish)**	**23 days**	**Fri 11/3/23**	**Tue 12/5/23**
121		3.3.10.1	Detention Devices	10 days	Fri 11/3/23	Thu 11/16/23
122		3.3.10.1	Security Access Controls	10 days	Wed 11/22/23	Tue 12/5/23
123		3.3.10.1	**Substantial Completion Unit "B"**	0 days	Tue 12/12/23	Tue 12/12/23
124		**3.4**	**Unit C**	**149 days**	**Fri 6/17/22**	**Wed 1/11/23**
125		**3.4.1**	**Site / Building Prep**	**15 days**	**Fri 6/17/22**	**Thu 7/7/22**
126		3.4.1.1	Selective Demolition (Outside Rec Concrete Etc.)	10 days	Fri 6/17/22	Thu 6/30/22
127		3.4.1.2	Building Pad To Grade	5 days	Fri 7/1/22	Thu 7/7/22
128		**3.4.2**	**Building Construction**	**99 days**	**Fri 7/8/22**	**Wed 11/23/22**
129		3.4.2.1	Concrete Footings	7 days	Fri 7/8/22	Mon 7/18/22
130		3.4.2.2	Electrical - Underslab	7 days	Tue 7/19/22	Wed 7/27/22
131		3.4.2.3	Plumbing - Underslab	7 days	Tue 7/19/22	Wed 7/27/22
132		3.4.2.4	Slab On Grade	5 days	Thu 7/28/22	Wed 8/3/22
133		3.4.2.5	Masonry Partitions	7 days	Tue 7/19/22	Wed 7/27/22
134		3.4.2.6	Structural Steel	10 days	Thu 10/27/22	Wed 11/9/22
135		3.4.2.7	Steel Decking	5 days	Thu 11/10/22	Wed 11/16/22
136		3.4.2.8	Roofing at Mechanical Room	5 days	Thu 11/17/22	Wed 11/23/22
137		**3.4.3**	**HVAC Equipment Installation / Piping**	**20 days**	**Thu 11/24/22**	**Wed 12/21/22**
138		3.4.3.1	Chill Water Equipment	10 days	Thu 11/24/22	Wed 12/7/22
139		3.4.3.2	Boiler Equipment	10 days	Thu 12/8/22	Wed 12/21/22
140		3.4.3.3	Heat / Cool Piping to Area "A"	15 days	Thu 12/1/22	Wed 12/21/22
141		**3.4.4**	**Electrical Rough-Ins (conduit/boxes/wire pulled)**	**20 days**	**Thu 11/24/22**	**Wed 12/21/22**
142		**3.4.4.1**	**Power**	**20 days**	**Thu 11/24/22**	**Wed 12/21/22**
143		3.4.4.1.1	Tranformer at ???	5 days	Thu 11/24/22	Wed 11/30/22
144		3.4.4.1.2	Sub Panels	10 days	Thu 12/1/22	Wed 12/14/22



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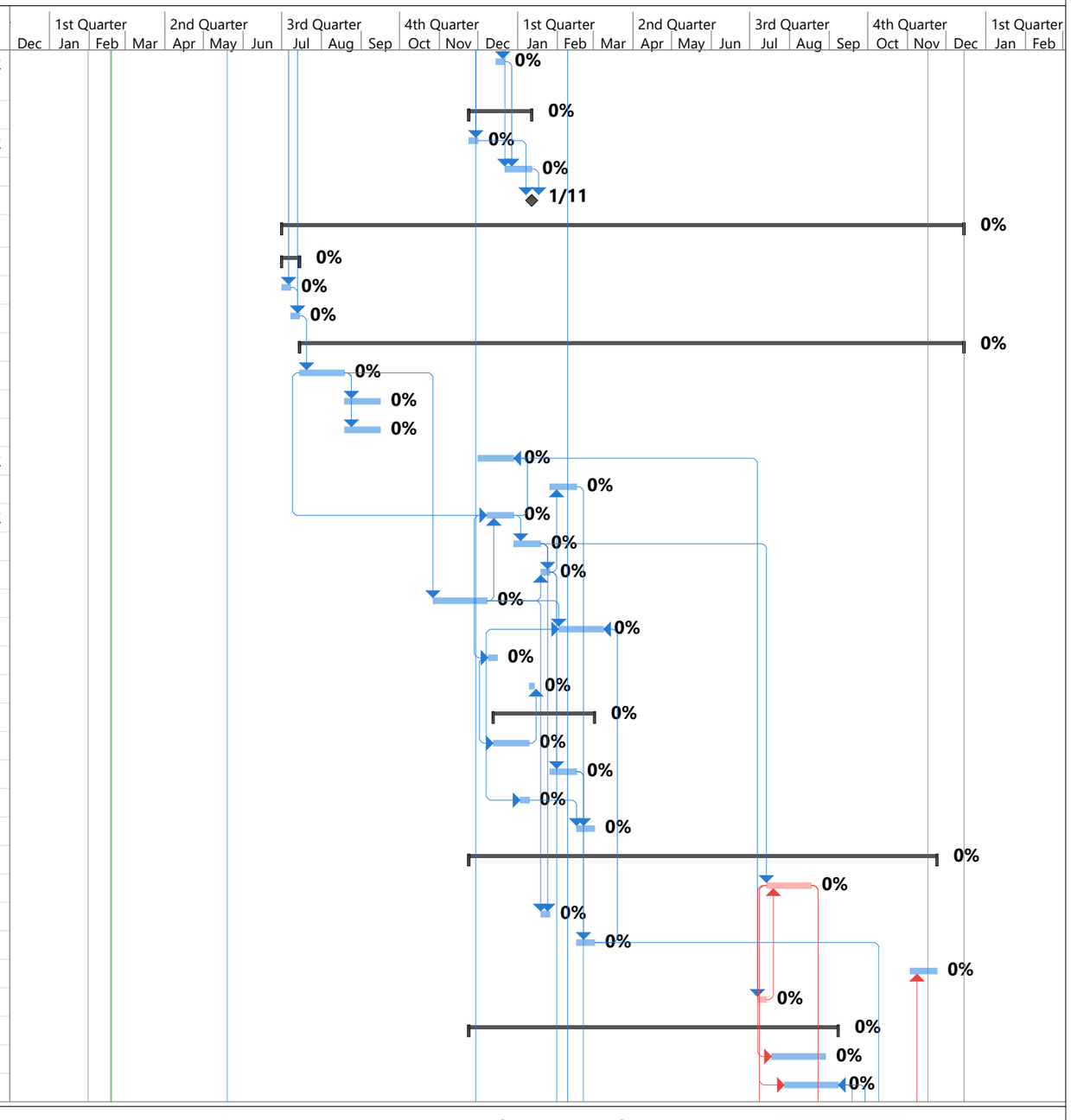
145		3.4.4.1.3	Mechanical Outlet / Switch / Conduit	5 days	Thu 12/15/22	Wed 12/21/22
146		**3.4.5**	**Interior Finishes**	**35 days**	**Thu 11/24/22**	**Wed 1/11/23**
147		3.4.5.1	Paint	5 days	Thu 11/24/22	Wed 11/30/22
148		3.4.5.2	Light Fixtures	15 days	Thu 12/22/22	Wed 1/11/23
149		3.4.5.3	**Substantial Completion Unit "C"**	0 days	Wed 1/11/23	Wed 1/11/23
150		**3.5**	**Unit D**	**380 days**	**Fri 7/1/22**	**Thu 12/14/23**
151		**3.5.1**	**Site / Building Prep**	**10 days**	**Fri 7/1/22**	**Thu 7/14/22**
152		3.5.1.1	Selective Demo at Exist Bldg Ext Walls	5 days	Fri 7/1/22	Thu 7/7/22
153		3.5.1.2	Bring Building Pad To Grade	5 days	Fri 7/8/22	Thu 7/14/22
154		**3.5.2**	**Exterior Construction**	**370 days**	**Fri 7/15/22**	**Thu 12/14/23**
155		3.5.2.1	Concrete Grade Beams / Footings	25 days	Fri 7/15/22	Thu 8/18/22
156		3.5.2.2	Electrical - Underslab	20 days	Fri 8/19/22	Thu 9/15/22
157		3.5.2.3	Plumbing - Underslab	20 days	Fri 8/19/22	Thu 9/15/22
158		3.5.2.4	Slab On Grade	20 days	Thu 12/1/22	Wed 12/28/22
159		3.5.2.5	Slab on Deck	15 days	Thu 1/26/23	Wed 2/15/23
160		3.5.2.6	EXT Masonry Partitions	15 days	Thu 12/8/22	Wed 12/28/22
161		3.5.2.7	Structural Steel	15 days	Thu 12/29/22	Wed 1/18/23
162		3.5.2.8	Steel Decking	5 days	Thu 1/19/23	Wed 1/25/23
163		3.5.2.9	PEB Framing	30 days	Thu 10/27/22	Wed 12/7/22
164		3.5.2.10	PEB Siding / Roofing	25 days	Thu 2/2/23	Wed 3/8/23
165		3.5.2.11	Rigid Insulation at Exterior Walls	5 days	Fri 12/9/22	Thu 12/15/22
166		3.5.2.12	Exterior HM Doors & Windows	4 days	Tue 1/10/23	Fri 1/13/23
167		**3.5.2.13**	**Exterior Finishes**	**57 days**	**Tue 12/13/22**	**Wed 3/1/23**
168		3.5.2.13	Exterior Brick	20 days	Tue 12/13/22	Mon 1/9/23
169		3.5.2.13	Roof Insulation / Membrane	15 days	Thu 1/26/23	Wed 2/15/23
170		3.5.2.13	Wood Blocking at CMU	5 days	Tue 1/3/23	Mon 1/9/23
171		3.5.2.13	Parapet Coping / Flashing	10 days	Thu 2/16/23	Wed 3/1/23
172		**3.5.2.14**	**Interior Construction**	**261 days**	**Thu 11/24/22**	**Thu 11/23/23**
173		3.5.2.14	Interior CMU Partitions	25 days	Fri 7/14/23	Thu 8/17/23
174		3.5.2.14	Interior Steel Stairs	5 days	Thu 1/19/23	Wed 1/25/23
175		3.5.2.14	Jail Pods	10 days	Thu 2/16/23	Wed 3/1/23
176		3.5.2.14	Interior Security Fencing Barriers	15 days	Fri 11/3/23	Thu 11/23/23
177		3.5.2.14	HM Security Frames	5 days	Fri 7/7/23	Thu 7/13/23
178		**3.5.2.14**	**M&P Rough-Ins**	**206 days**	**Thu 11/24/22**	**Thu 9/7/23**
179		3.5.2.14	Piping Rough IN at Partitions	30 days	Tue 7/18/23	Mon 8/28/23
180		3.5.2.14	Ductwork	30 days	Fri 7/28/23	Thu 9/7/23



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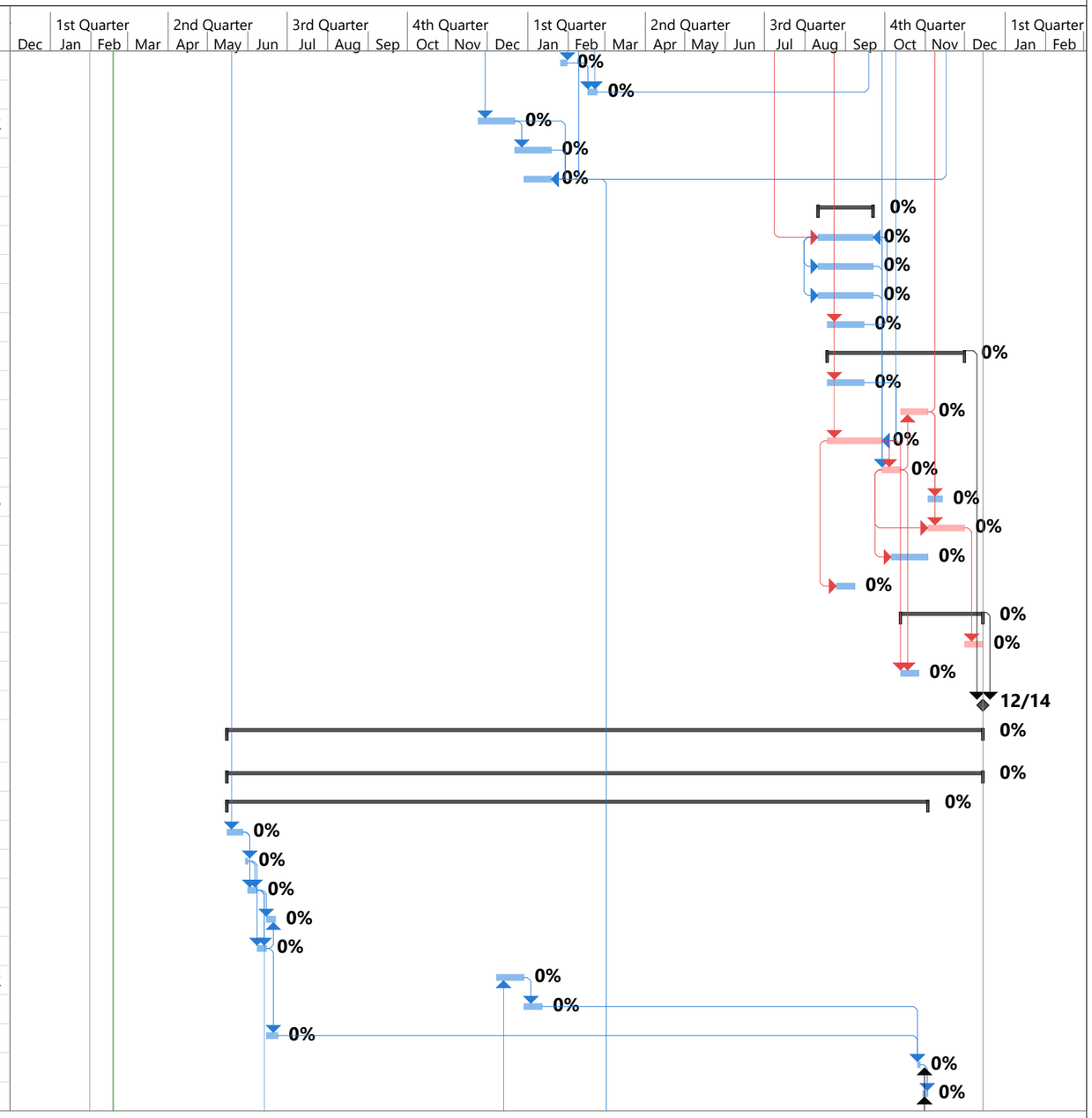
Inactive Summary
Deadline

KNOX County Detention Schedule 22-0218R.mpp

ID	Task Mode	WBS	Task Name	Duration	Start	Finish
181		3.5.2.14	AHU Roof Curbs	3 days	Thu 1/26/23	Mon 1/30/23
182		3.5.2.14	Set AHU's	5 days	Thu 2/16/23	Wed 2/22/23
183		3.5.2.14	Chill Water Equipment	20 days	Thu 11/24/22	Wed 12/21/22
184		3.5.2.14	Boiler Equipment	20 days	Thu 12/22/22	Wed 1/18/23
185		3.5.2.14	Heat / Cool Piping to Bldg "F"	15 days	Thu 12/29/22	Wed 1/18/23
186		**3.5.2.14**	**Electrical Rough-Ins**	**30 days**	**Fri 8/11/23**	**Thu 9/21/23**
187		3.5.2.14	Power	30 days	Fri 8/11/23	Thu 9/21/23
188		3.5.2.14	Data	30 days	Fri 8/11/23	Thu 9/21/23
189		3.5.2.14	Security	30 days	Fri 8/11/23	Thu 9/21/23
190		3.5.2.14	Panels and Sub-Panels Installed	20 days	Fri 8/18/23	Thu 9/14/23
191		**3.5.2.15**	**Interior Finishes**	**75 days**	**Fri 8/18/23**	**Thu 11/30/23**
192		3.5.2.15	Doors / Hardware	20 days	Fri 8/18/23	Thu 9/14/23
193		3.5.2.15	Flooring	15 days	Fri 10/13/23	Thu 11/2/23
194		3.5.2.15	Paint	30 days	Fri 8/18/23	Thu 9/28/23
195		3.5.2.15	Acoustical Ceilings	10 days	Fri 9/29/23	Thu 10/12/23
196		3.5.2.15	Cabinets / Tops	7 days	Fri 11/3/23	Mon 11/13/23
197		3.5.2.15	Light Fixtures	20 days	Fri 11/3/23	Thu 11/30/23
198		3.5.2.15	HVAC Grilles / Diffusers	20 days	Fri 10/6/23	Thu 11/2/23
199		3.5.2.15	Electrical Devices / Trim	10 days	Fri 8/25/23	Thu 9/7/23
200		**3.5.2.16**	**Building Systems (Finish)**	**45 days**	**Fri 10/13/23**	**Thu 12/14/23**
201		3.5.2.16	Detention Devices	10 days	Fri 12/1/23	Thu 12/14/23
202		3.5.2.16	Security Access Controls	10 days	Fri 10/13/23	Thu 10/26/23
203		3.5.3	**Substantial Completion Bldg "D"**	0 days	Thu 12/14/23	Thu 12/14/23
204		**4**	**Community Corrections**	**414 days**	**Mon 5/16/22**	**Thu 12/14/23**
205		**4.1**	**Unit "F"**	**414 days**	**Mon 5/16/22**	**Thu 12/14/23**
206		**4.1.1**	**Site / Building Prep**	**384 days**	**Mon 5/16/22**	**Thu 11/2/23**
207		4.1.1.1	Site Cut / Fill	10 days	Mon 5/16/22	Fri 5/27/22
208		4.1.1.2	Layout	2 days	Mon 5/30/22	Tue 5/31/22
209		4.1.1.3	Bring Building Pad To Grade	5 days	Wed 6/1/22	Tue 6/7/22
210		4.1.1.4	Expand Storm Retention Pond	5 days	Wed 6/15/22	Tue 6/21/22
211		4.1.1.5	Site Storm Piping	5 days	Wed 6/8/22	Tue 6/14/22
212		4.1.1.6	Sidewalks	15 days	Thu 12/8/22	Wed 12/28/22
213		4.1.1.7	Concrete Curbing	10 days	Thu 12/29/22	Wed 1/11/23
214		4.1.1.8	Asphalt Paving - binder only	7 days	Wed 6/15/22	Thu 6/23/22
215		4.1.1.9	Asphalt Paving - top	2 days	Thu 10/26/23	Fri 10/27/23
216		4.1.1.10	Parking Signage / Stripes	4 days	Mon 10/30/23	Thu 11/2/23



Critical
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Critical Progress
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Start-only
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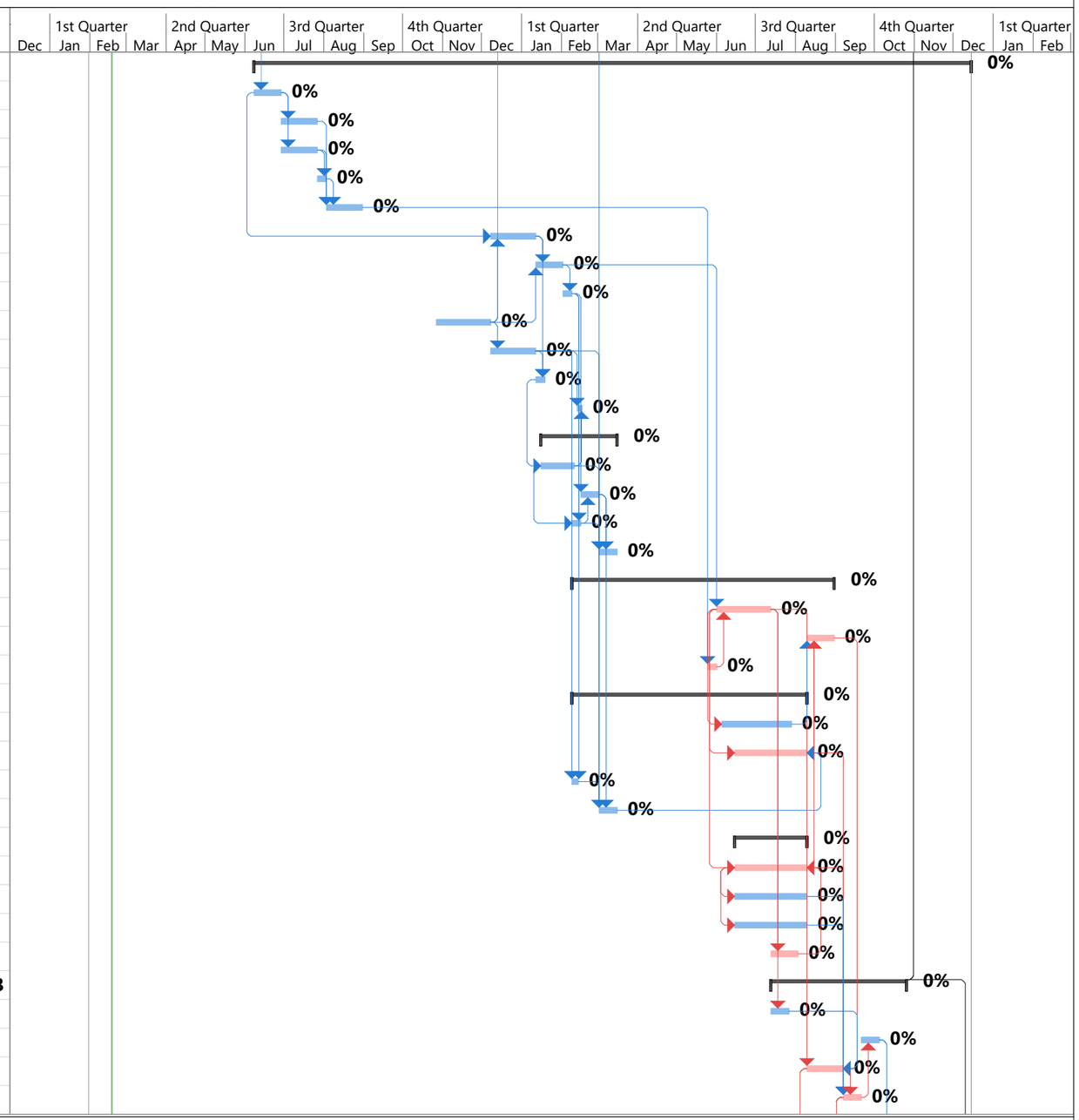
Baseline
Baseline Split
Baseline Milestone
Milestone
Summary Progress
Summary
Manual Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Deadline

ID	Task Mode	WBS	Task Name	Duration	Start	Finish
217		**4.1.2**	**Exterior Construction**	**397 days**	**Wed 6/8/22**	**Thu 12/14/23**
218		4.1.2.1	Concrete Footings / Grade Beams	15 days	Wed 6/8/22	Tue 6/28/22
219		4.1.2.2	Electrical - Underslab	20 days	Wed 6/29/22	Tue 7/26/22
220		4.1.2.3	Plumbing - Underslab	20 days	Wed 6/29/22	Tue 7/26/22
221		4.1.2.4	HVAC Underfloor Piping from Bldg "D"	5 days	Wed 7/27/22	Tue 8/2/22
222		4.1.2.5	Slab On Grade	20 days	Wed 8/3/22	Tue 8/30/22
223		4.1.2.6	EXT Masonry Partitions	25 days	Thu 12/8/22	Wed 1/11/23
224		4.1.2.7	Structural Steel	15 days	Thu 1/12/23	Wed 2/1/23
225		4.1.2.8	Steel Decking	5 days	Thu 2/2/23	Wed 2/8/23
226		4.1.2.9	PEB Framing	30 days	Thu 10/27/22	Wed 12/7/22
227		4.1.2.10	PEB Siding / Roofing	25 days	Thu 12/8/22	Wed 1/11/23
228		4.1.2.11	Rigid Insulation at Exterior Walls	5 days	Thu 1/12/23	Wed 1/18/23
229		4.1.2.12	Exterior HM Doors & Windows	4 days	Mon 2/13/23	Thu 2/16/23
230		**4.1.2.13**	**Exterior Finishes**	**43 days**	**Mon 1/16/23**	**Wed 3/15/23**
231		4.1.2.13	Exterior Brick	20 days	Mon 1/16/23	Fri 2/10/23
232		4.1.2.13	Roof Insulation / Membrane	10 days	Thu 2/16/23	Wed 3/1/23
233		4.1.2.13	Wood Blocking at CMU	5 days	Thu 2/9/23	Wed 2/15/23
234		4.1.2.13	Parapet Coping / Flashing	10 days	Thu 3/2/23	Wed 3/15/23
235		**4.1.2.14**	**Interior Construction**	**145 days**	**Thu 2/9/23**	**Wed 8/30/23**
236		4.1.2.14	Interior CMU Partitions	30 days	Thu 6/1/23	Wed 7/12/23
237		4.1.2.14	Construct Security Ceilings	15 days	Thu 8/10/23	Wed 8/30/23
238		4.1.2.14	HM Security Frames	5 days	Thu 5/25/23	Wed 5/31/23
239		**4.1.2.14**	**M&P Rough-Ins**	**130 days**	**Thu 2/9/23**	**Wed 8/9/23**
240		4.1.2.14	Piping Rough IN	40 days	Mon 6/5/23	Fri 7/28/23
241		4.1.2.14	Ductwork	40 days	Thu 6/15/23	Wed 8/9/23
242		4.1.2.14	AHU Roof Curbs	3 days	Thu 2/9/23	Mon 2/13/23
243		4.1.2.14	Set AHU's (Interior / Exterior)	10 days	Thu 3/2/23	Wed 3/15/23
244		**4.1.2.14**	**Electrical Rough-Ins**	**40 days**	**Thu 6/15/23**	**Wed 8/9/23**
245		4.1.2.14	Power	40 days	Thu 6/15/23	Wed 8/9/23
246		4.1.2.14	Data	40 days	Thu 6/15/23	Wed 8/9/23
247		4.1.2.14	Security	40 days	Thu 6/15/23	Wed 8/9/23
248		4.1.2.14	Panels and Sub-Panels Installed	15 days	Thu 7/13/23	Wed 8/2/23
249		**4.1.2.15**	**Interior Finishes**	**75 days**	**Thu 7/13/23**	**Wed 10/25/23**
250		4.1.2.15	Doors / Hardware	10 days	Thu 7/13/23	Wed 7/26/23
251		4.1.2.15	Flooring	10 days	Thu 9/21/23	Wed 10/4/23
252		4.1.2.15	Paint	20 days	Thu 8/10/23	Wed 9/6/23
253		4.1.2.15	Acoustical Ceilings	10 days	Thu 9/7/23	Wed 9/20/23



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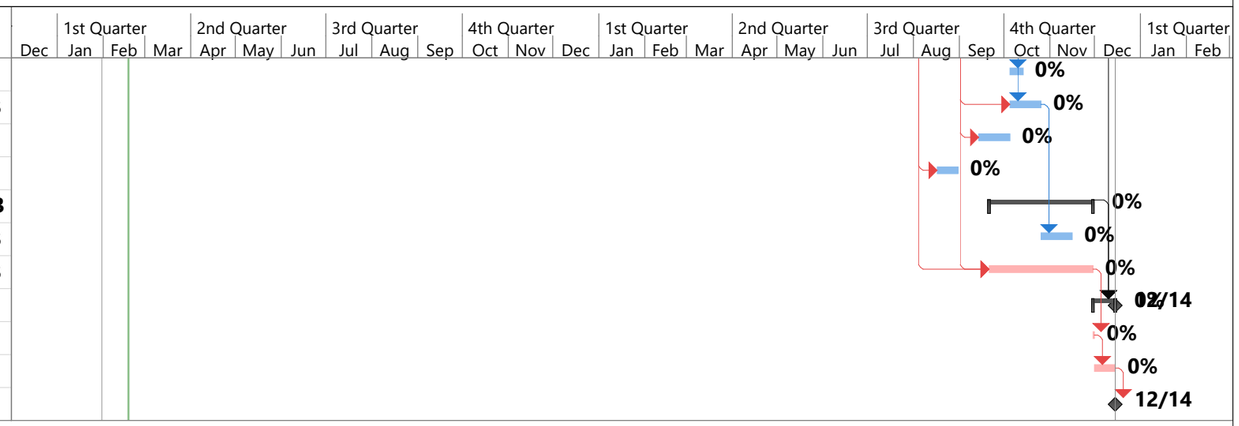
Inactive Summary
Deadline

KNOX County Detention Schedule 22-0218R.mpp

ID	Task Mode	WBS	Task Name	Duration	Start	Finish
254		4.1.2.15	Cabinets / Tops	7 days	Thu 10/5/23	Fri 10/13/23
255		4.1.2.15	Light Fixtures	15 days	Thu 10/5/23	Wed 10/25/23
256		4.1.2.15	HVAC Grilles / Diffusers	15 days	Thu 9/14/23	Wed 10/4/23
257		4.1.2.15	Electrical Devices / Trim	10 days	Thu 8/17/23	Wed 8/30/23
258		**4.1.2.16**	**Building Systems (Finish)**	**50 days**	**Thu 9/21/23**	**Wed 11/29/23**
259		4.1.2.16	Detention Devices	15 days	Thu 10/26/23	Wed 11/15/23
260		4.1.2.16	Security Access Controls	50 days	Thu 9/21/23	Wed 11/29/23
261		**4.1.2.17**	**Substantial Completion Unit "F"**	**11 days**	**Thu 11/30/23**	**Thu 12/14/23**
262		4.1.2.17	Punch List Review	1 day	Thu 11/30/23	Thu 11/30/23
263		4.1.2.17	Punch List Deficiency Correction	10 days	Fri 12/1/23	Thu 12/14/23
264		5	**Unit "F" Final Completion**	0 days	Thu 12/14/23	Thu 12/14/23



Critical		Split		Finish-only		Baseline Milestone		Manual Summary		Inactive Task	
Critical Split		Task Progress		Duration-only		Milestone		Project Summary		Inactive Milestone	
Critical Progress		Manual Task		Baseline		Summary Progress		External Tasks		Inactive Summary	
Task		Start-only		Baseline Split		Summary		External Milestone		Deadline	

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete as shown or implied by the Contract Documents.
2. Coordinate installation of vapor retarder, specified in Division 07.
3. Concrete fill in metal stair pans.
4. Concrete requirements for housekeeping pads and inertial isolation slabs.

B. Related Sections:

1. Division 03 Section: Concrete Formwork
2. Division 03 Section: Concrete Reinforcement
3. Division 03 Section: Grouting
4. Division 05 Section: Composite Metal Decking
5. Division 05 Section: Metal Stairs
6. Division 09 Flooring sections, for finishing and testing requirements for finished flooring.
7. Divisions 21, 22, and 23 for housekeeping pads and inertial isolation slabs
8. Division 26 - Electrical, for housekeeping pads
9. Division 32 Section: Site Concrete, for exterior walls and slabs-on-grade

1.2 REFERENCES

A. American Concrete Institute (ACI):

1. 116R – Cement and Concrete Terminology
2. 117 – Standard Specifications for Tolerances for Concrete Construction and Materials
3. 211.1 – Standard Practice For Selecting Proportions For Normal, Heavy Weight, And Mass Concrete
4. 211.2 – Standard Practice For Selecting Proportions For Structural Lightweight Concrete
5. 214 – Recommended Practice For Evaluation Of Strength Test Results Of Concrete
6. 301 – Specifications for Structural Concrete
7. 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete
8. 305 R – Recommended Practice For Hot Weather Concreting
9. 306 R – Recommended Practice For Cold Weather Concreting
10. 318 – Building Code Requirements For Reinforced Concrete

B. ASTM International (ASTM):

1. C 33 – Standard Specification for Concrete Aggregates
2. C 94 – Standard Specification for Ready-Mixed Concrete

3. C 143 – Standard Test Method for Slump of Hydraulic Cement Concrete
4. C 150 – Standard Specification for Portland Cement
5. C 260 – Standard Specification for Air-Entraining Admixtures for Concrete
6. C 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
7. C 330 – Standard Specification for Lightweight Aggregates for Structural Concrete
8. C 494 – Standard Specification for Chemical Admixtures for Concrete
9. C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
10. D 6 – Standard Test Method for Loss on Heating of Oil and Asphaltic Compounds
11. D 297 – Standard Test Methods for Rubber Products-Chemical Analysis
12. D 994 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
13. D 1752 – Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
14. E 1155 – Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers

1.3 SUBMITTALS

A. Product Data: Submit manufacturers literature for each type of product furnished.

B. Shop Drawings:

1. Provide layout drawings for coordination of floor slab pours. Indicate locations of expansion joints, construction joints, and control joints.

C. Quality Assurance Submittals:

1. Concrete Mix: Submit proposed concrete mix designs for each strength, slump, and combination of admixtures required for the Project.
2. Test Reports:

a. Submit chloride ion tests or total chloride tests (with generally accepted method to relate total chloride to chloride ion) to show compliance with maximum ion concentrations.

1) Tests may be from another job, utilizing the same proportions of aggregates, cements, and admixtures.

b. Submit slump, air-entrainment, compressive strength, and flatness and levelness test reports to the Architect/Engineer.

1.4 QUALITY ASSURANCE

A. Codes and Standards:

1. In addition to complying with all pertinent codes and regulations, comply with all pertinent requirements of the following American Concrete Institute Publications:

a. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials
b. ACI 211.1 – Standard Practice For Selecting Proportions For Normal, Heavy Weight, And Mass Concrete
c. ACI 211.2 – Standard Practice For Selecting Proportions For Structural Lightweight Concrete
d. ACI 214 – Recommended Practice For Evaluation Of Strength Test Results Of Concrete
e. ACI 305 R – Recommended Practice For Hot Weather Concreting
f. ACI 306 R – Recommended Practice For Cold Weather Concreting
g. ACI 318 – Building Code Requirements For Reinforced Concrete

2. Where provisions of pertinent codes and standards conflict with this section of the Project Manual, the more stringent provisions shall govern.

B. Qualification for Testing:

1. The following field-testing procedures shall be performed only by personnel holding current certificates issued by ACI for Concrete Field Testing Technician - Grade I as required by the local code.

a. Sampling of fresh concrete
b. Testing fresh concrete for slump
c. Testing fresh concrete for entrained air
d. Making concrete specimens for compression tests

2. Flatness and levelness testing: Floor flatness and levelness testing shall be performed by a technician trained in the use of the testing equipment and the procedures of ASTM E 1155.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section: Project Management and Coordination. Review methods and procedures related to concrete Work, including, but not limited to, the following:

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review requirements for concrete tolerances, finishing, and curing methods, prior to commencing concrete work

a. Include floor covering installers, to review specific tolerance and finish requirements.

1.5 PROJECT CONDITIONS

A. Environment Conditions:

1. Extreme temperature conditions:

a. When extreme hot or cold weather conditions occur, or are expected to occur, which might detrimentally affect concrete, employ handling and placing techniques to guard against such effects.

1) Comply with the ACI nomograph.

b. Comply with the recommendations of American Concrete Institute publications ACI 305 R and ACI 306 R, for hot and cold weather concreting.

2. Inclement weather:

a. Unless adequate protection is provided, do not place exterior concrete during rain, sleet, or snow.
b. Do not use calcium chloride or admixtures containing soluble chlorides.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement: ASTM C 150, Type I or III

B. Fine Aggregate: ASTM C 33 with fineness modules, 2.40 to 3.00. For pumped concrete, 15 to 30% passing number 50 sieve and 5 to 10% passing a number 100 sieve.

C. Coarse Aggregate:

1. ASTM C 33 with maximum size:

a. Three-fourths of minimum clear spacing between reinforcing bars or between bars and forms

2. Provide crushed stone for sidewalks, curbs, and exterior slabs/stairs
3. Pea gravel shall not be used as an aggregate for any part of the elevated structure or the foundation system. Pea gravel may be acceptable for miscellaneous structural items as approved by the Architect/Engineer.

D. Lightweight Aggregate: ASTM C 330
1. Nominal maximum size: ¾”
2. Pre-soak aggregate prior to mixing in accordance with aggregate supplier recommendations

E. Water: Clean, fresh, potable

F. Air-Entraining Admixture: ASTM C 260

G. Concrete shall not exceed maximum chloride ion content for corrosion protection as defined in ACI 318.

H. Fly Ash: ASTM C 618, Class C or F

1. Fly ash shall not replace more than 20% of the cement.

I. Curing and Sealing Compounds:

1. Products: Furnish one of the following curing or curing and sealing compounds for each application listed:

a. Interior concrete slabs to receive floor coverings or other applied material: ASTM C 309, Type 1D, Class B; water based, all resin, dissipating, VOC compliant, clear with fugitive dye.

1) The Euclid Chemical Company; Kurez DR VOX
2) Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W)
3) Laticrete International, Inc.; L&M Cure R
4) W.R. Meadows; 1100-CLEAR

b. Interior concrete slabs, finish scheduled as sealed concrete, or formed concrete requiring use of a curing compound: ASTM C 309, Type 1, Class B; water based, all resin, VOC compliant, clear.

1) Dayton Superior Corporation; Safe Cure & Seal 309 J18
2) The Euclid Chemical Company; Aqua-Cure VOX
3) Laticrete International, Inc.; Dress & Seal WB
4) W.R. Meadows; VOCOMP-20
5) BASF Corporation Building Systems; Kure-N-Seal W

c. Interior concrete slabs, finish scheduled as hardener/sealer or hardened sealed concrete (typical for all detention areas): Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

1) Conspec by Dayton Superior; Intraseal
2) Curecrete Distribution Inc.; Ashford Formula
3) Dayton Superior Corporation; Sure Hard Densifier J17
4) The Euclid Chemical Company; Euco Diamond Hard
5) Laticrete International, Inc.; Seal Hard
6) W.R. Meadows; Liqui-Hard

d. Product used shall be compatible with waterproofing if forms are stripped from concrete to receive waterproofing prior to 7 days curing above 50°F.
e. Refer to Part 3 Article “Curing” for removal of curing compounds.

2. If curing compound is not used, and the forms are stripped prior to 7 days curing, the following methods are approved:

a. Ponding or continuous sprinkling
b. Continuously wet mats
c. Sand kept continuously wet

J. Expansion Strips:

1. Self-expanding cork: ASTM D 1752, Type III, preformed, self-expanding strips formed of cork particles with a non-bitumen, isolable resin binder for all interior and exterior slabs at building vertical faces, or as noted.
2. Asphaltic board expansion joint: ASTM D 994, preformed joint material. Material shall not deform under normal handling, or become brittle. Use in exterior slabs, except at building vertical faces or as noted.
3. Closed-cell poly as denoted on the drawings.

K. Waterstops:

1. 20 OZ. Copper formed to shapes shown on the drawings.
2. PVC flat ribbed waterstops:

    a. Manufacturers:

        1) Vinylex Waterstop & Accessories
        2) Sika Greenstreak

    b. Shapes and sizes to be reviewed by the Architect/Engineer.

3. PVC dumbbell waterstops:

    a. Manufacturers:

        1) Vinylex Waterstop & Accessories
        2) Sika Greenstreak

    b. Shapes and sizes to be reviewed by the Architect/Engineer.

4. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

    a. Products: Subject to compliance with requirements, provide one of the following:
        1) Carlisle Coatings & Waterproofing; MiraStop
        2) CETCO; Volclay Waterstop-RX
        3) Concrete Sealants Inc.; Conseal CS-231
        4) Sika Corporation; Swellstop
        5) Henry Company; HF302 Hydro-Flex
        6) JP Specialties, Inc.; Earth Shield Type 20 or 23

5. Additional types, shapes, and sizes to fit the job conditions, with review by Architect/Engineer.

    a. Standard: Vinylex Waterstop & Accessories

L. Joint Sealant:

1. Flatwork: Two-part polysulfide compound

    a. Standard: The Euclid Chemical Company; Tammsflex NS/Tammsflex SL

2. Vertical joints: Two-part polysulfide compound

    a. Standard: W.R. Meadows

3. Vertical joints: Two-part polyurethane, refer to Division 07 Section: Sealants.

M. Water Reducing Admixtures:

1. Normal set: ASTM C 494, Type A
2. Retarders: ASTM C 494, Type D
3. Accelerators: ASTM C 494, Type C or E
4. High range water reducers: ASTM C 494, Type F

N. Crystalline Waterproofing Admixture: Waterproofing admixture that reacts with concrete to form dendritic crystalline structures in concrete pores and cracks.
1. Acceptable products:
    a. Kryton International, Inc.; Krystol Internal Membrane (KIM)
    b. Xypex Chemical Corporation; Xypex Admix
2. Provide in concrete where “integral crystalline waterproofing” or “integral waterproofing” is indicated.

O. Evaporation Retardant:

1. Standard: BASF Corporation; MasterKure ER 50
2. Apply per manufacturer's directions.

P. Vapor Retarders:

1. Refer to Division 07 Section: Vapor Retarders, or use the information within this section if there is no Specification section which pertains to vapor retarders.

2. Plastic Vapor Barrier: ASTM E 1745, Class A with a permeance of 0.01 as tested before and after mandatory conditioning (ASTM E 1745 Section 7.1 and sub paragraph 7.1.1-7.1.5) less than 0.01 perms (grains/(ft^2 hr in Hg). Include manufacturer’s recommended adhesive or pressure sensitive tape.
    a. Products:
        1) Fortifiber Corporation; Moistop Ultra 15.
        2) Reef Industries; Griffolyn G 15.
        3) Stego Industries, Stego Wrap 15.

Q. Bond Break:

1. 15 pound per square (100 sq.ft.) building paper

R. Bonding Agent:

1. Select bonding agent to suite the job condition and application.
2. Products:

    a. Conpro Chemicals Private Limited; Conpro SB-4
    b. The Euclid Chemical Company; SBR Latex

c. Laticrete International, Inc.; Everbond

3. Apply per manufacturer recommendations.
4. Finished concrete surface shall be roughened and cleaned, prior to application of the bonding agent.

2.2 MIX DESIGNS

A. Normal Weight Concrete:
1. Compressive strength: 4000 psi
2. Minimum cement content: 517 pounds per cubic yard (adjust for air entrainment)
3. Water/cement ratio: 0.45 maximum (typical), 0.40 for concrete exposed to de-icing salts, brackish water or salt spray. No water to be added to concrete after plant batching.
4. Slump: 4” + 1”, adjust with addition of admixture(s) for pumping.
5. Typical for all slabs, walls, beams, columns and footings unless noted otherwise.

B. Air-Entrainment:

1. Provide air entrainment at:

a. All concrete that is to be exposed to the elements (weather) in the completed structure.
b. All concrete in contact with salts.

2. All other concrete may be air-entrained or non-air-entrained, at the Contractor's option.

a. Hard-troweled finishes shall not have air-entrainment.

3. Percentage of air content shall be determined in accordance with the admixture manufacturer's recommendations, to meet ASTM C173 or ASTM C231, based on aggregate size and a moderate level of exposure.

C. Selection of Concrete Proportions:

1. Proportions of materials for concrete shall be established in accordance with Section 5.2 of ACI 318.

2. Follow ACI 211 and ACI 301 to determine the water-cement ratio for lightweight concrete.

3. Concrete Mixing:
a. Plant mix concrete materials in same proportions as approved concrete mix design in accordance with ACI 304.
1) Incorporate admixtures in quantities and using methods recommended by admixture manufacturers.
2) Incorporate only admixtures included in the approved mix design, or with approval by Architect/Engineer.
b. Do not add water to batched concrete without approval by Architect/Engineer.

D. High Slump Concrete:

1. Slumps greater than those specified may be used (up to 10") under the following conditions:

    a. Prior approval has been obtained from the Architect/Engineer, including location of pours and proposed mixes.
    b. Admixture systems or high range water reducers are used to achieve the high slumps.
    c. Water/cement ratios are compatible with normal mixes.
    d. Compressive strength of the concrete exceeds normal mixes at specified slumps.
    e. If high range water reducers are used, the admixture is added by a concrete technician employed by the concrete supplier.

2. Submit mix designs to Architect/Engineer for review.
3. This review is made to ensure that portions of the mix meet the specifications. All performance related criteria must still be met.

PART 3 - EXECUTION

3.1 SITE VERIFICATION OF CONDITIONS

A. Inspection:

1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that all items to be embedded in concrete are in place.
3. Verify that concrete may be placed to the lines and elevations indicated on the Drawings, with all required clearance from reinforcement.

B. Discrepancies:

1. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

A. Remove all wood scraps, ice, snow, frost, standing water, and debris from the area in which concrete will be placed.

B. Thoroughly wet the surface of excavations (except in freezing weather), coat forms with release agent, and remove all standing water.

C. Thoroughly clean all transporting and handling equipment.

D. All concrete slabs on grade to be placed on a granular fill. Depth of fill to equal the slab thickness unless otherwise noted.

E. Substrate over which the vapor barrier will be placed shall be compacted, smooth, and free of glass, large stones, and other objects that might puncture the barrier.

3.3 CONCRETE MIXING

A. Plant mix concrete materials in same proportions as approved concrete mix design and in accordance with ACI 304.

1. Incorporate admixtures in quantities and using methods recommended by admixture manufacturers.
2. Incorporate only admixtures included in the approved mix design, or with approval by Architect/Engineer.

B. Do not add water to batched concrete without approval by Architect/Engineer.

3.4 PLACING CONCRETE

A. Method:

1. Convey concrete from mixer to place of final deposit by methods that will prevent separation and loss of materials.
2. For chuting, pumping, and pneumatically conveying concrete, use only equipment of such size and design as to ensure a practically continuous flow of concrete at the delivery end without loss or separation of materials.
3. Deposit concrete as nearly as possible in its final position to avoid segregation due to re-handling and flowing.
4. Contractor shall use screed poles or similar devices to ensure that all slabs are cast at the proper elevations and that specified tolerances are maintained.
5. Deflections of supporting structure are to be anticipated to produce a level slab.

B. Rate of Placement:

1. Place concrete at such a rate that concrete is at all times plastic and flows readily between reinforcement.
2. When placing is once started, carry it on as a continuous operation until placement of the panel or section is complete.
3. Do not pour a greater area at one time than can be properly finished; this is particularly important during hot or dry weather.

C. Compaction:

1. Thoroughly consolidate all concrete by suitable means during placement, working it around all embedded fixtures and into corners of forms.
2. During placement, thoroughly compact the concrete by hand tamping and by mechanical vibration.

D. Acceptability:

1. Do not use retempered concrete or concrete that has been contaminated by foreign materials.

E. Limits of Pour:

1. Contractor to submit concrete placement drawings showing all the proposed construction joints for the prior approval of the Architect/Engineer.

2. Minimum time period between adjacent pours shall be 24 hours.

3.5 LEVELING AND FINISHING

A. General: Finish concrete in accordance with ACI 301.

B. Finishing Exposed Walls:

1. Remove fins and fill tie holes, honeycombs and air holes (bug holes).
2. Provide a rubbed finish on all interior exposed concrete walls.
3. Provide a smooth rubbed finish on all exposed exterior concrete walls, including site walls.
4. Finishing methods:

a. Rubbed finish:

1) Not later than one day after form removal, rub with carborundum brick or another abrasive to remove fins, ridges and other surface irregularities.

b. Smooth rubbed finish:

1) Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

C. Finishing Slabs, Flatwork, Walk, Stairs:

1. Trowel all interior slabs to a smooth, hard finish unless otherwise indicated.

a. Provide a non-slip finish in all areas subject to public traffic.

2. Surfaces to receive a light broom finish:

a. Exterior slabs, walks, stairs
b. Interior floors to receive a dry set mortar installation of ceramic tile, tile, or pavers.
c. Interior stair treads not scheduled to receive floor covering

3. Where floor drains or floor slopes are indicated, slope slabs uniformly to provide even fall for drainage.

D. Tolerances:

1. Place concrete so members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

    a. Level Alignment: Variance in elevation of top of slab in any typical structural bay shall not exceed 1/2 inch.
    b. Structural Steel and composite metal deck structures: Concrete shall be placed in a manner that produces a slab that will meet the specified flatness and levelness tolerances prior to application of any superimposed loads.

2. Floor slabs: Finish floor slabs to meet the following flatness and levelness test requirements.
3. Definitions:

    a. Test surface: The entire floor area on any one building level.
    b. Test Section: Any subdivision of the test surface measuring no less than 8 feet on a side and no less than 320 square feet.

4. Test Sections less than 8 feet on a side or less than 320 square feet or at slab boundaries, block-outs or other discontinuities excluded by ASTM E 1155: Finish and measure surface so gap at any point between concrete surface and an unleveled freestanding 10-foot- (3.05-m-) long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed 1/4 inch.

    a. Finish interior slab surfaces to the following tolerances, measured with a Type II apparatus within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface. Submit report to the Architect/Engineer within 72 hours of concrete placement.

        1) Specified overall values of flatness, F_F 30; and levelness, F_L 20; with minimum local values of flatness, F_F 24; and levelness, F_L 15.

        2) Note that floor levelness value need only be measured at slabs on grade and elevated floor slabs that are shored.

3.6 JOINTS

A. Expansion Joints:

1. Provide where indicated on the Contract Documents.
2. Install expansion strips full depth of joints.
3. Where caulking of joints is indicated on Drawings, install fillers to 1/2 inch of top and pour full with sealant.

    a. Standard: See "Joint Sealant for Flatwork," this section.

4. Provide self-expanding cork at all intersections of exterior concrete and vertical surfaces. Caulk top 1/2 inch of joint.
5. Where asphalt expansion joints are not sealed hold top of asphalt 1/4 inch below abutting concrete. Tool joints on both sides of expansion joint.

B. Tooled Joints:

1. Provide standard tooled joints where indicated on the Contract Documents.
2. Make joints straight, clean, and unragged.
3. Tool concrete on both sides of asphalt pavement.

C. Construction Joints:

1. Joints shall be made with properly constructed bulkheads and include formed keyways.
2. Reinforcing shall extend through all construction joints unless otherwise noted on the Contract Documents.
3. The Contractor shall consult with the Architect/Engineer before starting concrete work to establish a satisfactory placing schedule and to determine the location of construction joints so as to minimize the effects on the floor systems.
4. Horizontal construction joints, other than where shown on the Contract Documents, will not be permitted.
5. Vertical construction joints shall be located between quarter and third points of the spans. Submit construction joint layout for A/E review and approval.

D. Control Joints:

1. Control joints shall be provided in all slabs on grade unless waived by the Architect/Engineer. Elevated slabs shall not have control joints unless specifically detailed. Joints may not be required under carpet and sheet vinyl floor finishes.
2. Locate as shown on drawings or along column lines and at intervals not exceeding 20 feet in each direction. Review location with A/E prior to pouring slabs.
3. Control joints shall be 1/4 of the slab thickness and shall be sealed in accordance with "Joint Sealant" this section. Saw cut joints within 12 hours of placing the slab.

E. Bond Break:
1. Install where indicated, Lap seams a minimum of 4 inches.

F. Waterstops:

1. Install where indicated.

2. Install near center of concrete pour, unless otherwise indicated on the drawings.

3. Provide 3 inches minimum concrete cover for all bentonite waterstops unless otherwise indicated on the drawings or approved by the Architect/Engineer.

3.7 CURING

A. Formed Surfaces:

1. Cure formed surfaces by either of the following methods:

a. Refer to Division 03 Section: Concrete Formwork for minimum time periods that formwork must remain in place even when curing compound is used.

b. Leave forms in place until the cumulative number of days or fractions thereof, not necessarily consecutive, has totaled seven days during which the temperature of the air in contact with the concrete is 50°F or above.
c. Remove forms at an earlier time, but apply curing compound to concrete surfaces.
d. Apply compound in accordance with manufacturer's recommendations.
e. Do not add curing/sealing compound to walls that receive waterproofing unless a letter has been submitted to the Architect/Engineer, prior to the compound's use, that the specific compounds are compatible with their system.

B. Troweled Finish:

1. As soon as surface has dried sufficiently to not be marred by the application, apply sealer/curing compound in accordance with manufacturer's recommendations.
2. Do not add curing/sealing compound to walls that receive waterproofing unless a letter has been submitted to Architect/Engineer, prior to the compound's use, that the specific compounds are compatible with their system.
3. After application, keep all traffic, tools, materials, and equipment off such treated areas for at least twenty-four hours.
4. For floors scheduled as sealed concrete, after all other work in the area has been completed, apply a second coat of sealer/curing compound.

C. Wet Cure:

1. Concrete not covered with curing compound should be kept wet for at least 7 days.
2. Keep forms continuously wet to prevent the moisture loss until forms are removed.

D. Curing Compound Removal:

1. Remove residual curing compound from floor slabs to receive applied finishes using methods recommended by the manufacturer of the curing compound.
2. Remove curing compound no earlier than 28 days after application or after structure is enclosed and protected from exterior water sources.
3. Wet mop or rinse and wet vacuum slab to remove traces of cleaning products.

E. Hardener/Sealer:

1. Apply to wet-cured concrete in accordance with manufacturer’s instructions.

3.8 PATCHING AND REPAIR

A. Inspection/Remedial Work:

1. Immediately after forms and curing membranes have been removed, inspect all concrete surfaces and patch all pour joints, voids, rock pockets, form tie holds, and other imperfections before the concrete is thoroughly dry.

B. Patching and Minor Repairs:

1. At all permanently exposed portion of interior concrete formed surfaces, repair surface defects including color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface.

    a. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth.

        1) Make edges of cuts perpendicular to concrete surface.

    b. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
    c. Fill and compact with patching mortar before bonding agent has dried.
    d. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color.

    a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
    b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete durability and structural performance as determined by Architect/Engineer.
4. Remove all fins, offsets and projections by dry-stoning surfaces which will be exposed in the finished structure or will receive waterproofing or other barrier coating or membrane.

    a. Provide additional patching of foundation wall for application of waterproofing membrane, in accordance with the manufacturer's recommendations.

5. Remove or fill all ridges, trowel marks, protrusions or pits more than 1/8-inch diameter on floor slabs by dry-stoning, grinding, or filling with trowelable cementitious underlayment.

C. Patching of Existing Concrete:

1. Patch in manner to receive new finishes so that existing and patched surfaces are smooth and continuous and have a uniform appearance, using methods specified for patching and repair.

D. Major Defective Areas:

1. If the defects are serious or affect the strength of the structure, or if patching does not satisfactorily restore the quality and appearance of the surface, the Architect/Engineer may require the concrete to be removed and replaced complete in accordance with the provisions of this Section, all at no additional cost to the Owner.
2. Floor slabs that do not meet tolerances specified shall be remediated by the Contractor to the elevation, flatness, or levelness specified at no additional cost to the Owner.

a. Contractor shall use floor-leveling materials acceptable to the manufacturer of floor finishes scheduled for the area to be remediated.

3.9 TESTS

A. Testing Laboratory:

1. The **Contractor** shall engage the testing agency to conduct the testing for compliance with the requirements of the Project Manual.

B. Compression Tests:

1. Secure minimum five standard cylinders from each pour of concrete, additional five sets of cylinders for every 50 cubic yards of concrete placement of the day, in accordance with ASTM C31, and cure under standard moisture and temperature conditions.
2. From each batch test in accordance with ASTM C39.
3. Test two cylinders at 7 days and two cylinders at 28 days, and save one for additional test, if needed.
4. Submit duplicate tests reports of results from testing to Architect/Engineer.
5. Take steps immediately to evaluate unsatisfactory test results. Test the fifth cylinder.
6. In the event of unsatisfactory test results, an investigation as outlined in Section 5.6.4 of ACI 318-Latest Edition shall be employed.

C. Slump/Air-Entrainment:

1. Perform slump tests in accordance with ASTM C 143.
2. Determine the air content of air-entrained concrete in accordance with ASTM standards.
3. Report results of slump tests on each compression test report, and report whether the concrete represented by the compression tests is air-entrained or non air-entrained.

D. Floor Profile:

1. Test floor profile in accordance with ASTM E 1155 within 24 hours of floor placement, before shoring is removed.
2. Submit test results to Architect/Engineer within 72 hours of concrete placement.

E. Retesting:

1. Should additional testing be required because of unsatisfactory tests results, the Contractor shall bear the costs incurred for correcting any deficiencies and the costs of any tests.

END OF SECTION 03 30 00

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

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 high-performance coating systems on the following substrates:

1. Exterior Substrates:

a. Steel.
b. Galvanized metal.
c. Aluminum (not anodized or otherwise coated.)

2. Interior Substrates

a. Steel.
b. Galvanized metal.
c. Aluminum (not anodized or otherwise coated).

B. Related Requirements:

1. Section 051200 “Structural Steel Framing” and Section 051213 “Architecturally Exposed Structural Steel Framing” for shop priming of structural steel with primers specified in this Section.
2. Section 055213 “Pipe and Tube Railings” for shop priming and painting of pipe and tube railings with coatings specified in this Section.
3. Section 099113 “Exterior Painting” for general field painting.
4. Section 099123 “Interior Painting” for general field painting.

1.3 DEFINITIONS

A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
C. MPI 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.
1. Include printout of current “MPI Approved Products List” for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps 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: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

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. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 DELIVERY, STORAGE & HANDLING

A. 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.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.
B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Sherwin-Williams Company (The).
2. Benjamin Moore

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to products listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

2.2 HIGH-PERFORMANCE COATINGS: GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists".
B. Material Compatibility:

    1. Materials for use within each paint system shall be 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, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
    3. Products shall be of same manufacturer for each coat in a coating system.

C. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers".
D. Colors: As selected by Architect from manufacturer's full range.

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. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
C. Proceed with coating application only after unsatisfactory conditions have been corrected.

    1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPERATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems 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 coatings, including dust, dirt, oil, grease and incompatible paints and encapsulants.

    1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Steel Substrates: Remove rust, loose mill scale and shop primer (if any). Clean using methods recommended in writing by paint manufacturer; but not less than the following:

    1. SSPC-SP: 7/NACE, No. 4.
    2. SSPC-SP: 11.

3. SSPC-SP: 6/NACE, No. 3.
4. SSPC-SP: 10/NACE, No. 2.
5. SSPC-SP: 5/NACE, No. 1.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.
G. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in “MPI Architectural Painting Specification Manual”.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat but provide enough difference in shade of undercoats to distinguish each separate coat.
C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color and appearance.
D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections. Produce sharp glass lines and color breaks.

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 coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING & PROTECTION

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

C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, 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 coated surfaces.

3.6 COATING SYSTEMS FOR INTERIOR STEEL & NONFERROUS METALS

A. Interior Exposed Structural Steel:

1. System Type: Hydrophobic Acrylic Primer:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

1) Surface preparation: SSPC-2 or SSPC-3 and concrete surface shall be clean and dry.

a) Primer: Tnemec Series 115, applied at DFT 3.0 to 4.0 mils.
b) Primer: Carboline Santile 120, applied at DFT 2.0 to 3.0 mils.
c) Finish Coat: Tnemec Series 115, applied at DFT 3.0 to 4.0 mils.
d) Finish Coat: Carboline Sanilite 120, applied a DFT 2.0 to 3.0 mils.

2. System Type: Waterborne Acrylic Dryfall:

a. Primer: Sherwin-Williams WB Dryfall, 2.0 to 4.0 mils.
b. Finish: Sherwin-Williams WB Dryfall, 2.0 to 4.0 mils.

3.7 COATING SYSTEMS FOR SHOP-PRIMED STEEL TRIM, DOORS, RAILINGS & WINDOWS: INTERIOR & EXTERIOR

A. Steel

1. Surface Preparation: Clean and dry.

a. Primer: Sherwin-Williams - None needed.
b. Intermediate: Sherwin-Williams - SherCryl HPA, 2.0 to 3.0 mils.
c. Finish: Sherwin-Williams - SherCryl HPA, 2.0 to 3.0 mils.

3.8 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Wood Substrates: Glued-laminated construction.

1. Pigmented Polyurethane System MPI INT 6.1E:

a. Prime Coat: Polyurethane, two components, pigmented, matching topcoat.
b. Intermediate Coat: Polyurethane, two components, pigmented, matching topcoat.
c. Topcoat: Polyurethane, two components, pigmented, gloss (MPI Gloss Level 6), MPI #72.

END OF SECTION

SECTION 22 05 48

SEISMIC CONTROL FOR PLUMBING

GENERAL

1.1 SUMMARY

A. Section includes inertia bases, vibration isolation, acoustic housings, and for plumbing equipment.

1.2 PERFORMANCE REQUIRMENTS:

A. Provide vibration isolation on motor driven equipment over 0.5 hp, plus connected piping.

B. Provide minimum static deflection of isolators for equipment as indicated.

1. 1. Basement, Under 20 hp

a. Under 400 rpm: 1 inch

b. 400 – 600 rpm: 1 inch

c. 600 – 800 rpm: 0.5 inch

d. 800 – 900 rpm: 0.2 inch

e. 1100 – 1500 rpm: 0.14 inch

f. Over 1500 rpm: 0.1 inch

2. Basement, Over 20 hp

a. Under 400 rpm: 2 inch

b. 400 – 600 rpm: 2 inch

c. 600 – 800 rpm: 1 inch

d. 800 – 900 rpm: 0.5 inch

e. 1100 – 1500 rpm: 0.2 inch

f. Over 1500 rpm: 0.15 inch

3. Upper Floors, Normal

a. Under 400 rpm: 3.5 inch

b. 400- 600 rpm: 3.5 inch

c. 600 – 800 rpm: 2 inch

d. 800 – 900 rpm: 1 inch

e. 1100 – 1500 rpm: 0.5 inch

f. Over 1500 rpm: 0.2 inch

4. Upper Floors, Critical

a. Under 400 rpm: 3.5 inch

b. 400 – 600 rpm: 3.5 inch

c. 600 – 800 rpm: 3.5 inch

d. 800 – 900 rpm: 2 inch

e. 1100 – 1500 rpm 1 inch

f. Over 1500 rpm: 0.5 inch

C. Consider upper floor locations critical unless otherwise indicated.

D. Use concrete inertia bases for fans having static pressure in excess of 3.5 inch or motors in excess of 40 hp, and on base mounted pumps over 10 hp.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal procedures: Submittal procedures.

B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.

C. Product Data: Submit schedule of vibration isolator type with location and load on each. Provide catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.

D. Design Data: Provide engineering calculations maximum room sound levels are not exceeded.

E. Test Reports: Indicate dynamic insertion loss and noise generation values of silencers, acoustic housings meet or exceed specified sound transmission loss values.

F. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements that maintain integrity of sound isolation.

G. Manufacturer's Certificate: Certify that isolators meet or exceed specified requirements.

H. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 77 00 – Closeout Procedures: Closeout procedures.

B. Project Record Documents: Record actual locations of cross-talk silencers, acoustic housings and ductwork lagging. Record actual locations of hangers including attachment points.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with AMCA 300, ANSI S1.13, ARI 575, ASA 16, (ANSI S1.36) standards and recommendations of ASHRAE 68.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 3 years documented experience.

B. Design application of duct silencers, acoustic housings and seismic snubbers under direct supervision of a professional engineer experienced in design of this work and licensed at the place where the project is located.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 WARRANTY

A. Section 01 77 00 – Closeout Procedures: Product warranties and product bonds.

B. Provide five-year manufacturer warranty for bases.

PART 2 -PRODUCTS

2.1 INERTIA BASES

A. Structural Bases:

1. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
2. Vibrex Type "RMSBI": Shall be constructed of concrete cast into a fabricated inertia base frame, the steel members of which are designed and supplied by the isolator manufacturer. The concrete shall be poured into a welded structural steel frame, incorporating prelocated mounting templates, ½" diameter reinforcing bars on nominal 8" center each way, and external isolator mounting brackets to reduce the mounting height of the equipment. The inertia base must have a welded solid steel bottom plate. No formed or bolted light gauge steel bases will be allowed.

MOTOR SIZE	MIN. THICKNESS (inches)
5 – 15	6
20 – 50	8
60 – 75	10
100 – 200	12

3. Minimum thickness of the inertia base shall be according to the following tabulation:

4. A minimum operating clearance of 2 inches shall exist between the inertia base and housekeeping pad.

5. Construction: Welded structural steel with gusset brackets, supporting equipment and motor with motor slide rails.

B. Concrete Inertia Bases:

1. Mass: Minimum of 1.5 times weight of isolated equipment.
2. Construction: Structured steel channel perimeter frame, with gusset brackets and anchor bolts, adequately reinforced, concrete filled.
3. Connecting Point: Reinforced to connect isolators and snubbers to base
4. Concrete: Reinforced 3,000pse concrete

2.2 VIBRATION ISOLATORS

A. Open Spring Isolators:

1. Spring Isolators:

a. For Exterior and Humid Areas: provide hot dipped galvanized housings and neoprene coated springs.

b. Code: Color code springs for load carrying capacity

2. Vibration Isolator Types:

a. Spring isolators shall incorporate the following:

1) Minimum diameter equal to the loaded operating height and horizontal spring stiffness 0.9 to 1.5 times rated vertical spring stiffness. Corrosion resistance where exposed to weather, hardware shall be cadmium plated.

2) Reserved deflection (from loaded to solid height (of 50 percent of rated deflection with leveling device.

3) Minimum ¼ inch thick neoprene acoustical base pad on underside, unless designated otherwise. Neoprene acoustical grommets at baseplate lag holes.

4) Designed and installed so that ends of springs remain parallel.

5) Spring Isolators to be Vibrex Type “RMS”.

3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.

4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

B. Restrained Spring Isolators:

1. Seismic Restraints: Shall be capable of safely accepting 0.7 g' external forces without failure, or one "g" for life safety equipment. Shall maintain equipment in a captive position. Shall no short circuit vibration isolation systems or transmit objectionable vibration or noise. Shall be provided on all equipment s scheduled on drawings. Calculations by California Structural or Civil Engineer shall be submitted to verify snubber capacities.

   a. Seismic Restraint, Type II: Each corner of side seismic restraint shall incorporate minimum 5/16 inch thick resilient pad limit stops. Restraints shall be made of plate, structural members, or steel pipes in a welded assembly incorporating resilient pads. Vibrex Type SR – "e500" O.S.H.P.D. pre-approved seismic restraint, R #0029.

2. Spring Isolators:

   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

   b. Code: Color code springs for load carrying capacity.

3. Springs: Minimum horizontal stiffness equal to 50 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Spring Mounts: provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
5. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
6. Restraint: Provide heavy mounting frame and limit stops.

C. Closed Spring Isolators:

1. Spring Isolators:

   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

   b. Code: color code springs for load carrying capacity.

2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 50 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.

D. Restrained Closed Spring Isolators:

1. Spring Isolators:

   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

   b. Code: color code springs for load carrying capacity.

2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.

E. Spring Hanger:

1. Spring Isolators

   a. For Exterior and Humid Areas: provide hot dipped galvanized housings and neoprene coated springs.

   b. Code: color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
4. Misalignment: Capable of 20 degree hanger rod misalignment.

F. Neoprene Pad Isolators:

1. Rubber or neoprene-waffle pads

    a. 30 durometer

    b. Minimum ½ inch thick

    c. Maximum loading 40 psi

    d. Height of ribs shall not exceed 0.7 times width.

2. Configuration: ½ inch thick waffle pads bonded each side ¼ inch thick steel plate.

G. Rubber Mount or Hanger: Molded rubber designed for 0.5 inch deflection with threaded insert.

H. Glass Fiber pads: Neoprene jacketed pre-compressed molded glass fiber.

I. Seismic Snubbers:

1. Type: Non-Directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
2. Neoprene Elements: Replaceable, minimum of 0.75 inch thick
3. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

2.3 ACOUSTIC HOUSINGS

A. Description: Modular panels, including access doors and windows, nominal 4 inches thick, with filled outer and inner casing. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible.

B. Materials:

1. Outer Casing: Minimum 18 gage thick galvanized steel stiffened as required, with welded seams for overlapping lip joining.
2. Inner Casing and Splitters: Minimum 22 gage thick perforated galvanized steel.
3. Fill: Glass fiber or mineral wool of minimum 4-3/4 lb/cu feet density.
4. Fill Liner: Bonded glass fiber matting
5. Window: Size per design. Double glazed with ¼ inch safety glass

C. Rating: Provide ASTM E90 sound transmission loss minimum at Octave Band Center Frequencies (Hz) of 63, 125, 250, 500, 1000, 2000, 4000.

PART 3 -EXECUTION

3.1 EXAMINATION

A. Verify that all equipment, ductwork and piping that are installed before work in this section begins are as shown on the Contract drawings.

3.2 EXISTING WORK

A. Ensure access to existing piping and ductwork and other installations which remain active and which require access. Modify installation or provide access panel as appropriate.

B. Extend existing piping and ductwork installations using materials and methods as specified.

3.3 INSTALLATION

A. Install isolation for motor driven equipment.

1. Bases:

a. Set steel bases for 1-inch clearance between housekeeping pad and base.

b. Set concrete inertia bases for 2-inch clearance between housekeeping pad and base.

c. Adjust equipment level.

B. Install spring hangers without binding.

C. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

D. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

E. Provide pairs of horizontal limit springs on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans.

F. Provide resiliently mounted equipment and piping with seismic snubbers. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05-inch maximum clearance. Other snubbers shall have clearance between 0.15 inch and 0.25 inch.

G. Support piping connections to isolated equipment resiliently as follows:

1. Up to 4 inch diameter: First three points of support
2. 5 to 8 inch diameter: First four points of support
3. 10 inch diameter and over: First six points of support
4. Select 3 hangers closest to vibration source for minimum 1.0-inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or ½ static deflection of isolated equipment.

H. Connect wiring to isolated equipment with flexible hanging loop.

3.4 FIELD QUALITY CONTROL

A. Inspect isolated equipment after installation and submit reports. Include static deflections.

B. After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations, as directed. Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements. Submit complete report of test results including sound curves.

3.5 MANUFACTURER'S FIELD SERVICES

A. Provide services of testing agency to take noise measurement. Use meters meeting requirements of ASA 47 (ANSI S1.4).

END OF SECTION

SECTION 22 05 53

PIPE AND EQUIPMENT IDENTIFICATION

PART 1 - GENERAL

1.1 REFERENCE

A. All applicable requirements of other portions of the Contract Documents apply to the work of this Section, including, but not limited to, Division 01, General Requirements.

1.2 DESCRIPTION OF WORK

A. Work of this Section includes, but is not limited to: Piping identification, Valve identification, Equipment identification.

1.3 QUALITY ASSURANCE

A. Piping System Identification: ANSI A13.1-1981, "Scheme for the Identification of Piping Systems."

1.4 SUBMITTALS

A. Shop Drawings: Not required for review.

B. Product Data: Manufacturer's cut sheets and/or literature.

C. Samples: Not required for review.

D. Reference Submittals: Not required for review.

E. Contract Closeout Information: Valve chart showing valve numbers, type, and location.

PART 2 - PRODUCTS

2.1 PIPE MARKERS

A. Conform to ANSI A13.1-81.
   1. Pressure-sensitive vinyl (self-sticking) material.
   2. Mechanically Fastened Type: Snap-on or strap-on. For dirty greasy, oily pipe where pressure-sensitive markers may not perform satisfactorily.
   3. Provide with direction of flow arrows.
   4. Size of Letters Legend

Outside Diameter of Pipe or Pipe Covering	Length of Color Field	Size of Letters and Arrows
3/4 to 1-1/4 inch	8 inch	1/2 inch
1-1/2 to 2 inch	8 inch	3/4 inch
2-1/2 to 6 inch	12 inch	1-1/4 inch
8 to 10 inch	24 inch	2-1/2 inch
Over 10 inch	32 inch	3-1/2 inch

2.2 VALVE TAGS

A. Brass or Anodized Aluminum Type
   1. Brass: Minimum 19 ga, polished, 1-1/2-inch diameter with following lettering:
      a. Service: 1/4 inch stamped black filled letters.
      b. Valve numbers: 1/2 inch stamped black filled letters.
   2. Aluminum: 2-inch diameter, 0.032 inch thick, with following lettering:
      a. Service: 1/4 inch engraved letters.
      b. Valve numbers: 1/2 inch engraved letters.

B. Valve Tag Fasteners: 4-ply 0.018 copper or monel wire meter seals, brass "S" hooks or No. 16 brass jack chain.

2.3 EQUIPMENT NAME PLATES

A. 1/16-inch rigid plastic "Setonply," "Emedolite," or bakelite with 4 edges beveled, or engraved aluminum with black enamel background and natural aluminum border and letters.
   1. Two 3/8-inch mounting holes.
   2. Lettering size: Minimum 1/2-inch high.
   3. Fasteners: Commercial quality, rust-resisting nuts and bolts with backwashers and self-tapping screws or rivets.

2.4 CHART AND DIAGRAM FRAMES

A. Extruded aluminum with plexiglass or glass windows.

2.5 ACCEPTABLE MANUFACTURERS

A. Pipe, Valve, and Equipment Markers: Craftmark Identification Systems, W. H. Brady Co, EMED Company, Inc., Kolbi Industries, Inc., 3M Co., Seton Name Plate Corp.

PART 3 - EXECUTION

3.1 VALVE AND EQUIPMENT IDENTIFICATION

A. Designate all equipment and valves by distinguishing numbers and letters on charts and/or diagrams. Tag and locate following equipment items: Valves, All items indicated on drawing equipment schedules.

B. Install tags on all devices with numbers and letters corresponding to charts.

C. Fasten tags securely to devices with tag fasteners in manner for easy reading.

D. Attach equipment nameplates in conspicuous location on item of equipment or apparatus such as starters, pumps, and control panels. Secure nameplates with self-tapping screws, or nuts and bolts.

E. For unsuitable conditions, such as high temperature or lack of space, use copper or brass rings or chains to attach tags.

F. Furnish 4 charts including device number, location (room number, department) and purpose. Mount 1 chart in frame and secure on wall in location directed by Owner. Include remaining 3 sets in "Operation and Maintenance Manuals."

G. Provide all devices located above ceilings with additional identification. Use access panel markers (metal-tack-style) for acoustical tile ceilings, or engraved plastic style, 3/4 inch square, for mounting on panel door. Coordinate with Owner on identification method and color codes.

3.2 PIPE IDENTIFICATION

A. Soil, waste, and vent piping do not require color coded paint or bands.

B. Locate pipe markers as follows:
1. Next to each valve and fitting, except on plumbing fixtures and equipment.
2. At each branch or riser take-off.
3. At each passage through walls, floors, and ceilings.
4. At each pipe passage to underground.
5. On all horizontal pipe runs every 20 ft., at least once in each room and each story traversed by piping system.
6. Identify piping contents, flow direction, supply and return.

C. Install markers with tape color bands over each end of marker, extending around pipe and overlapping a minimum of 30 degrees.

D. Where supplementary color identification of medical gas piping is used, paint in accordance with gases and colors indicated in CGA Pamphlet C-9.

3.3 SERVICE ABBREVIATIONS

A. General

1.	CW	Domestic Cold Water
2.	HW (___)	Domestic Hot Water Supply (indicate temperature)
3.	HWC	Domestic Hot Water Circulating
4.	P	Discharge Plumbing-Sump Pump/Sewage Ejector
5.	G	Natural Gas

END OF SECTION 22 05 53

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Pipe Stands.
3. Pipe Support Accessories.
4. Flashing.
5. Equipment curbs.
6. Formed steel channel.
7. Equipment bases and supports.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping.
3. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
2. ASTM E814 - Standard Test Method for Fire Tests of Through Penetration Fire Stops.
3. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials and Services Approved By Factory Mutual Research For Property Conservation.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

G. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

C. Firestopping Materials: Comply with requirements of Section 078400.

D. Seismic applications listed within SMACNA that are not usable within a given structure, shall be resolved through engineered adaptations or alteration. Whenever possible these adaptations or alternations shall use SMACNA approved components, to maintain compliance and uniformity with SMACNA's engineering standards and design principles. In all cases, and prior to installation, these adaptations or alternations shall be engineered in accordance with standard engineering practices by a qualified, registered structural engineer, and shall be submitted to project structural engineer and mechanical engineer for their review and approval.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Submittal procedures.

B. Action Submittals:

1. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
2. Product Data: Submit manufacturers catalog data including load capacity for all hangers, supports, stands, rods, and structural channel products.
3. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit sizing methods sealed by a registered professional engineer.
4. Manufacturer's Installation Instructions:

    a. Hangers and Supports: Submit special procedures and assembly of components.
    b. Firestopping: Submit preparation and installation instructions.

5. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

C. Informational Submittals:

1. Welding Certificates.
2. Operational and Maintenance Data for all products installed.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience or as approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.

B. Provide ventilation in areas to receive solvent cured materials.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Acceptable Manufacturers: Acceptable Manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.

1. Anvil International
2. B-Line Systems
3. Empire Industries, Inc.
4. ERICO/Michigan Hanger Co.
5. Globe Pipe Hanger Products
6. Grinnel Corp.
7. Hilti
8. National Pipe Hanger Corp.
9. PHD Manufacturing, Inc.

B. General Descriptions:

1. Carbon-Steel Pipe Hangers and Supports

a. Factory fabricated, galvanized Carbon-steel MSS SP-58, Types 1 through 58, pipe hangers.
b. Plastic Coated, Jacketed, or lined as required.
c. Padded with fiberglass or other pipe insulation pad or cushioning to support bearing surface of piping.

2. Saddles:

a. Galvanized steel, 180 degree shaped, marked with insulation outside diameter.
b. Standard manufacturer’s size to correspond to insulated pipe size.

3. Copper Pipe Hangers

a. Factory fabricated, copper-coated-steel MSS SP-58, Types 1 through 58

4. Trapeze Pipe Hangers:

a. Shop or Field Fabricated pipe support assembly compliant with MSS SP-69, Type 59, made rom structural carbon steel shapes and hanger rods, nuts, saddles, and U-Bolts compliant with MSS SP-58.

C. Hydronic Piping hangers:

1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inch and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inch: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inch and Larger: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches (150 mm) and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes 3 inches (76 mm) and Smaller: Cast iron hooks.
9. Wall Support for Pipe Sizes 4 inch and Larger: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 inch and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 4 inch and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Copper-plated, carbon steel ring.
16.

D. Refrigerant Piping Hangers:

1. Conform to ASME B31.5, ASTM F708, MSS SP58, MSS SP69, and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inch and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods or approved structural strut product.
5. Wall Support for Pipe Sizes 3 inch and Smaller: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inch and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated carbon-steel ring.

2.2 PIPE STANDS

A. General Description: Shop or field fabricated assemblies made of corrosion resistant components to support roof or ground mounted piping.

B. Low-type, Single-Pipe Stand: One-piece plastic, stainless steel, or rubber base unit with a plastic roller for installation on a roof without penetrating the membrane. Include roof pads between stand and membrane.

C. High-Type, Single- or Multiple-Pipe Stands: Base or Assembly of bases, vertical and horizontal members, pipe supports, and pipe support accessories for hanging or setting pipe on a roof without penetrating a membrane.

1. Plastic, stainless steel, or rubber base, one or more.
2. Two or more vertical structural steel or channel, protectively coated.
3. Two or more horizontal structural steel or channel, protectively coated.
4. Pipe supports set on top of bottom horizontal member or hung from top horizontal member.

D. Curb Mounted Stands: Shop- or Field-fabricated pipe supports made from structural steel or channel, threaded rods, rollers, and other pipe hangers and accessories, mounted on a permanent, stationary roof curb.

2.3 PIPE SUPPORT ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

B. Thermal Shield Inserts

1. Cold Pipe: ASTM C 552 Type II Cellular glass with 100-PSIG or ASTM C 591, Type VI Grade I polyisocyanurate with 125 PSIG minimum compressive strength vapor barrier.
2. Hot Pipe: Water repellant treated, ASTM C 533, Type I Calcium silicate with 100-PSIG ASTM C 552, Type II cellular glass with 100 PSIG, or ASTM C 591, Type VI, Grade I, polyisocyanurate with 125-PSIG minimum compressive strength.
3. Metal shield shall cover lower 180 degrees of pipe in clevis and band hangers, full pipe circumference for pipe in trapeze and clamp hangers.
4. Insert shall extend a minimum of 2 inches beyond shield metal shield.

2.3 FLASHING

A. Metal Flashing: Minimum 26 gage thick galvanized steel unless otherwise indicated by the Architectural specifications and details.

B. Metal Counterflashing: Minimum 22 gage thick galvanized steel unless otherwise indicated by the Architectural specifications and details.

C. Flexible Flashing: Minimum 47 mil thick sheet unless otherwise indicated by the Architectural specifications and details, compatible with roofing.

D. Caps: Steel, minimum thickness 22 gage minimum; minimum thickness 16 gage at fire resistant elements.

2.4 EQUIPMENT CURBS

A. Acceptable Manufacturers: To all feasible extents, utilize the equipment manufacture’s curbs. When a third-party curb is required, then select from the Acceptable Manufacturers listed below. Other manufacturers of equivalent products may be submitted for review.

1. LM Curbs
2. Metal Form Manufacturing
3. Pate Company
4. Roof Products, Inc.

B. Fabrication: Welded 18 gage galvanized steel shell and base, mitered 3 inch cant, minimum 1-inch insulation, glued and pinned.

2.5 FORMED STEEL CHANNEL

A. Acceptable Manufacturers: Acceptable Manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.

1. Unistrut
2. B-line by Eaton
3. Hilti

B. Product Description: Galvanized 12 gage thick steel with holes at regular intervals, 2-inch or less, on center.

2.6 FIRESTOPPING

A. Firestopping Materials: Comply with requirements of Section 078400.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install damming materials to arrest liquid material leakage.

D. Obtain permission from Architect/Engineer before using powder-actuated anchors.

E. Do not drill or cut structural members.

3.3 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inch (100 mm) and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with the same ASME B31 section as listed in common requirements, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Support vertical piping at every floor.

G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Prime coat exposed steel hangers and supports. Refer to Section 099000. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

N. Pipe Stand Installation
   1. Pipe stand types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stands and mount on permanent, stationary roof curb.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4-inch-thick and extending 6 inches beyond supported equipment. Refer to Section 033000.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 210548.

3.6 INSTALLATION - FLASHING

A. Refer to Architectural specifications for Flashing and Waterproofing. When Architectural sections do not explicitly state requirements:

1. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
2. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.
3. Provide curbs for roof installations 14 inch minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing to equipment and lap base flashing on roof curbs. Flatten and solder joints.
4. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting, testing.

B. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

C. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect adjacent surfaces from damage by material installation.

3.10 SCHEDULES

A. Copper Tube Hanger Spacing:

1. Pipe Size 1-1/4 Inch and smaller:
   a. Maximum Horizontal Hanger Spacing: 6 feet.
   b. Maximum Vertical Spacing: 10 feet or at each floor penetration.
   c. Hanger Rod Diameter: 3/8 inch.

2. Pipe Size 1-1/2 Inch and larger
   a. Maximum Horizontal Hanger Spacing: 10 feet.
   b. Maximum Vertical Spacing: 10 feet or at each floor penetration.
   c. Hanger Rod Diameter: 1/2 inch.

B. Steel Pipe Hanger Spacing:

1. Pipe Size 3 inch and smaller:
   a. Maximum Horizontal Hanger Spacing: 10 feet.
   b. Maximum Vertical Spacing: 15 feet or at each floor penetration.
   c. Minimum Hanger Rod Diameter: 1/2 inch.

2. Pipe Size over 3 inch and under 6 inch:

   a. Maximum Horizontal Hanger Spacing: 12 feet.
   b. Maximum Vertical Spacing: 15 feet or at each floor penetration.
   c. Minimum Hanger Rod Diameter: 5/8 inch.

3. Pipe Size 6 inch and over but and under 10 inch:

   a. Maximum Hanger Spacing: 12 feet.
   b. Maximum Horizontal Vertical Spacing: 15 feet or at each floor penetration.
   c. Minimum Hanger Rod Diameter: 3/4 inch.

4. Pipe Size 10 inch and over but under 14 inch:

   a. Maximum Hanger Spacing: 12 feet.
   b. Maximum Horizontal Vertical Spacing: 15 feet or at each floor penetration.
   c. Minimum Hanger Rod Diameter: 7/8 inch.

5. Pipe Size 14 inch and over but under 20 inch:

   a. Maximum Hanger Spacing: 12 feet.
   b. Maximum Horizontal Vertical Spacing: 15 feet or at each floor penetration.
   c. Minimum Hanger Rod Diameter: 1 inch.

C. Plastic Pipe Hanger Spacing:

1. Pipe Material: ABS.

   a. Maximum Horizontal Hanger Spacing: 4 feet.
   b. Maximum Vertical Support Spacing: 10 feet or at each floor penetration.
   c. Minimum Hanger Rod Diameter: 1/2 inch.

2. Pipe Material: FRP.

   a. Maximum Horizontal Hanger Spacing: 4 feet.
   b. Maximum Vertical Support Spacing: 10 feet or at each floor penetration.
   c. Minimum Hanger Rod Diameter: 1/2 inch.

3. Pipe Material: PVC.

   a. Maximum Horizontal Hanger Spacing: 4 feet.
   b. Maximum Vertical Support Spacing: 10 feet or at each floor penetration.
   c. Minimum Hanger Rod Diameter: 1/2 inch.

END OF SECTION 230529

SECTION 23 09 23

DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes DDC system for monitoring and controlling of HVAC systems.

B. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over a single BACnet open protocol bus.
   1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara N4™ Framework.
   2. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, BACnet, and Modbus. Non BACnet communication protocol for specific pieces of equipment must be approved on a case by case basis.
   3. System architecture shall provide secure Web access using MS Internet Explorer from any computer on the owner's LAN.
   4. All control devices furnished with this Section shall be programmable directly from the Niagara-N4™ Workbench upon completion of this project. The use of configurable or programmable controllers that require additional software tools for post-installation maintenance shall not be acceptable.
   5. Any control vendor that must provide additional BMS server software shall be unacceptable. Only systems that utilize the WEBs Niagara N4™ Framework shall satisfy the requirements of this section.
   6. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus Niagara-N4 framework server
   7. A laptop computer including engineering/programming software to modify Operating System Server BMS programs and graphics shall be included
   8. **OPEN NIC STATEMENTS - All NiagaraN4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*"and "accept.wb.in=*"and "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications**

1.2 SUBMITTALS

A. Action Submittals:

   1. Product Data: For each type of product include:
      a. Product description with complete technical data, performance curves, and product specification sheets. Clearly indicate and highlight applicable information.

b. Installation, operation and maintenance instructions.

2. Software Submittal:

a. Listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
b. Description and technical data of all software provided.
c. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
d. Description of system database, including data included in database, database capacity and limitations to expand database.
e. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, and model number. Include written description of sequence of operation including schematic diagram.

3. Shop Drawings:

a. Floor plan drawings indicating the following:

1) Each desktop workstation, server, gateway, router, DDC controller, control panel, damper, and valve connecting to DDC controller.
2) Placement of devices in rooms, ducts, and piping.
3) Network communication cable and raceway routing.
4) Routing of wiring, cabling, conduit, and tubing, coordinated with building services.

b. Schematic drawings for each controlled HVAC system indicating the following:

1) I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve.
2) I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
3) Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
4) Unique identification of each I/O point.
5) Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
6) Narrative sequence of operation.

c. DDC system network riser diagram indicating each device connected to network with unique identification for each. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or optical fiber cable type. Indicate raceway type and size for each.

d. DDC system electrical power riser diagram indicating each point of connection to field power with requirements (volts/phase//hertz/amperes/connection type) listed, control power supplies, transformers, power-line conditioners, transient voltage suppression, high filter noise units, DC power supplies, UPS units, products requiring power with requirements, power wiring type and size, and raceway type.

e. Color graphics indicating itemized list of color graphic displays, a true color copy of each display screen, and intended operator access between related hierarchical display screens.

4. System Description:

a. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
b. Description of testing plans and procedures.
c. Description of Owner training.

B. Informational Submittals:

1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135 (BACnet).
2. Product Test Reports: For each product that requires testing.

C. Closeout Submittals:

1. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.

a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.

c. As-built versions of submittal Product Data.
d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
g. Engineering, installation, and maintenance manuals that explain how to:
    1) Design and install new points, panels, and other hardware.
    2) Perform preventive maintenance and calibration.
    3) Debug problems.
    4) Repair or replace hardware.
h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
i. Backup copy of graphic files, programs, and database on electronic media such as DVDs or USB drive.
j. List of recommended spare parts with part numbers and suppliers.
k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
m. Licenses, guarantees, and warranty documents.
n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
o. Owner training materials.

1.3 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies. Install updates only after receiving Owner's written authorization.
3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.
4. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DDC SYSTEM MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Automated Logic (by Automated Logic branch)
2. Alerton Inc, (by Open Control Systems)
3. Distech Controls (by Jackson Systems)
4. Honeywell International Inc. (by Honeywell branch)
5. Johnson Controls, Inc. (by Conserv or Johnson Controls branch)
6. Precision Controls.
7. EMCOR.
8. Siemens Building Technologies, Inc. (by Siemens branch)
9. Trane. (by Trane branch)

2.2 DDC SYSTEM DESCRIPTION

A. Microprocessor-based monitoring and control including analog/digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices to achieve a set of predefined conditions.

1. DDC system shall consist of a high-speed, peer-to-peer network of distributed DDC controllers, other network devices, operator interfaces, and software.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 WEB ACCESS

A. DDC system shall be Web compatible. Server shall perform overall system supervision and configuration, graphical user interface, management report generation, and alarm annunciation. DDC system shall support Web browser access to building data. Operator using a standard Web browser shall be able to access control graphics and change adjustable set points. Web access shall be password protected.

2.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional to design DDC system to satisfy requirements indicated.

1. System Performance Objectives:

a. DDC system shall manage HVAC systems.
b. DDC system control shall operate HVAC systems to achieve optimum operating costs while maintaining specified performance.
c. DDC system shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.
d. DDC system shall operate while unattended by an operator as well as through operator interaction.
e. DDC system shall record trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.

B. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency. Flame-spread index 25 or less. Smoke-developed index 50 or less.

C. DDC System Speed:

1. Response Time of Connected I/O:

a. Input point values connected to DDC system updated at least every five seconds for use by DDC controllers. Points used globally also complying with this requirement.
b. Output points connected to DDC system begin to respond to controller output commands within two seconds. Global commands also complying with this requirement.

2. Display of Connected I/O:

a. Point changes of value connected to DDC system updated and displayed at least every 10 seconds for use by operator.
b. Alarms of points connected to DDC system displayed within 45 seconds of activation or change of state.
c. Graphic display refresh updated within eight seconds.

D. Network Bandwidth: Design each network of DDC system to include at least **30** percent available spare bandwidth with DDC system operating under normal and heavy load conditions indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.

E. DDC System Data Storage:

1. Include capability to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
2. Local Storage: Provide server with data storage indicated. Servers shall use IT industry standard database platforms and be capable of functions described in "DDC Data Access" Paragraph.
3. Cloud Storage: Provide application-based and web browser interfaces to configure, upload, download, and manage data, and service plan with storage adequate to store all data for term indicated. Cloud storage shall use IT industry standard database platforms

and be capable of functions described in "DDC Data Access" Paragraph.

F. DDC Data Access: When logged into the system, operator able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.

Systems used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.

G. Expandability: DDC system size expandable to an ultimate capacity of at least two times total I/O points indicated. Additional DDC controllers, I/O and associated cond shall be all that is needed to achieve ultimate capacity. Initial network infrastructure designed and installed to support ultimate capacity. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.

H. Input Point Displayed Accuracy: Input point displayed values shall meet following end-to-end overall system accuracy, including errors associated with meter, sensor, transmitter, lead wire or cable, and analog to digital conversion.

1. Energy:

    a. Thermal: Within 3 percent of reading.
    b. Electric Power: Within 1 percent of reading.
    c. Requirements indicated on Drawings for meters not supplied by utility.

2. Flow:

    a. Air: Within 5 percent of design flow rate.
    b. Air (Terminal Units): Within 10 percent of design flow rate.
    c. Water: Within 5 percent of design flow rate.

3. Gas:

    a. Carbon Dioxide: Within 50 ppm.
    b. Carbon Monoxide: Within 5 percent of reading.
    c. Oxygen: Within 5 percent of reading.
    d. Refrigerant: Within 50 ppm.

4. Moisture (Relative Humidity):

    a. Air: Within 5 percent RH.
    b. Space: Within 2 percent RH.
    c. Outdoor: Within 2 percent RH.

5. Level: Within 5 percent of reading.
6. Pressure:

    a. Air, Ducts and Equipment: 1 percent of instrument range.
    b. Space: Within 1 percent of instrument range.
    c. Water: Within 1 number> percent of instrument range.

7. Speed: Within 5 percent of reading.
8. Temperature, Dew Point:

    a. Air: Within 1 deg F (0.5 deg C).
    b. Space: Within 1 deg F (0.5 deg C).
    c. Outdoor: Within 3 deg F (1.5 deg C).

9. Temperature, Dry Bulb:

    a. Air: Within 1 deg F (0.5 deg C).
    b. Space: Within 1 deg F (0.5 deg C).
    c. Outdoor: Within 1 deg F (0.5 deg C).
    d. Chilled Water: Within 1 deg F (0.5 deg C).
    e. Heating Hot Water: Within 1 deg F (0.5 deg C.
    f. Temperature Difference: Within 0.25 deg F (0.15 deg C).
    g. Other Temperatures Not Indicated: Within 1 deg F (0.5 deg C).

10. Temperature, Wet Bulb:

    a. Air: Within 1 deg F (0.5 deg C).
    b. Space: Within 1 deg F (0.5 deg C).
    c. Outdoor: Within 1 deg F (0.5 deg C).

11. Vibration: Within 5 percent of reading.

I. Precision of I/O Reported Values: Values reported in database and displayed shall have following precision:

1. Current:

    a. Milliamperes: Nearest 1/100th of a milliampere.
    b. Amperes: Nearest 1/10th of an ampere up to 100 A; nearest ampere for 100 A and more.

2. Energy:

    a. Electric Power:

        1) Rate (Watts): Nearest 1/10th of a watt through 1000 W.
        2) Rate (Kilowatts): Nearest 1/10th of a kilowatt through 1000 kW; nearest kilowatt above 1000 kW.
        3) Usage (Kilowatt-Hours): Nearest kilowatt through 10,000 kW; nearest 10 kW between 10,000 and 100,000 kW; nearest 100 kW for above 100,000 kW.

    b. Thermal, Rate:

        1) Heating: For Btu/h, nearest Btu/h up to 1000 Btu/h; nearest 10 Btu/h between 1000 and 10,000 Btu/h; nearest 100 Btu/h for above 10,000 Btu/h. For Mbh, round to nearest Mbh up to 1000 Mbh; nearest 10 Mbh between

1000 and 10,000 Mbh; nearest 100 Mbh above 10,000 Mbh.

2) Cooling: For tons, nearest ton up to 1000 tons; nearest 10 tons between 1000 and 10,000 tons; nearest 100 tons above 10,000 tons.

c. Thermal, Usage:

1) Heating: For Btu, nearest Btu up to 1000 Btu; nearest 10 Btu between 1000 and 10,000 Btu; nearest 100 Btu for above 10,000 Btu. For Mbtu, round to nearest Mbtu up to 1000 Mbtu; nearest 10 Mbtu between 1000 and 10,000 Mbtu; nearest 100 Mbtu above 10,000 Mbtu.

2) Cooling: For ton-hours, nearest ton-hours up to 1000 ton-hours; nearest 10 ton-hours between 1000 and 10,000 ton-hours; nearest 100 tons above 10,000 tons.

3. Flow:

a. Air: Nearest 1/10th of a cfm through 100 cfm; nearest cfm between 100 and 1000 cfm; nearest 10 cfm between 1000 and 10,000 cfm; nearest 100 cfm above 10,000 cfm.

b. Water: Nearest 1/10th gpm through 100 gpm; nearest gpm between 100 and 1000 gpm; nearest 10 gpm between 1000 and 10,000 gpm; nearest 100 gpm above 10,000 gpm.

4. Gas:

a. Carbon Dioxide (ppm): Nearest ppm.

b. Carbon Monoxide (ppm): Nearest ppm.

c. Oxygen (Percentage): Nearest 1/10th of 1 percent.

d. Refrigerant (ppm): Nearest ppm.

5. Moisture (Relative Humidity):

a. Relative Humidity (Percentage): Nearest 1 percent.

6. Level: Nearest 1/100th of an inch through 10 inches; nearest 1/10 of an inch between 10 and 100 inches; nearest inch above 100 inches.

7. Speed:

a. Rotation (rpm): Nearest 1 rpm.

b. Velocity: Nearest 1/10th fpm through 100 fpm; nearest fpm between 100 and 1000 fpm; nearest 10 fpm above 1000 fpm.

8. Position, Dampers and Valves (Percentage Open): Nearest 1 percent.

9. Pressure:

a. Air, Ducts and Equipment: Nearest 1/10th in. w.c.

b. Space: Nearest 1/100th in. w.c.

c. Steam: Nearest 1/10th psig through 100 psig; nearest psig above 100 psig.

d. Water: Nearest 1/10 psig through 100 psig; nearest psig above 100 psig.

10. Temperature:

a. Air, Ducts and Equipment: Nearest 1/10th of a degree.
b. Outdoor: Nearest degree.
c. Space: Nearest 1/10th of a degree.
d. Chilled Water: Nearest 1/10th of a degree.
e. Heating Hot Water: Nearest degree.

11. Vibration: Nearest 1/10th in/s.
12. Voltage: Nearest 1/10 volt up to 100 V; nearest volt above 100 V.

J. Control Stability: Control variables indicated within the following limits:

1. Flow:

a. Air, Ducts and Equipment, except Terminal Units: Within 5 percent of design flow rate.
b. Air, Terminal Units: Within 10 percent of design flow rate.
c. Water: Within 5 percent of design flow rate.

2. Gas:

a. Carbon Dioxide: Within 50 ppm.
b. Carbon Monoxide: Within 5 percent of reading.
c. Oxygen: Within 5 percent of reading.
d. Refrigerant: Within 50 ppm.

3. Moisture (Relative Humidity):

a. Air: Within 5 percent RH.
b. Space: Within 2 percent RH.
c. Outdoor: Within 2 percent RH.

4. Level: Within 5 percent of reading.
5. Pressure:

a. Air, Ducts and Equipment: 1 percent of instrument range.
b. Space: Within 1 percent of instrument range.
c. Water: Within 1 percent of instrument range.

6. Temperature, Dew Point:

a. Air: Within 1 deg F. (0.5 deg C)
b. Space: Within 1 deg F. (0.5 deg C).

7. Temperature, Dry Bulb:

a. Air: Within 2 deg F (1 deg C).
b. Space: Within 2 deg F (1 deg C).
c. Chilled Water: Within 1 deg F (1 deg C).
d. Heating Hot Water: Within 2 deg F (1 deg C).

8. Temperature, Wet Bulb:

    a. Air: Within 1 deg F (1 deg C).
    b. Space: Within 1 deg F (1 deg C).

K. Environmental Conditions for Controllers, Gateways, and Routers:

1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.

    a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.

2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:

    a. Outdoors, Protected: Type 3.
    b. Outdoors, Unprotected: Type 4.
    c. Indoors, Heated with Filtered Ventilation: Type 2.
    d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
    e. Indoors, Heated and Air Conditioned: Type 1.
    f. Mechanical Equipment Rooms:

        1) Chiller and Boiler Rooms: Type 4.
        2) Air-Moving Equipment Rooms: Type 1.

    g. Localized Areas Exposed to Washdown: Type 4.
    h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 3.
    i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.
    j. Hazardous Locations: Explosion-proof rating for condition.

L. Environmental Conditions for Instruments and Actuators:

1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

    a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by instrument and application.

2. Instruments, actuators and accessories shall be protected with enclosures satisfying the

following minimum requirements unless more stringent requirements are indicated. Instruments and actuators not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:

a. Outdoors, Protected: Type 3.
b. Outdoors, Unprotected: Type 4.
c. Indoors, Heated with Filtered Ventilation: Type 2.
d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
e. Indoors, Heated and Air-conditioned: Type 1.
f. Mechanical Equipment Rooms:

1) Chiller and Boiler Rooms: Type 4.
2) Air-Moving Equipment Rooms: Type 1.

g. Localized Areas Exposed to Washdown: Type 4.
h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 3.
i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.
j. Hazardous Locations: Explosion-proof rating for condition.

M. DDC System Reliability:

1. Design, install and configure DDC controllers, gateways and routers to yield a mean time between failures of at least 40,000 hours, based on a confidence level of at least 90 percent. mean time between failures value shall include any failure for any reason to any part of products indicated.
2. If required to comply with mean time between failures indicated, include DDC system and product redundancy to maintain DCC system, and associated systems and equipment that are being controlled, operational and under automatic control.
3. Critical systems and equipment that require a higher degree of DDC system redundancy than mean time between failures indicated shall be indicated on Drawings.

N. Electric Power Quality:

1. Power-Line Surges:

a. Protect susceptible DDC system products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41.
b. Do not use fuses for surge protection.
c. Test protection in the normal mode and in the common mode, using the following two waveforms:

1) 10-by-1000-mic.sec. waveform with a peak voltage of 1500 V and a peak current of 60 A.
2) 8-by-20-mic.sec. waveform with a peak voltage of 1000 V and a peak current of 500 A.

2. Power Conditioning:

a. Protect susceptible DDC system products connected to ac power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be as follows:

1) At 85 percent load, output voltage shall not deviate by more than plus or minus 1 percent of nominal when input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
2) During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 percent of nominal.
3) Accomplish full correction of load switching disturbances within five cycles, and 95 percent correction within two cycles of onset of disturbance.
4) Total harmonic distortion shall not exceed 3-1/2 percent at full load.

3. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

O. Backup Power Source:

1. HVAC systems and equipment served by a backup power source shall have associated DDC system products that control such systems and equipment also served from a backup power source.

P. UPS:

1. DDC system products powered by UPS units shall include the following:

a. Desktop workstations.
b. Printers.
c. Servers.
d. Gateways.
e. DDC controllers, except application-specific controllers.

2. DDC system instruments and actuators powered by UPS units shall include the following:

a. Instruments associated with the following systems controlled by DDC system:

1) Pod exhaust, AHU controllers, RTU controllers, smoke dampers, fans, and all associated systems and components.

b. Dampers and actuators associated with the following systems controlled by DDC system:

1) Pod exhaust, AHU controllers, RTU controllers, smoke dampers, fans, and all associated systems and components.

c. Valves and actuators associated with the following systems controlled by DDC system:

1) Pod exhaust, AHU controllers, RTU controllers, smoke dampers, smoke fans, and all associated systems and components.

Q. Continuity of Operation after Electric Power Interruption:

1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.5 SYSTEM ARCHITECTURE

A. DDC system shall consist of dedicated and separated LANs that are not shared with other building systems and tenant data and communication networks.

B. System architecture shall be modular and have inherent ability to expand to not less than **two** times system size indicated with no impact to performance indicated.

C. System architecture shall perform modifications without having to remove and replace existing network equipment.

D. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.

E. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.

F. Special Network Architecture Requirements:

1. Air-Handling Systems: For control applications of an air-handling system that consists of air-handling unit(s) and VAV terminal units, include a dedicated LAN of application-specific controllers serving VAV terminal units connected directly to controller that is controlling air-handling system air-handling unit(s). Basically, create a DDC system LAN that aligns with air-handling system being controlled.

2. Pod Exhaust System: For control application of air handling systems and integration with fire alarm and master override at control room.

2.6 DDC SYSTEM OPERATOR INTERFACES

A. Operator Means of System Access: Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:

1. Desktop and portable workstation with hardwired connection through LAN port.

2. Portable operator terminal with hardwired connection through LAN port.
3. Portable operator workstation with wireless connection through LAN router.
4. Mobile device and application with secured wireless connection through LAN router or cellular data service.
5. Remote connection through web access.

B. Access to system, regardless of operator means used, shall be transparent to operator.

C. Network Ports: For hardwired connection of desktop or portable workstation. Network port shall be easily accessible, properly protected, clearly labeled, and installed at the following locations:

1. Each mechanical equipment room (at each Air Handling Unit in POD).
2. Inside of vehicle Sallyport.
3. Each boiler room.
4. Each chiller room or outdoor chiller yard.
5. Each different roof level with roof-mounted air-handling units or rooftop units.
6. Security system command center/Control Room.
7. Fire-alarm system command center.

D. Desktop Workstations:

1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.

E. Portable Workstations:

1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.
3. Connect to DDC system Level two LAN through a communications port on an application-specific controller, or a room temperature sensor connected to an application-specific controller.
4. Portable workstation shall be able to communicate with any device connected to any system LAN regardless of point of physical connection to system.
5. Monitor, program, schedule, adjust set points, and report capabilities of I/O connected anywhere in system.
6. Have dynamic graphic displays that are identical to desktop workstations.

F. Portable Operator Terminal:

1. Connect DDC controller through a communications port local to controller.
2. Able to communicate with any DDC system controller that is directly connected o**r** connected to DDC system.

G. Critical Alarm Reporting:

1. Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention.
2. DDC system shall send alarm notification to multiple recipients that are assigned for each

alarm.

3. DDC system shall notify recipients by any or all means, including e-mail, text message and prerecorded phone message to mobile and landline phone numbers.

H. Simultaneous Operator Use: Capable of accommodating up to five simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

2.7 NETWORKS

A. Acceptable networks for connecting workstations and network controllers include the following:
   1. IP.
   2. IEEE 8802-3, Ethernet.

B. Acceptable networks for connecting programmable application controllers include the following:
   1. IP.
   2. IEEE 8802-3, Ethernet.

C. Acceptable networks for connecting application-specific controllers include the following:
   1. EIA-485A.
   2. IP.
   3. IEEE 8802-3, Ethernet.

2.8 NETWORK COMMUNICATION PROTOCOL

A. Network communication protocol(s) used throughout entire DDC system shall be open to Owner and available to other companies for use in making future modifications to DDC system.

B. ASHRAE 135 Protocol:

   1. ASHRAE 135 communication protocol shall be sole and native protocol used throughout entire DDC system.
   2. DDC system shall not require use of gateways except to integrate HVAC equipment and other building systems and equipment, not required to use ASHRAE 135 communication protocol.
   3. If used, gateways shall connect to DDC system using ASHRAE 135 communication protocol and Project object properties and read/write services indicated by interoperability schedule.
   4. Operator workstations, controllers and other network devices shall be tested and listed by BACnet Testing Laboratories.

2.9 DESKTOP WORKSTATIONS

A. Description: A tower or all-in-one computer designed for normal use at a single, semi-permanent location.

B. Performance Requirements (Minimum):

1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
2. Energy Star compliant.

C. Personal Computer:

1. Minimum Processor Speed: Intel, 2.8 GHz.
2. RAM:

    a. Capacity: 4.0 GB.
    b. Speed and Type: 1333 MHz.

3. Hard Drive:

    a. Media: Solid state.
    b. Number of Hard Drives: One.
    c. Capacity: 1000 GB.

4. At least four expansion slots of 64 bit.
5. Video Card:

    a. Resolution: 1600 by 1200 pixels.
    b. Video Adapter
    c. 64 MB video memory
    d. TV out.

6. Network Interface Card: Include card with connection, as applicable.

    a. Integrated Intel Pro 10-100-1000 base Ethernet with RJ45 connector port.

D. Wireless Ethernet, 802.11 a/b/g/n.
1. I/O Ports:

    a. Two USB 3.0 ports on front panel, six on back panel, and three internal on motherboard.
    b. One serial port.
    c. One parallel port.
    d. Two PS/2 ports.
    e. One RJ45.
    f. One stereo line-in and headphone/line-out on back panel.
    g. One microphone and headphone connector on front panel.
    h. One IEEE 1394 on front and back panel with PCI-e card.
    i. One ESATA port on back panel.

2. Battery: Life of at least three years to maintain system clock/calendar and ROM, as a minimum.

E. DVD/RW:
1. 48x24x48

F. Keyboard:

1. QWERTY, 105 keys.
2. Full upper- and lowercase ASCII keyset, numeric keypad, dedicated cursor control keypad, and 12 programmable function keys.

G. Pointing Device:

1. Three-button, optical mouse.
2. Wireless operation within up to 72 inches (1800 mm) in front of workstation.

H. Flat Panel Display Monitor:

1. Display:

a. Color display with 19 inches diagonal viewable area, LCD color.
b. Digital input signal.
c. Aspect Ratio: 16 to 9.
d. Antiglare display.
e. Dynamic Contrast Ratio: 50000 to 1.
f. Brightness: 250 cd/sq. m.
g. Tilt adjustable base.
h. Energy Star compliant.
i. Resolution: 1920 by 1080 pixels at 60 Hz with pixel size of 0.277 mm or smaller.
j. Number of Displays: One.

I. Speakers:

1. Two, with individual controls for volume, bass and treble.
2. Signal to Noise Ratio: At least 65 dB.
3. Power: At least 4 W per speaker/channel.
4. Magnetic shielding to prevent distortion on the video monitor.

J. I/O Cabling: Include applicable cabling to connect I/O devices.

2.10 PORTABLE WORKSTATIONS

A. Description: A self-contained computer designed to allow for normal use in different locations and conditions.

B. Performance Requirements:

1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
2. Energy Star compliant.
3. Hardware and software shall support local down-loading to DDC controllers.
4. Data transfer rate to DDC controller shall be at network speed.
5. Windows 10 Operating System to match Workstation with minimum 2 year license.

C. Processor:
   1. RAM:
      a. Capacity: 2GB.
      b. Speed and Type: 1600 MHz, DDR3.
   2. Hard Drive:
      a. Number of Hard Drives: One.
      b. Capacity: 500 GB

D. Input and Output Ports:
   1. Serial port.
   2. Shared port for external keyboard or mouse.
   3. Four USB 3.0 ports.
   4. Ethernet port.
   5. HDMI port.
   6. IEEE 1394 port.

E. Battery:
   1. Capable of supporting operation of portable workstation for a minimum of 8 hours.
   2. Battery life of at least three years.
   3. Battery charge time of less than three hours.

F. Keyboard:
   1. 85-key backlit keyboard.
   2. Full upper- and lowercase ASCII keyset.

G. Integral Pointing Device: Touchpad with two buttons. Gesture enabled.

H. Display:
   1. 11 inches diagonal or larger high-definition LED color display.
   2. Antiglare screen.
   3. 1920 by 1080 pixel resolution.
   4. Brightness: 300 nits.

I. Network Interfaces:
   1. Network Interface Card: Include card with connection, as application.
      a. Pro 10-100-1000 base Ethernet with RJ45 connector port.
   2. Wireless:
      a. Internal with integrated antenna, capable of supporting 802.11 a/b/g/n.

J. Digital Video Disc Rewrite Recorder (DVD+/-RW):

1. Compatible with DVD disks and data, audio, recordable and rewritable compact disks.

2. 160-ms access time.

K. Accessories:

1. Nylon carrying case.
2. Docking station.
3. Mobile broadband card.
4. Wireless optical mouse.
5. 2 TB portable hard drive.
6. Light-sensitive web cam and noise-cancelling digital array microphone.
7. Category 6a patch cable. Minimum cable length shall be 10 ft.
8. HDMI cable. Minimum cable length shall be 10 ft.

2.11 PRINTERS

A. Color Laser Printer:
1. 1200 by 1200 dots per inch resolution black and white, 1200 by 1200 dots per inch resolution black and white and color.
2. First sheet printed within 10 seconds.
3. 4 pages per minute rated print speed at best quality mode.
4. Print buffer with at least 512 MB of RAM, expandable to at least one GB.
5. Complies with Energy Star requirements.
6. Capable of handling letter- and legal-size paper and overhead transparencies.
7. Two paper trays; one tray with 100 sheet capacity, and one tray with 500 sheet capacity.
8. At least 2-page toner/cartridge capacity.

2.12 SYSTEM SOFTWARE

A. System Software Minimum Requirements:

1. Real-time multitasking and multiuser 64-bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.
2. Operating system shall be capable of operating DOS and Microsoft Windows applications.
3. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
4. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
5. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
6. Scheduling software shall schedule centrally based time and event, temporary, and

exception day programs.

B. Operator Interface Software:

1. Minimize operator training through use of English language prorating and English language point identification.
2. Minimize use of a typewriter-style keyboard through use of a pointing device similar to a mouse.
3. Operator sign-off shall be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
4. Automatic sign-off period shall be programmable from one to 60 minutes in one-minute increments on a per operator basis.
5. Operator sign-on and sign-off activity shall be recorded and sent to printer.
6. Security Access:

    a. Operator access to DDC system shall be under password control.
    b. An alphanumeric password shall be field assignable to each operator.
    c. Operators shall be able to access DDC system by entry of proper password.
    d. Operator password shall be same regardless of which computer or other interface means is used.
    e. Additions or changes made to passwords shall be updated automatically.
    f. Each operator shall be assigned an access level to restrict access to data and functions the operator is cable of performing.
    g. Software shall have at least five access levels.
    h. Each menu item shall be assigned an access level so that a one-for-one correspondence between operator assigned access level(s) and menu item access level(s) is required to gain access to menu item.
    i. Display menu items to operator with those capable of access highlighted. Menu and operator access level assignments shall be online programmable and under password control.

7. Data Segregation:

    a. Include data segregation for control of specific data routed to a workstation, to an operator or to a specific output device, such as a printer.
    b. Include at least 32 segregation groups.
    c. Segregation groups shall be selectable such as "fire points," "fire points on second floor," "space temperature points," "HVAC points," and so on.
    d. Points shall be assignable to multiple segregation groups. Display and output of data to printer or monitor shall occur where there is a match of operator or peripheral segregation group assignment and point segregations.
    e. Alarms shall be displayed and printed at each peripheral to which segregation allows, but only those operators assigned to peripheral and having proper authorization level will be allowed to acknowledge alarms.
    f. Operators and peripherals shall be assignable to multiple segregation groups and all assignments are to be online programmable and under password control.

8. Operators shall be able to perform commands including, but not limited to, the following:

    a. Start or stop selected equipment.
    b. Adjust set points.

c. Add, modify, and delete time programming.
d. Enable and disable process execution.
e. Lock and unlock alarm reporting for each point.
f. Enable and disable totalization for each point.
g. Enable and disable trending for each point.
h. Override control loop set points.
i. Enter temporary override schedules.
j. Define holiday schedules.
k. Change time and date.
l. Enter and modify analog alarm limits.
m. Enter and modify analog warning limits.
n. View limits.
o. Enable and disable demand limiting.
p. Enable and disable duty cycle.
q. Display logic programming for each control sequence.

9. Reporting:

a. Generated automatically and manually.
b. Sent to displays, printers and disk files.
c. Types of Reporting:

1) General listing of points.
2) List points currently in alarm.
3) List of off-line points.
4) List points currently in override status.
5) List of disabled points.
6) List points currently locked out.
7) List of items defined in a "Follow-Up" file.
8) List weekly schedules.
9) List holiday programming.
10) List of limits and deadbands.

10. Summaries: For specific points, for a logical point group, for an operator selected group(s), or for entire system without restriction due to hardware configuration.

C. Graphic Interface Software:

1. Include a full interactive graphical selection means of accessing and displaying system data to operator. Include at least five levels with the penetration path operator assignable (for example, site, building, floor, air-handling unit, and supply temperature loop). Native language descriptors assigned to menu items are to be operator defined and modifiable under password control.
2. Include a hierarchical-linked dynamic graphic operator interface for accessing and displaying system data and commanding and modifying equipment operation. Interface shall use a pointing device with pull-down or penetrating menus, color and animation to facilitate operator understanding of system.
3. Include at least 10 levels of graphic penetration with the hierarchy operator assignable.
4. Descriptors for graphics, points, alarms and such shall be modified through operator's workstation under password control.

5. Graphic displays shall be online user definable and modifiable using the hardware and software provided.
6. Data to be displayed within a graphic shall be assignable regardless of physical hardware address, communication or point type.
7. Graphics are to be online programmable and under password control.
8. Points may be assignable to multiple graphics where necessary to facilitate operator understanding of system operation.
9. Graphics shall also contain software points.
10. Penetration within a graphic hierarchy shall display each graphic name as graphics are selected to facilitate operator understanding.
11. Back-trace feature shall permit operator to move upward in the hierarchy using a pointing device. Back trace shall show all previous penetration levels. Include operator with option of showing each graphic full screen size with back trace as horizontal header or by showing a "stack" of graphics, each with a back trace.
12. Display operator accessed data on the monitor.
13. Operator shall select further penetration using pointing device to click on a site, building, floor, area, equipment, and so on. Defined and linked graphic below that selection shall then be displayed.
14. Include operator with means to directly access graphics without going through penetration path.
15. Dynamic data shall be assignable to graphics.
16. Display points (physical and software) with dynamic data provided by DDC system with appropriate text descriptors, status or value, and engineering unit.
17. Use color, rotation, or other highly visible means, to denote status and alarm states. Color shall be variable for each class of points, as chosen by operator.
18. Points shall be dynamic with operator adjustable update rates on a per point basis from one second to over a minute.
19. For operators with appropriate privilege, points shall be commanded directly from display using pointing device.

    a. For an analog command point such as set point, current conditions and limits shall be displayed and operator can position new set point using pointing device.
    b. For a digital command point such as valve position, valve shall show its current state such as open or closed and operator could select alternative position using pointing device.
    c. Keyboard equivalent shall be available for those operators with that preference.

20. Operator shall be able to split or resize viewing screen into quadrants to show one graphic on one quadrant of screen and other graphics or spreadsheet, bar chart, word processing, curve plot and other information on other quadrants on screen. This feature shall allow real-time monitoring of one part of system while displaying other parts of system or data to better facilitate overall system operation.
21. Help Features:

    a. On-line context-sensitive help utility to facilitate operator training and understanding.
    b. Bridge to further explanation of selected keywords. Document shall contain text and graphics to clarify system operation.
        1) If help feature does not have ability to bridge on keywords for more information, a complete set of user manuals shall be provided in an indexed

word-processing program, which shall run concurrently with operating system software.

c. Available for Every Menu Item:

1) Index items for each system menu item.

22. Graphic generation software shall allow operator to add, modify, or delete system graphic displays.

a. Include libraries of symbols depicting HVAC symbols such as fans, coils, filters, dampers, valves pumps, and electrical symbols similar to those indicated.
b. Graphic development package shall use a pointing device in conjunction with a drawing program to allow operator to perform the following:

1) Define background screens.
2) Define connecting lines and curves.
3) Locate, orient and size descriptive text.
4) Define and display colors for all elements.
5) Establish correlation between symbols or text and associated system points or other displays.

D. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:

1. Site plan showing each building, and additional site elements, which are being controlled or monitored by DDC system.
2. Plan for each building floor, including interstitial floors, and each roof level of each building, showing the following:

a. Room layouts with room identification and name.
b. Locations and identification of all monitored and controlled HVAC equipment and other equipment being monitored and controlled by DDC system.
c. Location and identification of each hardware point being controlled or monitored by DDC system.
d. AHU Zones
e. Pod Control Zones.

3. Control schematic for each of following, including a graphic system schematic representation, similar to that indicated on Drawings, with point identification, set point and dynamic value indication, sequence of operation and control logic diagram.
4. Graphic display for each piece of equipment connected to DDC system through a data communications link. Include dynamic indication of all points associated with equipment.
5. DDC system network riser diagram that shows schematic layout for entire system including all networks and all controllers, gateways, operator workstations and other network devices.

E. Customizing Software:

1. Software to modify and tailor DDC system to specific and unique requirements of equipment installed, to programs implemented and to staffing and operational practices planned.

2. Online modification of DDC system configuration, program parameters, and database using menu selection and keyboard entry of data into preformatted display templates.
3. As a minimum, include the following modification capability:

    a. Operator assignment shall include designation of operator passwords, access levels, point segregation and auto sign-off.
    b. Peripheral assignment capability shall include assignment of segregation groups and operators to consoles and printers, designation of backup workstations and printers, designation of workstation header points and enabling and disabling of print-out of operator changes.
    c. System configuration and diagnostic capability shall include communications and peripheral port assignments, DDC controller assignments to network, DDC controller enable and disable, assignment of command trace to points and application programs and initiation of diagnostics.
    d. System text addition and change capability shall include English or native language descriptors for points, segregation groups and access levels and action messages for alarms, run time and trouble condition.
    e. Time and schedule change capability shall include time and date set, time and occupancy schedules, exception and holiday schedules and daylight savings time schedules.
    f. Point related change capability shall include the following:

        1) System and point enable and disable.
        2) Run-time enable and disable.
        3) Assignment of points to segregation groups, calibration tables, lockout, and run time and to a fixed I/O value.
        4) Assignment of alarm and warning limits.

    g. Application program change capability shall include the following:

        1) Enable and disable of software programs.
        2) Programming changes.
        3) Assignment of comfort limits, global points, time and event initiators, time and event schedules and enable and disable time and event programs.

4. Software shall allow operator to add points, or groups of points, to DDC system and to link them to energy optimization and management programs. Additions and modifications shall be online programmable using operator workstation, downloaded to other network devices and entered into their databases. After verification of point additions and associated program operation, database shall be uploaded and recorded on hard drive and disk for archived record.
5. Include high-level language programming software capability for implementation of custom DDC programs. Software shall include a compiler, linker, and up- and down-load capability.
6. Include a library of DDC algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences. Also include, as a minimum, the following:

    a. Proportional control (P).
    b. Proportional plus integral (PI).
    c. Proportional plus integral plus derivative (PID).

d. Adaptive and intelligent self-learning control.

1) Algorithm shall monitor loop response to output corrections and adjust loop response characteristics according to time constant changes imposed.
2) Algorithm shall operate in a continuous self-learning manner and shall retain in memory a stored record of system dynamics so that on system shut down and restart, learning process starts from where it left off.

7. Fully implemented intrinsic control operators including sequence, reversing, ratio, time delay, time of day, highest select AO, lowest select AO, analog controlled digital output, analog control AO, and digitally controlled AO.
8. Logic operators such as "And," "Or," "Not," and others that are part of a standard set available with a high-level language.
9. Arithmetic operators such as "Add," "Subtract," "Multiply," "Divide," and others that are part of a standard set available with a high-level language.
10. Relational operators such as "Equal To," "Not Equal To," "Less Than," "Greater Than," and others that are part of a standard set available with a high-level language.

F. Alarm Handling Software:

1. Include alarm handling software to report all alarm conditions monitored and transmitted through DDC controllers, gateways and other network devices.
2. Include first in, first out handling of alarms according to alarm priority ranking, with most critical alarms first, and with buffer storage in case of simultaneous and multiple alarms.
3. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to DDC system.
4. Alarms display shall include the following:

a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
b. "Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."
c. Discrete per point alarm action message, such as "Call Maintenance Dept. Ext-5561."
d. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.

5. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.
6. Send e-mail alarm messages to designated operators.
7. Send e-mail, page, text and voice messages to designated operators for critical alarms.
8. Alarms shall be categorized and processed by class.

a. Class 1:

1) Associated with fire, security and other extremely critical equipment monitoring functions; have alarm, trouble, return to normal, and acknowledge conditions printed and displayed.

2) Unacknowledged alarms to be placed in unacknowledged alarm buffer.
3) All conditions shall cause an audible sound and shall require individual acknowledgment to silence audible sound.

b. Class 2:

1) Critical, but not life-safety related, and processed same as Class 1 alarms, except do not require individual acknowledgment.
2) Acknowledgement may be through a multiple alarm acknowledgment.

c. Class 3:

1) General alarms; printed, displayed and placed in unacknowledged alarm buffer queues.
2) Each new alarm received shall cause an audible sound. Audible sound shall be silenced by "acknowledging" alarm or by pressing a "silence" key.
3) Acknowledgement of queued alarms shall be either on an individual basis or through a multiple alarm acknowledgement.
4) Alarms returning to normal condition shall be printed and not cause an audible sound or require acknowledgment.

d. Class 4:

1) Routine maintenance or other types of warning alarms.
2) Alarms to be printed only, with no display, no audible sound and no acknowledgment required.

9. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.
10. To ensure that no alarm records are lost, it shall be possible to assign a backup printer to accept alarms in case of failure of primary printer.

G. Reports and Logs:

1. Include reporting software package that allows operator to select, modify, or create reports using DDC system I/O point data available.
2. Each report shall be definable as to data content, format, interval and date.
3. Report data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on workstation for historical reporting.
4. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
5. Reports and logs shall be stored on workstation hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.
6. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.

H. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.

1. All I/O: With current status and values.
2. Alarm: All current alarms, except those in alarm lockout.
3. Disabled I/O: All I/O points that are disabled.
4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
6. Logs:

    a. Alarm history.
    b. System messages.
    c. System events.
    d. Trends.

I. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report. Reports shall be time and date stamped and shall contain a report title.

J. Utility Reports: Prepare Project-specific reports.

1. Electric Report:

    a. Include weekly report showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
    b. Include monthly report showing the daily electrical consumption and peak electrical demand with time and date stamp for each meter.
    c. Include annual report showing the monthly electrical consumption and peak electrical demand with time and date stamp for each meter.
    d. For each weekly, monthly and annual report, include sum total of submeters combined by load type, such as lighting, receptacles and HVAC equipment showing daily electrical consumption and peak electrical demand.
    e. For each weekly, monthly and annual report, include sum total of all submeters in building showing electrical consumption and peak electrical demand.

2. Natural Gas Report:

    a. Include weekly report showing daily natural gas consumption and peak natural gas demand with time and date stamp for each meter.
    b. Include monthly report showing the daily natural gas consumption and peak natural gas demand with time and date stamp for each meter.
    c. Include annual report showing the monthly natural gas consumption and peak natural gas demand with time and date stamp for each meter.
    d. For each weekly, monthly and annual report, include sum total of submeters combined by load type, such as boilers and service water heaters showing daily natural gas consumption and peak natural gas demand.
    e. For each weekly, monthly and annual report, include sum total of all submeters in building showing natural gas consumption and peak natural gas demand.

K. Weather Reports:

1. Include daily report showing the following:

    a. Daily minimum, maximum, and average outdoor dry-bulb temperature.

b. Daily minimum, maximum, and average outdoor wet-bulb temperature.
c. Daily minimum, maximum, and average outdoor dew point temperature.
d. Number of heating degree-days for each day calculated from a base temperature of 55 deg F (13 deg C).
e. Number of cooling degree-days for each day calculated from a base temperature of 65 deg F (18 deg C).
f. Daily minimum, maximum, and average outdoor carbon dioxide level.
g. Daily minimum, maximum, and average relative humidity.
h. Daily minimum, maximum, and average barometric pressure.
i. Daily minimum, maximum, and average wind speed and direction.

2. Include weekly report showing the following:

a. Daily minimum, maximum, and average outdoor dry-bulb temperature.
b. Daily minimum, maximum, and average outdoor wet-bulb temperature.
c. Daily minimum, maximum, and average outdoor dew point temperature.
d. Number of heating degree-days for each day calculated from a base temperature of 55 deg F (13 deg C).
e. Number of cooling degree-days for each day calculated from a base temperature of 65 deg F (18 deg C).
f. Weekly minimum, maximum, and average outdoor carbon dioxide level.
g. Daily minimum, maximum, and average relative humidity.
h. Daily minimum, maximum, and average barometric pressure.
i. Daily minimum, maximum, and average wind speed and direction.

3. Include monthly report showing the following:

a. Daily minimum, maximum, and average outdoor dry-bulb temperature.
b. Daily minimum, maximum, and average outdoor wet-bulb temperature.
c. Daily minimum, maximum, and average outdoor dew point temperature.
d. Number of heating degree-days for each day calculated from a base temperature of 55 deg F (13 deg C).
e. Number of cooling degree-days for each day calculated from a base temperature of 65 deg F (18 deg C).
f. Monthly minimum, maximum, and average outdoor carbon dioxide level.
g. Daily minimum, maximum, and average relative humidity.
h. Daily minimum, maximum, and average barometric pressure.
i. Daily minimum, maximum, and average wind speed and direction.

4. Include annual (12-month) report showing the following:

a. Monthly minimum, maximum, and average outdoor dry-bulb temperature.
b. Monthly minimum, maximum, and average outdoor wet-bulb temperature.
c. Monthly minimum, maximum, and average outdoor dew point temperature.
d. Number of heating degree-days for each day calculated from a base temperature of 55 deg F (13 deg C).
e. Number of cooling degree-days for each day calculated from a base temperature of 65 deg F (18 deg C).
f. Annual minimum, maximum, and average outdoor carbon dioxide level.
g. Monthly minimum, maximum, and average relative humidity.

h. Daily minimum, maximum, and average barometric pressure.
i. Daily minimum, maximum, and average wind speed and direction.

L. Standard Trends:

1. Trend all I/O point present values, set points, and other parameters indicated for trending.
2. Trends shall be associated into groups, and a trend report shall be set up for each group.
3. Trends shall be stored within DDC controller and uploaded to hard drives automatically on reaching 75 percent of DDC controller buffer limit, or by operator request, or by archiving time schedule.
4. Preset trend intervals for each I/O point after review with Owner.
5. Trend intervals shall be operator selectable from 10 seconds up to 60 minutes. Minimum number of consecutive trend values stored at one time shall be 100 per variable.
6. When drive storage memory is full, most recent data shall overwrite oldest data.
7. Archived and real-time trend data shall be available for viewing numerically and graphically by operators.

M. Custom Trends: Operator shall be able to define a custom trend log for any I/O point in DDC system.

1. Each trend shall include interval, start time, and stop time.
2. Data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on workstation hard drives.
3. Data shall be retrievable for use in spreadsheets and standard database programs.

N. Programming Software:

1. Include programming software to execute sequences of operation indicated.
2. Include programming routines in simple and easy to follow logic with detailed text comments describing what the logic does and how it corresponds to sequence of operation.
3. Programming software shall be any of the following:

a. Graphic Based: Programming shall use a library of function blocks made from preprogrammed code designed for DDC control systems.

1) Function blocks shall be assembled with interconnection lines that represent to control sequence in a flowchart.
2) Programming tools shall be viewable in real time to show present values and logical results of each function block.

b. Menu Based: Programming shall be done by entering parameters, definitions, conditions, requirements and constraints.

4. Include means for detecting programming errors and testing software control strategies with a simulation tool before implementing in actual control. Simulation tool may be inherent with programming software or as a separate product.

2.13 OFFICE APPLICATION SOFTWARE

A. Include current version of office application software at time of Substantial Completion.

B. Office application software package shall include multiple separate applications and use a common platform for all applications, similar to Microsoft's "Office Professional" Windows 10 with high-speed Internet Access.

1. Database.
2. E-mail.
3. Presentation.
4. Publisher.
5. Spreadsheet.
6. Word processing.

2.14 ASHRAE 135 GATEWAYS

A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to, boilers, chillers, and variable-speed drives.

B. Include gateways to connect BACnet to legacy systems, existing non-BACnet devices, and existing non-BACnet DDC-controlled equipment, only when specifically requested and approved by Owner.

C. Include with each gateway an interoperability schedule showing each point or event on legacy side that BACnet "client" will read, and each parameter that BACnet network will write to. Describe this interoperability of BACnet services, or BIBBs, defined in ASHRAE 135, Annex K.

D. Gateway Minimum Requirements:

1. Read and view all readable object properties on non-BACnet network to BACnet network and vice versa where applicable.
2. Write to all writeable object properties on non-BACnet network from BACnet network and vice versa where applicable.
3. Include single-pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet and vice versa.
4. Comply with requirements of Data Sharing Read Property, Data Sharing Write Property, Device Management Dynamic Device Binding-B, and Device Management Communication Control BIBBs according to ASHRAE 135.
5. Hardware, software, software licenses, and configuration tools for operator-to-gateway communications.
6. Backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.

2.15 DDC CONTROLLERS

A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.

E. Environment Requirements:

1. Controller hardware shall be suitable for the anticipated ambient conditions.
2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F (Zero to 50 deg C).
3. Controllers located outdoors shall be rated for operation at -10 to 150 deg F (40 to 65 deg C).

F. Power and Noise Immunity:

1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches (900 mm) of enclosure.

G. DDC Controller Spare Processing Capacity:

1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:

a. Network Controllers: 50 percent.
b. Programmable Application Controllers: Not less than 60 percent.
c. Application-Specific Controllers: Not less than 70 percent.

2. Memory shall support DDC controller's operating system and database and shall include the following:

a. Monitoring and control.
b. Energy management, operation and optimization applications.
c. Alarm management.
d. Historical trend data of all connected I/O points.
e. Maintenance applications.
f. Operator interfaces.
g. Monitoring of manual overrides.

H. DDC Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:

1. Network Controllers:

a. 20 percent of each AI, AO, BI, and BO point connected to controller.
b. Minimum Spare I/O Points per Controller:

1) AIs: Three.

2) AOs: Three.
3) BIs: Five.
4) BOs: Five.

2. Programmable Application Controllers:

a. 20 percent of each AI, AO, BI, and BO point connected to controller.
b. Minimum Spare I/O Points per Controller:

1) AIs: Three.
2) AOs: Three.
3) BIs: Five.
4) BOs: Five.

3. Application-Specific Controllers:

a. 10 percent of each AI, AO, BI, and BO point connected to controller.
b. Minimum Spare I/O Points per Controller:

1) AIs: Two.
2) AOs: Two.
3) BIs: Three.
4) BOs: Three.

I. Maintenance and Support: Include the following features to facilitate maintenance and support:

1. Mount microprocessor components on circuit cards for ease of removal and replacement.
2. Means to quickly and easily disconnect controller from network.
3. Means to quickly and easily access connect to field test equipment.
4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.

J. Input and Output Point Interface:

1. Hardwired input and output points shall connect to network, programmable application and application-specific controllers.
2. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller.
3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.
4. AIs:

a. AIs shall include monitoring of low-voltage (zero- to 10-V dc), current (4 to 20 mA) and resistance signals from thermistor and RTD sensors.
b. AIs shall be compatible with, and field configurable to, sensor and transmitters installed.
c. Controller AIs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 12 bits or better to comply with accuracy requirements indicated.
d. Signal conditioning including transient rejection shall be provided for each AI.

e. Capable of being individually calibrated for zero and span.
f. Incorporate common-mode noise rejection of at least 50 dB from zero to 100 Hz for differential inputs, and normal-mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10000 ohms.

5. AOs:

a. Controller AOs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 12 bits or better to comply with accuracy requirements indicated.
b. Output signals shall have a range Division 26 for as required to include proper control of output device.
c. Capable of being individually calibrated for zero and span.
d. AOs shall not exhibit a drift of greater than 0.4 percent of range per year.

6. BIs:

a. Controller BIs shall accept contact closures and shall ignore transients of less than 5-ms duration.
b. Isolation and protection against an applied steady-state voltage of up to 180-V ac peak.
c. BIs shall include a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against effects of contact bounce and noise.
d. BIs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
e. Pulse accumulation input points shall comply with all requirements of BIs and accept up to 10 pulses per second for pulse accumulation. Buffer shall be provided to totalize pulses. Pulse accumulator shall accept rates of at least 20 pulses per second. The totalized value shall be reset to zero on operator's command.

7. BOs:

a. Controller BOs shall include relay contact closures or triac outputs for momentary and maintained operation of output devices.

1) Relay contact closures shall have a minimum duration of 0.1 second. Relays shall include at least 180 V of isolation. Electromagnetic interference suppression shall be provided on all output lines to limit transients to non-damaging levels. Minimum contact rating shall be 1 A at 24-V ac.
2) Triac outputs shall include at least 180 V of isolation. Minimum contact rating shall be 1 A at 24-V ac.

b. BOs shall include for two-state operation or a pulsed low-voltage signal for pulse-width modulation control.
c. BOs shall be selectable for either normally open or normally closed operation.
d. Include tristate outputs (two coordinated BOs) for control of three-point floating-type electronic actuators without feedback.
e. Limit use of three-point floating devices to VAV terminal unit control applications, and other applications indicated on Drawings. Control algorithms shall operate

actuator to one end of its stroke once every 24 hours for verification of operator tracking.

2.16 NETWORK CONTROLLERS

A. General Network Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers that perform scheduling shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.
9. The SNC shall be a JACE 8000 supporting the Tridium N4 framework
10. JACE shall include a 3-year Software Maintenance Agreement (SMA)

B.

C. Communication:

1. Network controllers shall communicate with other devices on DDC system Level one network.
2. Network controller also shall perform routing if connected to a network of programmable application and application-specific controllers.

D. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation.
2. Local Keypad and Display:

    a. Equip controller with local keypad and digital display for interrogating and editing data.
    b. Use of keypad and display shall require security password.

E. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss

for at least 96 hours.

2.17 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. Controller shall have enough memory to support its operating system, database, and programming requirements.
3. Data shall be shared between networked controllers and other network devices.
4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
5. Controllers that perform scheduling shall have a real-time clock.
6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
7. Controllers shall be fully programmable.

B. Communication:

1. Programmable application controllers shall communicate with other devices on network.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation.
2. Local Keypad and Display:

    a. Equip controller with local keypad and digital display for interrogating and editing data.
    b. Use of keypad and display shall require security password.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 96 hours.

2.18 APPLICATION-SPECIFIC CONTROLLERS

A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.

1. Capable of standalone operation and shall continue to include control functions without

being connected to network.
2. Data shall be shared between networked controllers and other network devices.

B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

C. Operator Interface: Controller shall be equipped with a service communications port for connection to a portable operator's workstation.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

2.19 CONTROLLER SOFTWARE

A. General Controller Software Requirements:

1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.
2. I/O points shall be identified by up to 30-character point name and up to 16-character point descriptor. Same names shall be used at operator workstations.
3. Control functions shall be executed within controllers using DDC algorithms.
4. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.

B. Security:

1. Operator access shall be secured using individual security passwords and user names.
2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.
3. Operator log-on and log-off attempts shall be recorded.
4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.

C. Scheduling: Include capability to schedule each point or group of points in system. Each schedule shall consist of the following:

1. Weekly Schedule:

a. Include separate schedules for each day of week.
b. Each schedule should include the capability for start, stop, optimal start, optimal stop, and night economizer.
c. Each schedule may consist of up to 10 events.

d. When a group of objects are scheduled together, include capability to adjust start and stop times for each member.

2. Exception Schedules:

a. Include ability for operator to designate any day of the year as an exception schedule.
b. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by regular schedule for that day of week.

3. Holiday Schedules:

a. Include capability for operator to define up to 99 special or holiday schedules.
b. Schedules may be placed on scheduling calendar and will be repeated each year.
c. Operator shall be able to define length of each holiday period.

D. System Coordination:

1. Include standard application for proper coordination of equipment.
2. Application shall include operator with a method of grouping together equipment based on function and location.
3. Group may then be used for scheduling and other applications.

E. Binary Alarms:

1. Each binary point shall be set to alarm based on operator-specified state.
2. Include capability to automatically and manually disable alarming.

F. Analog Alarms:

1. Each analog object shall have both high and low alarm limits.
2. Alarming shall be able to be automatically and manually disabled.

G. Alarm Reporting:

1. Operator shall be able to determine action to be taken in event of an alarm.
2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.

H. Remote Communication:

1. System shall have ability to dial out in the event of an alarm.

I. Electric Power Demand Limiting:

1. Demand-limiting program shall monitor building or other operator-defined electric power consumption from signals connected to electric power meter or from a watt transducer or current transformer.

2. Demand-limiting program shall predict probable power demand such that action can be taken to prevent exceeding demand limit. When demand prediction exceeds demand limit, action will be taken to reduce loads in a predetermined manner. When demand prediction indicates demand limit will not be exceeded, action will be taken to restore loads in a predetermined manner.
3. Demand reduction shall be accomplished by the following means:

    a. Reset air-handling unit supply temperature set points.
    b. Reset space temperature set points.
    c. De-energize equipment based on priority.

4. Demand-limiting parameters, frequency of calculations, time intervals, and other relevant variables shall be based on the means by which electric power service provider computes demand charges.
5. Include demand-limiting prediction and control for any individual meter monitored by system or for total of any combination of meters.
6. Include means operator to make the following changes online:

    a. Addition and deletion of loads controlled.
    b. Changes in demand intervals.
    c. Changes in demand limit for meter(s).
    d. Maximum shutoff time for equipment.
    e. Minimum shutoff time for equipment.
    f. Select rotational or sequential shedding and restoring.
    g. Shed and restore priority.

7. Include the following information and reports, to be available on an hourly, daily, weekly, monthly and annual basis:

    a. Total electric consumption.
    b. Peak demand.
    c. Date and time of peak demand.
    d. Daily peak demand.

J. Maintenance Management: System shall monitor equipment status and generate maintenance messages based on operator-designated run-time, starts, and calendar date limits.

K. Sequencing: Include application software based on sequences of operation indicated to properly sequence chillers, boilers, and other applicable HVAC equipment.

L. Control Loops:

1. Support any of the following control loops, as applicable to control required:

    a. Two-position (on/off, open/close, slow/fast) control.
    b. Proportional control.
    c. Proportional plus integral (PI) control.
    d. Proportional plus integral plus derivative (PID) control.

        1) Include PID algorithms with direct or reverse action and anti-windup.

2) Algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs.
3) Controlled variable, set point, and PID gains shall be operator-selectable.

e. Adaptive (automatic tuning).

M. Staggered Start: Application shall prevent all controlled equipment from simultaneously restarting after a power outage. Order which equipment (or groups of equipment) is started, along with the time delay between starts, shall be operator-selectable.

N. Anti-Short Cycling:

1. BO points shall be protected from short cycling.
2. Feature shall allow minimum on-time and off-time to be selected.

O. On and Off Control with Differential:

1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
2. Algorithm shall be direct- or reverse-acting and incorporate an adjustable differential.

P. Run-Time Totalization:

1. Include software to totalize run-times for all BI and BO points.
2. A high run-time alarm shall be assigned, if required, by operator.

2.20 ENCLOSURES

A. General Enclosure Requirements:

1. House each controller and associated control accessories in a single enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
2. Do not house more than one controller in a single enclosure.
3. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
4. Individual wall-mounted single-door enclosures shall not exceed 36 inches (900 mm) wide and 48 inches (1200 mm) high.
5. Include wall-mounted enclosures with brackets suitable for mounting enclosures to wall or freestanding support stand as indicated.
6. Supply each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature located in a pocket on inside of door.

B. Internal Arrangement:

1. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components associated with a controller, but not an integral part of controller.
2. Arrange layout to group similar products together.
3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
4. Factory or shop install products, tubing, cabling and wiring complying with requirements

and standards indicated.

5. Terminate field cable and wire using heavy-duty terminal blocks.
6. Include spare terminals, equal to not less than 10 percent of used terminals.
7. Include spade lugs for stranded cable and wire.
8. Install a maximum of two wires on each side of a terminal.
9. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
10. Include enclosure with a line-voltage nominal 20-A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with a 5-A circuit breaker.
11. Mount products within enclosure on removable internal panel(s).
12. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch- (6-mm-) high lettering.
13. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.
14. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.
15. Size enclosure internal panel to include at least 25 percent spare area on face of panel.

C. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.
3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.
5. Include temperature-controlled cooling within the enclosure for applications where ventilation fans cannot maintain inside temperature of enclosure below maximum operating temperature of product with most stringent requirement.
6. Where required by application, include humidity-controlled electric dehumidifier or cooling to maintain inside of enclosure below maximum relative humidity of product with most stringent requirement and to prevent surface condensation within enclosure.

D. Wall-Mounted, NEMA 250, Type 1:

1. Enclosure shall be NRTL listed according to UL 50 or UL 50E.
2. Construct enclosure of steel, not less than:

    a. Enclosure size less than 24 in. (600 mm): 0.053 in. (1.35 mm) or 0.067 in. (1.7 mm) thick.
    b. Enclosure size 24 in. (600 mm) and larger: 0.067 in. (1.7 mm) or 0.093 in. (2.36 mm) thick.

3. Finish enclosure inside and out with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Exterior color shall be manufacturer's standard.
    b. Interior color shall be manufacturer's standard.

4. Hinged door full size of front face of enclosure and supported using:

    a. Enclosures sizes less than 36 in. (900 mm) tall: Multiple butt hinges.
    b. Enclosures sizes 36 in. (900 mm) tall and larger: Continuous piano hinges.

5. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Size less than 24 in. (600 mm): Solid or Perforated steel, 0.053 in. (1.35 mm) thick.
    b. Size 24 in. (600 mm) and larger: Solid steel, 0.093 in. (2.36 mm) thick.

6. Internal panel mounting hardware, grounding hardware and sealing washers.
7. Grounding stud on enclosure body.
8. Thermoplastic pocket on inside of door for record Drawings and Product Data.

E. Wall Mounted NEMA 250, Types 4 and 12:

1. Enclosure shall be NRTL listed according to UL 508A.
2. Seam and joints are continuously welded and ground smooth.
3. Where recessed enclosures are indicated, include enclosures with face flange for flush mounting.
4. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
5. Single-door enclosure sizes up to 60 inches tall by 36 inches wide (1500 mm tall by 900 mm wide).
6. Double-door enclosure sizes up to 36 inches tall by 60 inches wide (900 mm tall by 1500 mm wide).
7. Construct enclosure of steel, not less than the following:

    a. Size Less Than 24 Inches (600 mm): 0.053 inch (1.35 mm) or 0.067 inch (1.7 mm) thick.
    b. Size 24 Inches (600 mm) and Larger: 0.067 inch (1.7 mm) thick.

8. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Exterior color shall be manufacturer's standard.
    b. Interior color shall be manufacturer's standard.

9. Corner-formed door, full size of enclosure face, supported using multiple concealed hinges with easily removable hinge pins.

    a. Sizes through 24 Inches (600 mm) Tall: Two hinges.

b. Sizes between 24 Inches (600 mm) through 48 Inches (1200 mm) Tall: Three hinges.
c. Sizes Larger 48 Inches (1200 mm) Tall: Four hinges.

10. Double-door enclosures with overlapping door design to include unobstructed full-width access.

    a. Single-door enclosures 48 inches (1200 mm) and taller, and all double-door enclosures, with three-point (top, middle and bottom) latch system.

11. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Size Less Than 24 Inches (600 mm): Solid or perforated steel, 0.053 inch (1.35 mm) thick.
    b. Size 24 Inches (600 mm) and Larger: Solid steel, 0.093 inch (2.36 mm) thick.

12. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
13. Grounding stud on enclosure body.
14. Thermoplastic pocket on inside of door for record Drawings and Product Data.

F. Wall-Mounted, NEMA 250, Type 4X SS:

1. Enclosure shall be NRTL listed according to UL 508A.
2. Seam and joints are continuously welded and ground smooth.
3. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
4. Construct enclosure of Type 304 or Type 316L stainless steel, not less than the following:

    a. Size Less Than 24 Inches (600 mm): 0.053 inch (1.35 mm) thick.
    b. Size 24 Inches (600 mm) and Larger: 0.067 inch (1.7 mm) thick.

5. Outside body and door of enclosure with brushed No. 4 finish.
6. Corner-formed door, full size of enclosure face, supported using continuous piano hinge full length of door.
7. Removable internal panel shall be 0.093-inch (2.36-mm) solid steel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
8. Internal panel mounting studs and hardware, grounding hardware, and sealing washers.
9. Install corrosion-resistant polyester vent drain in a stainless-steel sleeve at the bottom of enclosure.
10. Include enclosure with stainless-steel mounting brackets.

G. Freestanding, NEMA 250, Type 1:

1. Enclosure shall be NRTL listed according to UL 508A.
2. Seam and joints are continuously welded and ground smooth.
3. Externally formed body flange around perimeter of enclosure face.
4. Single-door enclosure sizes up to 84 inches tall by 36 inches wide (2100 mm tall by 900 mm wide).

5. Construct enclosure of steel, not less than 0.067 inch (1.7 mm) thick.
6. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Exterior color shall be manufacturer's standard.
    b. Interior color shall be manufacturer's standard.

7. Corner-formed flush door, full size of enclosure face, supported using four concealed hinges with easily removable hinge pins.
8. Doors with three-point (top, middle, and bottom) latch system with single heavy-duty handle and integral locking mechanism.
9. Removable back covers.
10. Removable solid steel internal panel, 0.093 inch (2.36 mm) thick, with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
11. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
12. Grounding stud on enclosure body.
13. Thermoplastic pocket on inside of door for record Drawings and Product Data.
14. Nominal 4-inch- (100-mm-) tall integral lifting base, not less than 0.123 inch (3.12 mm) thick, with predrilled holes for attachment to mounting surface.
15. Each top end of enclosure fitted with lifting tabs, not less than 0.172 inch (4.37 mm) thick.
16. Internal rack-mount shelves and angles as required by application.

H. Freestanding, NEMA 250, Types 4 and 12:

1. Enclosure shall be NRTL listed according to UL 508A.
2. Seam and joints are continuously welded and ground smooth.
3. Externally formed body flange around perimeter of enclosure face.
4. Type 12 Enclosure Sizes:

    a. Single-door enclosure sizes up to 90 inches tall by 36 inches wide (2250 mm tall by 900 mm wide).

5. Type 4 Enclosure Sizes:

    a. Single-door enclosure sizes up to 72 inches tall by 36 inches wide (1800 mm tall by 900 mm wide).

6. Construct enclosure of steel, not less than 0.093 inch (2.36 mm) thick.
7. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Exterior color shall be manufacturer's standard.
    b. Interior color shall be manufacturer's standard.

8. Corner-formed door with continuous perimeter oil-resistant gasket supported using continuous piano hinge full length of door.
9. Doors fitted with three-point (top, middle, and bottom) latch system with latching rod rollers and single, heavy-duty oil-tight handle with integral locking mechanism.
10. Removable solid steel internal panel, 0.093 inch (2.36 mm) thick, with a white polyester

powder coating that is electrostatically applied and then baked to bond to substrate.
Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
11. Grounding stud on enclosure body.
12. Thermoplastic pocket on inside of door for record Drawings and Product Data.
13. Top of enclosure fitted with no fewer than two lifting eyes.
14. Internal rack-mount shelves and angles as required by application.

I. Accessories:

1. Electric Heater:

a. Aluminum housing with brushed finish.
b. Thermostatic control with adjustable set point from zero to 100 deg F (Minus 18 to 38 deg C).
c. Capacity: 100, 200, 400, and 800 W as required by application.
d. Fan draws cool air from bottom of enclosure and passes air across thermostat and heating elements before being released into enclosure cavity. Heated air is discharged through the top of heater.

2. Ventilation Fans, Filtered Intake and Exhaust Grilles:

a. Number and size of fans, filters and grilles as required by application.
b. Compact cooling fans engineered for 50,000 hours of continuous operation without lubrication or service.
c. Fans capable of being installed on any surface and in any position within enclosure for spot cooling or air circulation.
d. Thermostatic control with adjustable set point from 32 to 140 deg F (Zero to 60 deg C).
e. Airflow Capacity at Zero Pressure:

1) 4-Inch (100-mm) Fan: 100 cfm (47 L/s).
2) 6-Inch (150-mm) Fan: 240 cfm (113 L/s).
3) 10-Inch (250-mm) Fan: 560 cfm (264 L/s).

f. Maximum operating temperature of 158 deg F (70 deg C).
g. 4-inch (100-mm) fan thermally protected and provided with permanently lubricated ball-bearings.
h. 6- and 10-inch (150- and 250-mm) fans with ball-bearing construction and split capacitor motors thermally protected to avoid premature failure.
i. Dynamically balanced impellers molded from polycarbonate material.
j. Fan furnished with power cord and polarized plug for power connection.
k. Fan brackets, finger guards and mounting hardware provided with fans to complete installation.
l. Removable Intake and Exhaust Grilles: stainless steel of size to match fan size and suitable for NEMA 250, Types 1 and 12 enclosures.
m. Filters for NEMA 250, Type 1 Enclosures: Washable aluminum, of a size to match intake grille.
n. Filters for NEMA 250, Type 12 Enclosures: Disposable, of a size to match intake grille.

3. Air Conditioner:
    a. Electric-powered, self-contained air-conditioning unit specially designed for electrical enclosures to maintain temperature inside enclosure below ambient temperature outside enclosure.
    b. Thermostatic control with adjustable set point from 60 to 120 deg F (16 to 49 deg C).
    c. Enclosure side or top mounting with unit capacity as required by application.
    d. Designed for closed-loop cooling with continuous operation in ambient environments up to 125 deg F (52 deg C).
    e. HFC refrigerant.
    f. Reusable and washable air filter.
    g. High-performance, industrial-grade, and high-efficiency fans.
    h. Furnished with power cord and polarized plug for power connection.
    i. Condensate management system with base pan side drain.
    j. Mounting hardware, gaskets, mounting template and instruction manual furnished with unit.
    k. Outdoor units equipped with head pressure control for low ambient operation, compressor heater, coated condenser coil and thermostat.

4. Thermoelectric Humidifier:

    a. ABS plastic enclosure.
    b. Capacity of 8 oz. (0.24 L) of water per 24 hours.
    c. Built-in drain captures moisture and plastic hose directs moisture to outside enclosure through a drain.
    d. Controlled to maintain enclosure relative humidity at an adjustable set point.
    e. Unit power supply shall be internally wired to enclosure electrical power source.

5. Framed Fixed Window Kit for NEMA 250, Types 4, 4X, and 12 Enclosures:

    a. 0.25-inch- (6-mm-) thick, scratch-resistant acrylic or polycarbonate window mounted in a metal frame matching adjacent door material.
    b. Enclosure types, except NEMA 250 Type 1, shall have a continuous gasket material around perimeter of window and frame to provide watertight seal.
    c. Window kit shall be factory or shop installed before shipment to Project.

6. Frameless Fixed Window Kit for NEMA 250, Type 1 Enclosures:

    a. 0.125-inch- (3-mm-) thick, polycarbonate window mounted in enclosure door material.
    b. Window attached to door with screw fasteners and continuous strip of high-strength double-sided tape around window perimeter.
    c. Window kit shall be factory or shop installed before shipment to Project.

7. Frame Fixed or Hinged Window Kit for NEMA 250, Types 1 and 12 Enclosures:

    a. 0.25-inch- (6-mm-) thick, scratch-resistant acrylic or polycarbonate window mounted in a metal frame matching adjacent door material.
    b. Enclosure types, except NEMA 250 Type 1, shall have a continuous gasket material around perimeter of window and frame to provide watertight seal.

c. Window kit shall be factory or shop installed before shipment to Project.

8. Bar handle with keyed cylinder lock set.

2.21 RELAYS

A. General-Purpose Relays:

1. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three-pole double-throw relays.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Relays shall have LED indication and a manual reset and push-to-test button.
7. Performance:

   a. Mechanical Life: At least 10 million cycles.
   b. Electrical Life: At least 100,000 cycles at rated load.
   c. Pickup Time: 15 ms or less.
   d. Dropout Time: 10 ms or less.
   e. Pull-in Voltage: 85 percent of rated voltage.
   f. Dropout Voltage: 50 percent of nominal rated voltage.
   g. Power Consumption: 2 VA.
   h. Ambient Operating Temperatures: Minus 40 to 115 deg F (Minus 40 to 46 deg C).

8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

B. Multifunction Time-Delay Relays:

1. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.
2. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
3. Use a plug-in-style relay with either an 8- or 11-pin octal plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a dust-tight cover.
6. Include knob and dial scale for setting delay time.
7. Performance:

   a. Mechanical Life: At least 10 million cycles.
   b. Electrical Life: At least 100,000 cycles at rated load.
   c. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
   d. Repeatability: Within 2 percent.
   e. Recycle Time: 45 ms.
   f. Minimum Pulse Width Control: 50 ms.

g. Power Consumption: 5 VA or less at 120-V ac.
h. Ambient Operating Temperatures: Minus 40 to 115 deg F (Minus 40 to 46 deg C).

8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

C. Latching Relays:

1. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either DPDT or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with a multibladed plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Performance:

a. Mechanical Life: At least 10 million cycles.
b. Electrical Life: At least 100,000 cycles at rated load.
c. Pickup Time: 15 ms or less.
d. Dropout Time: 10 ms or less.
e. Pull-in Voltage: 85 percent of rated voltage.
f. Dropout Voltage: 50 percent of nominal rated voltage.
g. Power Consumption: 2 VA.
h. Ambient Operating Temperatures: Minus 40 to 115 deg F (Minus 40 to 46 deg C).

7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

D. Current Sensing Relay:

1. Monitors ac current.
2. Independent adjustable controls for pickup and dropout current.
3. Energized when supply voltage is present and current is above pickup setting.
4. De-energizes when monitored current is below dropout current.
5. Dropout current is adjustable from 50 to 95 percent of pickup current.
6. Include a current transformer, if required for application.
7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

E. Combination On-Off Status Sensor and On-Off Relay:

1. Description:

a. On-off control and status indication in a single device.
b. LED status indication of activated relay and current trigger.

c. Closed-Open-Auto override switch located on the load side of the relay.

2. Performance:
   a. Ambient Temperature: Minus 30 to 140 deg F (Minus 34 to 60 deg C).
   b. Voltage Rating: Single-phase loads rated for 300-V ac. Three-phase loads rated for 600-V ac.

3. Status Indication:

   a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.
   b. Current Sensor Range: As required by application.
   c. Current Set Point: Fixed or adjustable as required by application.
   d. Current Sensor Output:

      1) Analog, zero- to 5- or 10-V dc.
      2) Analog, 4 to 20 mA, loop powered.

4. Relay: Single-pole double-throw, continuous-duty coil; rated for 10-million mechanical cycles.
5. Enclosure: NEMA 250, Type 1 enclosure.

2.22 ELECTRICAL POWER DEVICES

A. Transformers:

1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
2. Transformer shall be at least 100 VA.
3. Transformer shall have both primary and secondary fuses.

B. Power-Line Conditioner:

1. General Power-Line Conditioner Requirements:

   a. Design to ensure maximum reliability, serviceability and performance.
   b. Overall function of the power-line conditioner is to receive raw, polluted electrical power and purify it for use by electronic equipment. The power-line conditioner shall provide isolated, regulated, transient and noise-free sinusoidal power to loads served.

2. Standards: NRTL listed per UL 1012.
3. Performance:

   a. Single phase, continuous, 100 percent duty rated KVA/KW capacity. Design to supply power for linear or nonlinear, high crest factor, resistive and reactive loads.
   b. Automatically regulate output voltage to within 2 percent or better with input voltage fluctuations of plus 10 to minus 20 percent of nominal when system is loaded 100 percent. Use Variable Range Regulation to obtain improved line

voltage regulation when operating under less than full load conditions.

1) At 75 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 35 percent of nominal.
2) At 50 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 40 percent of nominal.
3) At 25 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 45 percent of nominal.

c. With input voltage distortion of up to 40 percent, limit the output voltage sine wave to a maximum harmonic content of 5 percent.
d. Automatically regulate output voltage to within 2.5 percent when load (resistive) changes from zero percent to 100 percent to zero percent.
e. Output voltage returns to 95 percent of nominal level within two cycles and to 100 percent within three cycles when the output is taken from no load to full resistive load or vice-versa. Recovery from partial resistive load changes is corrected in a shorter period of time.
f. K Factor: 30, designed to operate with nonlinear, non-sinusoidal, high crest factor loads without overheating.
g. Input power factor within 0.95 approaching unity with load power factor as poor as 0.6.
h. Attenuate load-generated odd current harmonics 23 dB at the input.
i. Electrically isolate the primary from the secondary. Meet isolation criteria as defined in NFPA 70, Article 250-5D.
j. Lighting and Surge Protection: Compares to UL 1449 rating of 330 V when subjected to Category B3 (6000 V/3000 A) combination waveform as established by IEEE C62.41.
k. Common-mode noise attenuation of 140 dB.
l. Transverse-mode noise attenuation of 120 dB.
m. With loss of input power for up to 16.6 ms, the output sine wave remains at usable ac voltage levels.
n. Reliability of 200,000 hours' mean time between failures.
o. At full load, when measured at 1-m distance, audible noise is not to exceed 54 dB.
p. Approximately 92 percent efficient at full load.

4. Transformer Construction:

a. Ferroresonant, dry type, convection cooled, 600V class. Transformer windings of Class H (220 deg C) insulated copper.
b. Use a Class H installation system throughout with operating temperatures not to exceed 150 deg C over a 40-deg C ambient temperature.
c. Configure transformer primary for multi-input voltage. Include input terminals for source conductors and ground.
d. Manufacture transformer core using M-6 grade, grain-oriented, stress-relieved transformer steel.
e. Configure transformer secondary in a 240/120-V split with a 208-V tap or straight 120 V, depending on power output size.
f. Electrically isolate the transformer secondary windings from the primary windings.

Bond neutral conductor to cabinet enclosure and output neutral terminal.

g. Include interface terminals for output power hot, neutral and ground conductors.
h. Label leads, wires and terminals to correspond with circuit wiring diagram.
i. Vacuum impregnate transformer with epoxy resin.

5. Cabinet Construction:

a. Design for panel or floor mounting.
b. NEMA 250, Type 1, general-purpose, indoor enclosure.
c. Manufacture the cabinet from heavy gauge steel complying with UL 50.
d. Include a textured baked-on paint finish.

C. Transient Voltage Suppression and High-Frequency Noise Filter Unit:

1. The maximum continuous operating voltage shall be at least 125 percent.
2. The operating frequency range shall be 47 to 63 Hz.
3. Protection modes according to NEMA LS-1.
4. The rated single-pulse surge current capacity, for each mode of protection, shall be no less than the following:

a. Line to Neutral: 45,000 A.
b. Neutral to Ground: 45,000 A.
c. Line to Ground: 45,000 A.
d. Per Phase: 90,000 A.

5. Clamping voltages shall be in compliance with test and evaluation procedures defined in NEMA LS-1. Maximum clamping voltage shall be as follows:

a. Line to Neutral: 360 V.
b. Line to Ground: 360 V.
c. Neutral to Ground: 360 V.

6. Electromagnetic interference and RF interference noise rejection or attenuation values shall comply with test and evaluation procedures defined in NEMA LS-1.

a. Line to Neutral:

1) 100 kHz: 42 dB.
2) 1 MHz: 25 dB.
3) 10 MHz: 21 dB.
4) 100 MHz: 36 dB.

b. Line to Ground:

1) 100 kHz: 16 dB.
2) 1 MHz: 55 dB.
3) 10 MHz: 81 dB.
4) 100 MHz: 80 dB.

7. Unit shall have LED status indicator that extinguishes to indicate a failure.
8. Unit shall be listed by an NRTL as a transient voltage surge suppressor per UL 1449, and

as an electromagnetic interference filter per UL 1283.
9. Unit shall not generate any appreciable magnetic field.
10. Unit shall not generate an audible noise.

D. DC Power Supply:

1. Plug-in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.
2. Enclose circuitry in a housing.
3. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.
4. Performance:

a. Output voltage nominally 25-V dc within 5 percent.
b. Output current up to 100 mA.
c. Input voltage nominally 120-V ac, 60 Hz.
d. Load regulation within 0.5 percent from zero- to 100-mA load.
e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.
f. Stability within 0.1 percent of rated volts for 24 hours after a 20-minute warmup.

2.23 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS FOR WORKSTATIONS

A. 250 through 1000 VA:

1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.

a. Larger-capacity units shall be provided for systems with larger connected loads.
b. UPS shall provide five minutes of battery power.

3. Performance:

a. Input Voltage: Single phase, 120- or 230-V ac, compatible with field power source.
b. Load Power Factor Range (Crest Factor): 0.65 to 1.0.
c. Output Voltage: 101- to 132-V ac, while input voltage varies between 89 and 152-V ac.
d. On Battery Output Voltage: Sine wave.
e. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
f. Recharge time shall be a maximum of six hours to 90 percent capacity after full discharge to cutoff.
g. Transfer Time: 6 ms.
h. Surge Voltage Withstand Capacity: IEEE C62.41, Categories A and B; 6 kV/200 and 500 A; 100-kHz ringwave.

4. UPS shall be automatic during fault or overload conditions.
5. Unit with integral line-interactive, power condition topology to eliminate all power

contaminants.

6. Include front panel with power switch and visual indication of power, battery, fault and temperature.
7. Unit shall include an audible alarm of faults and front panel silence feature.
8. Unit with four NEMA WD 1, NEMA WD 6 Configuration 5-15R receptacles.
9. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure) and connect the points to the DDC system.
10. Batteries shall be sealed lead-acid type and be maintenance free. Battery replacement shall be front accessible by user without dropping load.
11. Include tower models installed in ventilated cabinets to the particular installation location.

B. 1000 through 3000 VA:

1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.

    a. Larger-capacity units, or multiple units, shall be provided for systems with larger connected loads.
    b. UPS shall provide 10 minutes of battery power.
    c. 2 kVa (Minimum)

3. Performance:

    a. Input Voltage: Single phase, 120-V ac, plus 20 to minus 30 percent.
    b. Power Factor: Minimum 0.97 at full load.
    c. Output Voltage: Single phase, 120-V ac, within 3 percent, steady state with rated output current of 10.0 A, 30.0-A peak.
    d. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
    e. Recharge time shall be a maximum of eight hours to 90 percent capacity.

4. UPS bypass shall be automatic during fault or overload conditions.
5. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure) and connect the points to the DDC system.
6. Batteries shall be sealed lead-acid type and be maintenance free.

Include tower models installed in ventilated cabinets or rack models installed on matching racks, as applicable to the particular installation location and space availability/configuration

2.24 PIPING AND TUBING

A. Pneumatic, and Pressure Instrument Signal Air, Tubing and Piping:

1. Products in this paragraph are intended for use with the following:

    a. Signal air between pressure instruments, such as sensors, switches, transmitters, controllers and accessories.

2. Copper Tubing:

a. Seamless phosphor deoxidized copper, soft annealed or drawn tempered, with chemical and physical properties according to ASTM B 75.
b. Performance, dimensions, weight and tolerance according to ASTM B 280.
c. Diameter, as required by application, not less than nominal 0.25 inch (6 mm).
d. Wall thickness, as required by the application, but not less than 0.030 inch (0.8 mm).

3. Copper Tubing Connectors and Fittings:

a. Brass, compression type.

b. Brass, solder-joint type.

4. Polyethylene Tubing:

a. Fire-resistant black virgin polyethylene according to ASTM D 1248, Type 1, Class C and Grade 5.
b. Tubing shall comply with stress crack test according to ASTM D 1693.
c. Diameter, as required by application, of not less than nominal 0.25 inch (6 mm).

5. Polyethylene Tubing Connectors and Fittings:

a. Brass, barbered fittings.

b. Brass, compression type.

B. Process Tubing:

1. Products in this paragraph are intended for signals to instruments connected to liquid and steam systems.
2. Copper Tubing:

a. Seamless phosphor deoxidized copper, soft annealed or drawn tempered with chemical and physical properties according to ASTM B 75.
b. Performance, dimensions, weight and tolerance according to ASTM B 280.
c. Diameter, as required by application, of not less than nominal 0.25 inch (6 mm).
d. Wall thickness, as required by application, but not less than 0.030 inch (0.8 mm).

3. Copper Tubing Connectors and Fittings:

a. Brass, compression type.

b. Brass, solder-joint type.

4. Stainless-Steel Tubing:

a. Seamless Type 316 stainless steel, Grade TP, cold drawn, annealed and pickled, free from scale.
b. Chemical and physical properties according to ASTM A 269.
c. Diameter, as required by application, of not less than nominal 0.25 inch (6 mm).
d. Wall thickness, as required by application, but not less than 0.035 inch (0.9 mm).

e. Furnish stainless-steel tubing in 20-foot (6-mm) straight random lengths.

5. Stainless-Steel Tubing Connectors and Fittings:

a. Connectors and fittings shall be stainless steel, with stainless-steel collets, flareless type.

b. Connect instruments to tubing with connectors having compression connector on one end and IPS or NPT thread on other end.

2.25 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.

1. Wire size shall be as specified under Division 26. Wiring shall be furnished as part of Division 23 contractor's scope of work.
2. Conductor shall be 7/24 soft annealed copper strand with 2- to 2.5-inch (50- to 65-mm) lay.
3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
4. Conductor colors shall be black (hot), white (neutral), and green (ground).
5. Furnish wire on spools.

B. Single Twisted Shielded Instrumentation Cable above 24 V:

1. Wire size shall be as specified under Division 26. Wiring shall be furnished as part of Division 23 contractor's scope of work.
2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch (50- to 65-mm) lay.
3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
4. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 600-V, 90-deg C rating and shall be Type TC cable.
6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
7. Furnish wire on spools.

C. Single Twisted Shielded Instrumentation Cable 24 V and Less:

1. Wire size shall be as specified under Division 26. Wiring shall be furnished as part of Division 23 contractor's scope of work.
2. Conductors shall be a twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch (50- to 65-mm) lay.
3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
4. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 300-V, 105-deg C rating and shall be Type PLTC cable.
6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor

colors shall be black, red and white.
7. Furnish wire on spools.

D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.

1. Cable shall be balanced twisted pair.
2. Comply with the following requirements and for balanced twisted pair cable described in Division 26.

a. Cable shall be plenum rated.
b. Cable shall have a unique color that is different from other cables used on Project.

2.26 RACEWAYS

A. Comply with requirements in Division 26 for electrical power raceways and boxes.

B. Comply with requirements in Division 26 for raceways for balanced twisted pair cables and optical fiber cables.

2.27 OPTICAL FIBER CABLE AND CONNECTORS

A. Comply with requirements in Division 26 for optical fiber backbone cabling and connectors.

B. Comply with requirements in Division 26 for optical fiber horizontal cabling and connectors.

2.28 ACCESSORIES

A. Pneumatic Pressure Gages:

1. Pressure gages shall a 1.5-inch- (38-mm-) diameter face for pressures up through 30 psig (207 kPa) and 2.5-inch- (65-mm-) diameter face for greater pressures.
2. Include separate gages for branch pressure and main pressure lines.
3. White dial face with black printing.
4. Include 1-psig (6.9-kPa) increment for scale ranges through 30 psig (207 kPa) and 2-psig (13.8-kPa) increment for larger ranges.
5. Accuracy: Within 1 percent of full-scale range.

B. Pressure Electric Switches:

1. Diaphragm-operated snap acting switch.
2. Set point adjustable from 3 to 20 psig (21 to 138 kPa).
3. Differential adjustable from 2 to 6 psig (14 to 41 kPa).
4. Rated for resistance loads at 120-V ac.
5. Body and switch housing shall be metal.

C. Damper Blade Limit Switches:

1. Sense positive open and/or closed position of the damper blades.

2. NEMA 250, Type 13, oil-tight construction.
3. Arrange for the mounting application.
4. Additional waterproof enclosure when required by its environment.
5. Arrange to prevent "over-center" operation.

D. I/P and E/P Transducers:

1. Commercial Grade:
   a. The transducer shall convert an AO signal to a stepped pneumatic signal. Unless otherwise required by the operating sequence, use a 3- to 15-psig (21- to 103-kPa) pneumatic signal for pneumatic actuation.
   b. Construct the entire assembly so that shock and vibration will neither harm the transducer nor affect its accuracy.
   c. Transducer shall have auto/manual output switch, manual output control and an output pressure gage.
   d. Accuracy: Within 1.0 percent of the output span.
   e. Linearity: Within 0.5 percent of the output span.
   f. Output Capacity: Not less than 550 scim at 15 psig (103 kPa).
   g. Transducer shall have separate zero and span calibration adjustments.
   h. The transducer shall withstand up to 40 psig (276 kPa) of supply pressure without damage.
   i. For use on only modulating pneumatic outputs that are associated with terminal units, including fan-coil units, VAV units and unit heaters.

2. Industrial Grade:

   a. The transducer shall convert an AO signal to a proportional pneumatic signal. Unless otherwise required by the operating sequence, use a 3- to 15-psig (21- to 103-kPa) pneumatic signal for pneumatic actuation. A stepped pneumatic signal is unacceptable.
   b. Construct the entire assembly so that shock and vibration will neither harm the transducer nor affect its accuracy.
   c. Suitable for operation in an ambient temperature range of minus 40 to 150 deg F (minus 40 to 66 deg C).
   d. Accuracy: Within 0.5 percent of the output span.
   e. Linearity: Within 0.5 percent of the output span.
   f. Output Capacity: Not less than 5 scfm.
   g. Transducer shall have zero and span calibration adjustments.
   h. The transducer shall withstand up to 50 psig (345 kPa) of supply pressure without damage.
   i. For use on all modulating pneumatic outputs, not requiring a commercial-grade transducer.

E. E/P Switch:

1. Construct the body of cast aluminum or brass; three pipe body (common, normally open, and normally closed).
2. Internal construction of steel, copper or brass.
3. Air Connections: Barb.
4. Rating of 30 psig (207 kPa) when installed in systems below 25 psig (172 kPa) and of

150 psig (1034 kPa) when installed in systems above 25 psig (172 kPa).
5. Include coil transient suppression.

F. Instrument Enclosures:

1. Include instrument enclosure for secondary protection to comply with requirements indicated in "Performance Requirements" Article.
2. NRTL listed and labeled to UL 50.
3. Sized to include at least 25 percent spare area on subpanel.
4. Instrument(s) mounted within enclosure on internal subpanel(s).
5. Enclosure face with engraved, laminated phenolic nameplate for each instrument within enclosure.
6. Enclosures housing pneumatic instruments shall include main pressure gage and a branch pressure gage for each pneumatic device, installed inside.
7. Enclosures housing multiple instruments shall route tubing and wiring within enclosure in a raceway having a continuous removable cover.
8. Enclosures larger than 12 inches (300 mm) shall have a hinged full-size face cover.
9. Equip enclosure with lock and common key.

G. Manual Valves:

1. Needle Type:

a. PTFE packing.
b. Construct of brass for use with copper and polyethylene tubing and of stainless steel for use with stainless-steel tubing.
c. Aluminum T-bar handle.
d. Include tubing connections.

2. Ball Type:

a. Body: Bronze ASTM B 62 or ASTM B 61.
b. Ball: Type 316 stainless steel.
c. Stem: Type 316 stainless steel.
d. Seats: Reinforced PTFE.
e. Packing Ring: Reinforced PTFE.
f. Lever: Stainless steel with a vinyl grip.
g. 600 WOG.
h. Threaded end connections.

H. Wall-Mounted Portable Workstation Cabinet:

1. Surface-mounted wall cabinet for tilt-out operation of laptop computers and large-format mobile devices.
2. Cabinet shall have a load limit of 50 lb (23 kg).
3. Cabinet shall include the following:

a. Oil-filled dampers for controlled lowering of equipment to operational position.
b. 3RU EIA mounting rails.
c. Removable laptop shelf.

d. Separate top compartment with mounting area, hinged rail and security lock.
e. Front ventilation slots.
f. Knockouts for conduit connections on top and bottom of cabinet.

4. Cabinet shall be constructed of steel and painted with a powder-coat epoxy.

5. Inside center of backbox shall have provision to mount a field-furnished and-installed, single gang electrical outlet box.

2.29 IDENTIFICATION

A. Instrument Air Pipe and Tubing:

1. Engraved tag shall bear the following information:

   a. Service (Example): "Instrument Air."
   b. Pressure Range (Example): 0 to 30 psig (0 to 200 kPa).

2. Letter size shall be a minimum of 0.25 inch (6 mm) high.
3. Tag shall consist of white lettering on blue background.
4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded blue with contrasting white center exposed by engraving through outer layer.
5. Include tag with a brass grommet, chain and S-hook.

B. Control Equipment, Instruments, and Control Devices:

1. Self-adhesive label bearing unique identification.

   a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.

2. Letter size shall be as follows:

   a. Operator Workstations: Minimum of 0.5 inch (13 mm) high.
   b. Servers: Minimum of 0.5 inch (13 mm) high.
   c. Printers: Minimum of 0.5 inch (13 mm) high.
   d. DDC Controllers: Minimum of 0.5 inch (13 mm) high.
   e. Gateways: Minimum of 0.5 inch (13 mm) high.
   f. Repeaters: Minimum of 0.5 inch (13 mm) high.
   g. Enclosures: Minimum of 0.5 inch (13 mm) high.
   h. Electrical Power Devices: Minimum of 0.5 inch (13 mm) high.
   i. UPS units: Minimum of 0.5 inch (13 mm) high.Accessories: Minimum of 0.25 inch (6 mm) high.
   j. Instruments: Minimum of 0.25 inch (6 mm) high.
   k. Control Damper and Valve Actuators: Minimum of 0.25 inch (6 mm) high.

3. Legend shall consist of white lettering on black background.
4. Laminated acrylic or melamine plastic sign shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded black with contrasting white center exposed by engraving through outer layer and shall be fastened with drive pins.
5. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require additional identification.

C. Valve Tags:

1. Brass tags and brass chains attached to valve.
2. Tags shall be at least 1.5 inches (38 mm) in diameter.
3. Include tag with unique valve identification indicating control influence such as flow, level, pressure, or temperature; followed by location of valve, and followed by three-digit sequential number. For example: TV-1.001.
4. Valves with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

D. Raceway and Boxes:

1. Comply with requirements for identification specified in Division 26
2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls," using an engraved phenolic tag.
3. For raceways housing air signal tubing, add a phenolic tag labeled "HVAC Air Signal Tubing."

E. Equipment Warning Labels:

1. Self-adhesive label with pressure-sensitive adhesive back and peel-off protective jacket.
2. Lettering size shall be at least 14-point type with white lettering on red background.
3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inch (6 mm) beyond white border.

2.30 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate the following according to industry standards for each product, and to verify DDC system reliability specified in performance requirements:

1. DDC controllers.
2. Gateways.
3. Routers.
4. Operator workstations.

B. Product(s) and material(s) will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for products to verify actual locations of connections before installation.

1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

A. Communication Interface to Equipment with Integral Controls:

1. DDC system shall have communication interface with equipment having integral controls and having an open protocol communication interface for remote monitoring or control.
2. Equipment to Be Connected:

a. Domestic water booster pumps specified in Division 22.
b. Air-terminal units specified in Division 23.
c. Boilers specified in Division 23.
d. Heat wheels and heat exchangers specified in Division 23.
e. Air-handling units specified in Division 23.
f. Roof-top units specified in Division 23.
g. Chillers specified in Division 23.
h. Variable-frequency controllers specified in Division 23.
i. Diesel emergency engine generators specified in Division 26.
j. Fire Alarm.
k. Pod Exhaust System.
l. Gas Detection/Monitoring.
m. Refrigerant monitoring.

3.3 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS

A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.

B. Deliver the following to duct fabricator and Installer for installation in ductwork. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. DDC control dampers, which are specified in Division 23.
2. Airflow sensors and switches, which are specified in Division 23.
3. Pressure sensors, which are specified in Division 23.

C. Deliver the following to plumbing and HVAC piping installers for installation in piping. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. DDC control valves, which are specified in Section 230923.11 "Control Valves."
2. Pipe-mounted flow meters, which are specified in Section 230923.14 "Flow Instruments."
3. Pipe-mounted sensors, switches and transmitters. Flow meters are specified in Division 23. Liquid temperature sensors, switches, and transmitters are specified in Division 23.
4. Pipe-mounted thermowells. Liquid thermowells are specified in Division 23.

3.4 CONTROL DEVICES FOR EQUIPMENT MANUFACTURER FACTORY INSTALLATION

A. Deliver the following to air-handling unit manufacturer for factory installation. Include installation instructions to air-handling unit manufacturer.

1. Programmable application controller.
2. Unit-mounted DDC control dampers and actuators, which are specified in Division 23.
3. Unit-mounted airflow sensors, switches and transmitters, which are specified in Division 23.
4. Unit-mounted gas sensors and transmitters, which are specified in Division 23.
5. Relays.

B. Deliver the following to terminal unit manufacturer for factory installation. Include installation instructions to terminal unit manufacturer.

1. Application-specific controller.
2. Unit-mounted flow and pressure sensors, transmitters and transducers. Flow sensors, transmitters, and transducers are specified in Division 23. Pressure sensors, switches, and transmitters are specified in Division 23.
3. Unit-mounted temperature sensors. Air-temperature sensors, switches, and transmitters are specified in Division 23.
4. Relays.

3.5 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Support products, tubing, piping wiring and raceways.

D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Firestop Penetrations Made in Fire-Rated Assemblies: Comply with requirements in Division 7.

G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Division 7.

H. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

I. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

J. Corrosive Environments:

1. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive- resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Division 26.
2. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.6 WORKSTATION INSTALLATION

A. Desktop Workstations Installation:

1. Install workstation(s) at location(s) directed by Owner.
2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single duplex electrical power receptacle.
3. Install software on workstation(s) and verify software functions properly.

4. Develop Project-specific graphics, trends, reports, logs and historical database.

Power each workstation through a dedicated UPS unit. Locate UPS adjacent to workstation

B. Portable Workstations Installation:

1. Turn over portable workstations to Owner at Substantial Completion.
2. Install software on workstation(s) and verify software functions properly.

C. Color Graphics Application:

1. Use system schematics indicated as starting point to create graphics.
2. Develop Project-specific library of symbols for representing system equipment and products.
3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
4. Submit sketch of graphic layout with description of all text for each graphic for Owner's review before creating graphic using graphics software.
5. Seek Owner input in graphics development once using graphics software.
6. Final editing shall be done on-site with Owner's review and feedback.
7. Refine graphics as necessary for Owner acceptance.
8. On receiving Owner acceptance, print a hard copy for inclusion in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of DDC system operation and maintenance manual.

D. Wall-Mounted Portable Operator's Workstation Cabinet Installation:

1. Install wall-mounted portable operator's workstation cabinet(s) at following location(s) and at locations directed by Owner:
   a. Boiler mechanical room.
   b. Mezzanine Control Room.

2. Connect each cabinet to 120-V, single-phase, 60Hz field power source, and install single gang electrical box with NEMA WD 6, Type 20R duplex receptacle and metal cover plate in cabinet. Comply with requirements in Division 26 "Wiring Devices."
3. Connect each cabinet to Ethernet network and install an Ethernet network port for connection to portable operator workstation Ethernet cable. Comply with requirements in Division 26 or 27 for Horizontal Cabling.

3.7 PORTABLE OPERATOR TERMINAL INSTALLATION

A. Install one portable operator terminal.

B. Turn over portable operator terminals to Owner at Substantial Completion.

C. Install software on each portable operator terminal and verify that software functions properly.

3.8 PRINTER INSTALLATION

A. Provide the following printer(s) at location(s) directed by Owner:
   1. Color Laser: Quantity, one.

B. Install printer software on workstations and verify that software functions properly.

3.9 GATEWAY INSTALLATION

A. Install gateways if required for DDC system communication interface requirements indicated.
   1. Install gateway(s) required to suit indicated requirements.

B. Test gateway to verify that communication interface functions properly.

3.10 ROUTER INSTALLATION

A. Install routers if required for DDC system communication interface requirements indicated.

   1. Install router(s) required to suit indicated requirements.

B. Test router to verify that communication interface functions properly.

3.11 CONTROLLER INSTALLATION

A. Install controllers in enclosures to comply with indicated requirements.

   B. Connect controllers to field power supply. and to UPS units where indicated.

C. Install controller with latest version of applicable software and configure to execute requirements indicated.

D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

E. Installation of Network Controllers:

   1. Quantity and location of network controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
   2. Install controllers in a protected location that is easily accessible by operators.
   3. Top of controller shall be within 72 inches (1800 mm) of finished floor.

F. Installation of Programmable Application Controllers:

   1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
   2. Install controllers in a protected location that is easily accessible by operators.
   3. Top of controller shall be within 72 inches (1800 mm) of finished floor.

G. Application-Specific Controllers:

   1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
   2. For controllers not mounted directly on equipment being controlled, install

controllers in a protected location that is easily accessible by operators.

3.12 ENCLOSURES INSTALLATION

A. Install the following items in enclosures, to comply with indicated requirements:

1. Gateways.
2. Routers.
3. Controllers.
4. Electrical power devices.
5. UPS units.Relays.
6. Accessories.
7. Instruments.
8. Actuators

B. Attach wall-mounted enclosures to wall using the following types of steel struts:

1. For NEMA 250, Type 1 Enclosures: Use corrosion-resistant-coated steel strut and hardware.
2. For NEMA 250, Type 4 Enclosures and Enclosures Located Outdoors: Use stainless-steel strut and hardware.
3. Install plastic caps on exposed cut edges of strut.

C. Align top of adjacent enclosures.

D. Install floor-mounted enclosures located in mechanical equipment rooms on concrete housekeeping pads. Attach enclosure legs using stainless-steel anchors.

E. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireway used for application shall have protection equal to NEMA 250 rating of connected enclosures.

3.13 ELECTRIC POWER CONNECTIONS

A. Connect electrical power to DDC system products requiring electrical power connections.

B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with NFPA 70 and other requirements indicated.

C. Comply with requirements in Division 26 for electrical power circuit breakers.

D. Comply with requirements in Division 26 for electrical power conductors and cables.

E. Comply with requirements in Division 26 for electrical power raceways and boxes.

3.14 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with

requirements in Section 260553 "Identification for Electrical Systems" for identification products and installation.

B. Install self-adhesive labels with unique identification on face for each of the following:

1. Operator workstation.
2. Server.
3. Printer.
4. Gateway.
5. Router.
6. DDC controller.
7. Enclosure.
8. Electrical power device.
9. UPS unit.
10. Accessory.

C. Install unique instrument identification on face of each instrument connected to a DDC controller.

D. Install unique identification on face of each control damper and valve actuator connected to a DDC controller.

E. Where product is installed above accessible tile ceiling, also install matching identification on face of ceiling grid located directly below.

F. Where product is installed above an inaccessible ceiling, also install identification on face of access door directly below.

G. Warning Labels and Signs:

1. Shall be permanently attached to equipment that can be automatically started by DDC control system.
2. Shall be in highly visible location near power service entry points.

3.15 NETWORK INSTALLATION

A. Install optical fiber cable when connecting between the following network devices and when located in different buildings on campus, or when distance between devices exceeds 100 meters:

1. Operator workstations.
2. Operator workstations and network controllers.
3. Network controllers.

B. Install balanced twisted pair or optical fiber cable when connecting between the following network devices located in same building:

1. Operator workstations.
2. Operator workstations and network controllers.
3. Network controllers.

C. Install balanced twisted pair or copper cable (as required by equipment) when connecting between the following:

1. Gateways.
2. Gateways and network controllers or programmable application controllers.
3. Routers.
4. Routers and network controllers or programmable application controllers.
5. Network controllers and programmable application controllers.
6. Programmable application controllers.
7. Programmable application controllers and application-specific controllers.
8. Application-specific controllers.

D. Install cable in continuous raceway.

1. Where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

3.16 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

B. ASHRAE 135 Networks:

1. MAC Address:

a. Every network device shall have an assigned and documented MAC address unique to its network.
b. Ethernet Networks: Document MAC address assigned at its creation.
c. ARCNET or MS/TP networks: Assign from 00 to 64.

2. Network Numbering:

a. Assign unique numbers to each new network.
b. Provide ability for changing network number through device switches or operator interface.
c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.

3. Device Object Identifier Property Number:

a. Assign unique device object identifier property numbers or device instances for each device network.
b. Provide for future modification of device instance number by device switches or operator interface.
c. LAN shall support up to 4,194,302 unique devices.

4. Device Object Name Property Text:

a. Device object name property field shall support 32 minimum printable

characters.

b. Assign unique device "Object Name" property names with plain-English descriptive names for each device.

1) Example 1: Device object name for device controlling boiler plant at Building 1000 would be "HW System B1000."

2) Example 2: Device object name for a VAV terminal unit controller could be "VAV unit 102".

5. Object Name Property Text for Other Than Device Objects:

a. Object name property field shall support 32 minimum printable characters.
b. Assign object name properties with plain-English names descriptive of application.

1) Example 1: "Zone 1 Temperature."
2) Example 2 "Fan Start and Stop."

6. Object Identifier Property Number for Other Than Device Objects:

a. Assign object identifier property numbers according to Drawings or tables indicated.
b. If not indicated, object identifier property numbers may be assigned at Installer's discretion but must be approved by Owner in advance, be documented and be unique for like object types within device.

3.17 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NECA 1.

B. Wire and Cable Installation:
1. Provide rigid conduit in any exposed area 11 ft and below. Above 11 ft, free air cabling is acceptable in areas not accessible to inmates.
2. Controls Contractor shall procure all wiring and cabling for controls system.
3. Comply with installation requirements in Division 26 for Electrical Power Cables.
4. Comply with installation requirements in Division 27 for communications copper backbone cabling.
5. Comply with installation requirements in Division 27 for communications copper horizontal cabling.
6. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.

a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.

7. Terminate wiring in a junction box.

a. Clamp cable over jacket in junction box.
b. Individual conductors in the stripped section of the cable shall be slack

between the clamping point and terminal block.

8. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
9. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
10. Use shielded cable to transmitters.
11. Use shielded cable to temperature sensors.
12. Perform continuity and meager testing on wire and cable after installation.

C. Conduit Installation:

1. Comply with Division 26 for control-voltage conductors.
2. Comply with Division 27 for balanced twisted pair cabling and optical fiber installation.

3.18 OPTICAL FIBER CABLE SYSTEM INSTALLATION

A. Comply with installation requirements in Division 27 for Optical Fiber Backbone Cabling.

B. Comply with installation requirements in Division 27 for Optical Fiber Horizontal Cabling.

3.19 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Testing:

1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.
2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.
3. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.

4. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.
5. Test Equipment: Use an optical fiber time domain reflectometer for testing of length and optical connectivity.
6. Test Results: Record test results and submit copy of test results for Project record.

3.20 DDC SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.

E. For pneumatic products, verify that air supply for each product is properly installed.

F. Control Damper Checkout:

1. Verify that control dampers are installed correctly for flow direction.
2. Verify that proper blade alignment, either parallel or opposed, has been provided.
3. Verify that damper frame attachment is properly secured and sealed.
4. Verify that damper actuator and linkage attachment is secure.
5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
6. Verify that damper blade travel is unobstructed.

G. Control Valve Checkout:

1. Verify that control valves are installed correctly for flow direction.
2. Verify that valve body attachment is properly secured and sealed.
3. Verify that valve actuator and linkage attachment is secure.
4. Verify that actuator wiring is complete, enclosed and connected to correct power source.
5. Verify that valve ball, disc or plug travel is unobstructed.
6. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

H. Instrument Checkout:

1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
2. Verify that attachment is properly secured and sealed.
3. Verify that conduit connections are properly secured and sealed.

4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments:

    a. Verify sensing element type and proper material.
    b. Verify length and insertion.

3.21 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:

A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.

C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.

D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.

E. Provide diagnostic and test equipment for calibration and adjustment.

F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.

G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.

H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.

I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

J. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

K. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact making or breaking.

L. Control Dampers:

1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

M. Control Valves:

1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

N. Meters: Check sensors at zero, 50, and 100 percent of Project design values.

O. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

P. Switches: Calibrate switches to make or break contact at set points indicated.

Q. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

3.22 DDC SYSTEM CONTROLLER CHECKOUT

A. Verify power supply.

1. Verify voltage, phase and hertz.
2. Verify that protection from power surges is installed and functioning.
3. Verify that ground fault protection is installed.
4. If applicable, verify if connected to UPS unit.

5. If applicable, verify if connected to a backup power source.
6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.

B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.

C. Verify that spare I/O capacity is provided.

3.23 DDC CONTROLLER I/O CONTROL LOOP TESTS

A. Testing:

1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
2. Test every I/O point throughout its full operating range.
3. Test every control loop to verify operation is stable and accurate.
4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
5. Test and adjust every control loop for proper operation according to sequence of operation.
6. Test software and hardware interlocks for proper operation. Correct deficiencies.
7. Operate each analog point at the following:

    a. Upper quarter of range.
    b. Lower quarter of range.
    c. At midpoint of range.

8. Exercise each binary point.
9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.
10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

3.24 DDC SYSTEM VALIDATION TESTS

A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.

B. After approval of Test Plan, execute all tests and procedures indicated in plan.

C. After testing is complete, submit completed test checklist.

D. Pretest Checklist: Submit the following list with items checked off once verified:

1. Detailed explanation for any items that are not completed or verified.
2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
3. HVAC equipment motors operate below full-load amperage ratings.
4. Required DDC system components, wiring, and accessories are installed.
5. Installed DDC system architecture matches approved Drawings.
6. Control electric power circuits operate at proper voltage and are free from faults.
7. Required surge protection is installed.
8. DDC system network communications function properly, including uploading and downloading programming changes.
9. Each controller's programming is backed up.
10. Equipment, products, tubing, wiring cable and conduits are properly labeled.
11. All I/O points are programmed into controllers.
12. Testing, adjusting and balancing work affecting controls is complete.
13. Dampers and actuators zero and span adjustments are set properly.
14. Each control damper and actuator goes to failed position on loss of power.
15. Valves and actuators zero and span adjustments are set properly.
16. Each control valve and actuator goes to failed position on loss of power.
17. Meter, sensor and transmitter readings are accurate and calibrated.
18. Control loops are tuned for smooth and stable operation.
19. View trend data where applicable.
20. Each controller works properly in standalone mode.
21. Safety controls and devices function properly.
22. Interfaces with fire-alarm system function properly.
23. Electrical interlocks function properly.
24. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
25. Record Drawings are completed.

E. Test Plan:

1. Prepare and submit a validation test plan including test procedures for performance validation tests.
2. Test plan shall address all specified functions of DDC system and sequences of operation.
3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
5. Include a test checklist to be used to check and initial that each test has been successfully completed.
6. Submit test plan documentation minimum of 20 business days before start of tests.

F. Validation Test:

1. Verify operating performance of each I/O point in DDC system.
    a. Verify analog I/O points at operating value.
    b. Make adjustments to out-of-tolerance I/O points.

1) Identify I/O points for future reference.
2) Simulate abnormal conditions to demonstrate proper function of safety devices.
3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.

2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
4. After 24 Hours following Initial Validation Test:

   a. Re-check I/O points that required corrections during initial test.
   b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.

5. After 24 Hours of Second Validation Test:

   a. Re-check I/O points that required corrections during second test.
   b. Continue validation testing until I/O point is normal on two consecutive tests.

6. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.
7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

G. DDC System Response Time Test:

1. Simulate heavy load conditions.

   a. Heavy load shall be an occurrence of 50 percent of total connected binary changes of value, one-half of which represent an "alarm" condition, and 50 percent of total connected analog changes of value, one-half of which represent an "alarm" condition, that are initiated simultaneously on a one-time basis.

2. Initiate 10 successive occurrences of heavy load conditions and measure response time to typical alarms and status changes.
3. Measure with a timer having at least 0.1-second resolution and 0.01 percent accuracy.
4. Purpose of test is to demonstrate DDC system, as follows:

   a. Reaction to changes of value and alarm conditions during heavy load conditions.
   b. Ability to update DDC system database during heavy load conditions.

5. Passing test is contingent on the following:

   a. Alarm reporting at printer beginning no more than two seconds after the initiation (time zero) of heavy load conditions.
   b. All alarms, both binary and analog, are reported and printed; none are lost.
   c. Compliance with response times specified.

6. Prepare and submit a report documenting heavy load conditions tested and results of

test including time stamp and print out of all alarms.

H. DDC System Network Bandwidth Test:

1. Test network bandwidth usage on all DDC system networks to demonstrate bandwidth usage under DDC system normal operating conditions and under simulated heavy load conditions.
2. To pass, none of DDC system networks shall use more than 70 percent of available bandwidth under normal and heavy load conditions operation.

3.25 FINAL REVIEW

A. Submit written request to Architect and Construction Manager when DDC system is ready for final review. Written request shall state the following:

1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
4. DDC system is complete and ready for final review.

B. Review Architect and Construction Manager shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.

E. Prepare and submit closeout submittals and begin procedures indicated in "Extended Operation Test" Article when no deficiencies are reported.

F. A part of DDC system final review shall include a demonstration to parties participating in final review.

1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.
3. Demonstration shall include, but not be limited to, the following:

a. Accuracy and calibration of 10 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may

be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.

b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation. Up to **10** I/O points shall be randomly selected by reviewers. Additional I/O points may be selected by reviewers to discover problems with operation.

c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.

d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.

e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.

f. Trends, summaries, logs and reports set-up for Project.

g. For up to three HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.

h. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.

i. Software's ability to edit control programs off-line.

j. Data entry to show Project-specific customizing capability including parameter changes.

k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.

l. Execution of digital and analog commands in graphic mode.

m. Spreadsheet and curve plot software and its integration with database.

n. Online user guide and help functions.

o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.

p. System speed of response compared to requirements indicated.

q. For Each Network and Programmable Application Controller:

    1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.
    2) Operator Interface: Ability to connect directly to each type of digital controller with a portable workstation and mobile device. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.
    3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.
    4) Electric Power: Ability to disconnect any controller safely from its power source.
    5) Wiring Labels: Match control drawings.
    6) Network Communication: Ability to locate a controller's location on network and communication architecture matches

Shop Drawings.

7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.

r. For Each Operator Workstation:

1) I/O points lists agree with naming conventions.
2) Graphics are complete.
3) UPS unit, if applicable, operates.

s. Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. Requirements must be met even if only one manufacturer's equipment is installed.

1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.
2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.
3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated. Modifications are made with messages and write services initiated by an operator using workstation graphics, or by completing a field in a menu with instructional text.
4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
5) Alarm and Event Management: Alarms and events are installed and prioritized according to Owner. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.
10) Device and Network Management:

a) Display of network device status.
b) Display of BACnet Object Information.
c) Silencing devices transmitting erroneous data.
d) Time synchronization.
e) Remote device re-initialization.
f) Backup and restore network device programming and

master database(s).

g) Configuration management of routers.

3.26 ADJUSTING

A. Occupancy Adjustments: Contractor shall contact Owner within 10 months after substantial completion and provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose. Notify Engineer of Record to document each visit.

3.27 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 6 months' full maintenance by DDC system manufacturer's authorized service representative. Include monthly, quarterly, and semiannual preventive maintenance, repair or replacement of worn or defective components, cleaning, calibration and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.28 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for three years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access system and to upgrade computer equipment if necessary.

3.29 DEMONSTRATION

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.

B. Extent of Training:

1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
3. Minimum Training Requirements:

a. Provide not less than five days of training total.

b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
c. Total days of training shall be broken into not more than three separate training classes.
d. Each training class shall be not less than two consecutive days.

C. Training Schedule:

1. Schedule training with Owner 20 business days before expected Substantial Completion.
2. Schedule training to provide Owner with at least 20 business days of notice in advance of training.
3. Provide staggered training schedule as requested by Owner.

D. Training Attendee List and Sign-in Sheet:

1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
5. At end of each training day, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

E. Training Attendee Headcount:

1. Plan in advance of training for attendees.
2. Headcount may vary depending on training content covered in session. Attendee access may be restricted to some training content for purposes of maintaining system security.

F. Attendee Training Manuals:

1. Provide each attendee with a color hard copy of all training materials and visual presentations.
2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

G. Instructor Requirements:

1. One or multiple qualified instructors, as required, to provide training.
2. Instructors shall have not less than five years of providing instructional training on not less than five past projects with similar DDC system scope and complexity to DDC system installed.

H. Organization of Training Sessions:

1. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate the following three levels of operators:

   a. Daily operators.
   b. Advanced operators.
   c. System managers and administrators.

2. Plan and organize training sessions to group training content to protect DDC system security. Some attendees may be restricted to some training sessions that cover restricted content for purposes of maintaining DDC system security.

I. Training Outline:

1. Submit training outline for Owner review at least 10 business day before scheduling training.
2. Outline shall include a detailed agenda for each training day that is broken down into each of four training sessions that day, training objectives for each training session and synopses for each lesson planned.

J. On-Site Training:

1. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
2. Provide as much of training located on-site as deemed feasible and practical by Owner.
3. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
4. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

K. Training Content for Daily Operators:

1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.

8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals including control drawings.
11. Understanding physical location and placement of DDC controllers and I/O hardware.
12. Accessing data from DDC controllers.
13. Operating portable operator workstations.
14. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
15. Running each specified report and log.
16. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
17. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
18. Executing digital and analog commands in graphic mode.
19. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
20. Demonstrating DDC system performance through trend logs and command tracing.
21. Demonstrating scan, update, and alarm responsiveness.
22. Demonstrating spreadsheet and curve plot software, and its integration with database.
23. Demonstrating on-line user guide, and help function and mail facility.
24. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
25. Demonstrating the following for HVAC systems and equipment controlled by DDC system:

    a. Operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
    b. For HVAC equipment with factory-installed software, show that integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.
    c. Using graphed trends, show that sequence of operation is executed in correct manner, and HVAC systems operate properly through complete sequence of operation including seasonal change, occupied and unoccupied modes, warm-up and cool-down cycles and other modes of operation indicated.
    d. Hardware interlocks and safeties function properly and DDC system performs correct sequence of operation after electrical power interruption and resumption after power is restored.
    e. Reporting of alarm conditions for each alarm, and confirm that alarms are received at assigned locations, including operator workstations.
    f. Each control loop responds to set point adjustment and stabilizes within time period indicated.
    g. Sharing of previously graphed trends of all control loops to demonstrate that each control loop is stable and set points are being maintained.

26. Pod Exhaust System.

L. Training Content for Advanced Operators:

1. Making and changing workstation graphics.

2. Creating, deleting and modifying alarms including annunciation and routing.
3. Creating, deleting and modifying point trend logs including graphing and printing on an ad-hoc basis and operator-defined time intervals.
4. Creating, deleting and modifying reports.
5. Creating, deleting and modifying points.
6. Creating, deleting and modifying programming including ability to edit control programs off-line.
7. Creating, deleting and modifying system graphics and other types of displays.
8. Adding DDC controllers and other network communication devices such as gateways and routers.
9. Adding operator workstations.
10. Performing DDC system checkout and diagnostic procedures.
11. Performing DDC controllers operation and maintenance procedures.
12. Performing operator workstation operation and maintenance procedures.
13. Configuring DDC system hardware including controllers, workstations, communication devices and I/O points.
14. Maintaining, calibrating, troubleshooting, diagnosing and repairing hardware.
15. Adjusting, calibrating and replacing DDC system components.

M. Training Content for System Managers and Administrators:

1. DDC system software maintenance and backups.
2. Uploading, downloading and off-line archiving of all DDC system software and databases.
3. Interface with Project-specific, third-party operator software.
4. Understanding password and security procedures.
5. Adding new operators and making modifications to existing operators.
6. Operator password assignments and modification.
7. Operator authority assignment and modification.
8. Workstation data segregation and modification.

N. Video of Training Sessions:

1. Provide a digital video and audio recording of each training session. Create a separate recording file for each session.
2. Stamp each recording file with training session number, session name and date.
3. Provide Owner with two copies of digital files on DVDs or flash drives for later reference and for use in future training.
4. Owner retains right to make additional copies for intended training purposes without having to pay royalties.

END OF SECTION 23 09 23

SECTION 23 37 01

EXTRUDED ALUMINUM STATIONARY LOUVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Extruded aluminum stationary louvers with drainable blades.

1.2 RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete.

B. Section 04200 - Masonry Units.

C. Section 05100 - Structural Metal Framing.

D. Section 06100 - Rough Carpentry.

E. Section 07600 - Flashing and Sheet Metal.

F. Section 07920 - Joint Sealants.

G. Section 09910 - Paints.

1.3 REFERENCES

A. AAMA 605.2 - High Performance Organic Coatings on Architectural Extrusions and Panels.

B. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

C. AMCA 511 - Certified Ratings Program for Air Control Devices.

1.4 SUBMITTALS

A. Comply with requirements of Section 01330 - Submittal Procedures.

B. Product Data: Submit manufacturer's product data including performance data.

C. Shop Drawings: Submit shop drawings indicating materials, construction, dimensions, accessories, and installation details.

D. Samples: Submit sample of louver to show frame, blades, bird screen, gutters, downspouts, vertical supports, sill, accessories, finish, and color.

1.5 QUALITY ASSURANCE

A. Louvers licensed to bear AMCA Certified Ratings Seal. Ratings based on tests and procedures performed in accordance with AMCA 511 and comply with AMCA Certified Ratings Program. AMCA Certified Ratings Seal applies to air performance and water penetration ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. Storage: Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.

C. Handling: Protect materials and finishes during handling and installation to prevent damage.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Ruskin Manufacturing

B. Arrow

C. Cesco

D. Greenheck

E. Pottorff

F. Approved Equal

2.2 EXTRUDED ALUMINUM STATIONARY LOUVERS

A. Fabrication:
1. Performance Ratings: AMCA licensed.
2. Frame:
    a. Material: Extruded aluminum, Alloy 6063-T5.
    b. Wall Thickness: 0.125 inch (3.2 mm), nominal.
    c. Depth: 6 inches (152 mm).
    d. Downspouts and caulking surfaces.
3. Blades:
    a. Style: Drainable.
    b. Material: Extruded aluminum, Alloy 6063-T5.
    c. Wall Thickness: 0.125 inch (3.2 mm), nominal.
    d. Angle: 37.5 degrees.
    e. Centers: 5-29/32 inches (150 mm), nominal.
4. Bird Screen:
    a. Material: Aluminum, [3/4 inch x 0.051 inch (19 mm x 1.3 mm), expanded, flattened] [1/2 inch mesh x 0.063 inch (13 mm mesh x 1.6 mm), intercrimp].
    b. Frame: Removable, rewireable.
5. Gutters: Drain gutter in head frame and each blade.
6. Downspouts: Downspouts in jambs to drain water from louver for minimum water cascade from blade to blade.
7. Vertical Supports: Hidden vertical supports to allow continuous line appearance up to 120 inches (3,048 mm).

8. Sill: Steeply angled integral sill eliminating areas of standing or trapped moisture where mold or mildew may thrive and effect indoor air quality.
9. Assembly: Factory assemble louver components. All welded construction.

B. Design Load: Incorporate structural supports required to withstand wind load of 20.

2.3 ACCESSORIES

A. Bird Screens:

B. Insect Screens:

C. Extended Sills: Extruded aluminum, Alloy 6063-T5. Minimum nominal wall thickness 0.060 inch (1.5 mm).

D. Visible Mullions: Manufacturer's standard horizontal or vertical visible mullions for architectural accent as indicated on drawings.

2.4 FACTORY FINISH

A. Color Anodize Finish:
1. Comply with Aluminum Association AA-C22A44.
2. Apply finish following chemical etching and pretreatment.
3. Electrolytically deposited color anodized finish.
4. Minimum Thickness: 0.7 mils (0.018 mm).

B. Clear Anodize Finish:
1. Comply with Aluminum Association AA-C22A31. Clear anodize finish 204-R1.
2. Apply finish following chemical etching and pretreatment.
3. Minimum Thickness: 0.4 mils (0.01 mm), 30 minute anodizing process.

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect areas to receive louvers. Notify the Architect of conditions that would adversely affect the installation or subsequent utilization of the louvers. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install louvers at locations indicated on the drawings and in accordance with manufacturer's instructions.

B. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.

C. Install joint sealants as specified in Section 07920.

3.3 CLEANING

A. Clean louver surfaces in accordance with manufacturer's instructions.

B. Repair minor damaged surfaces as directed by Architect.

END OF SECTION

SECTION 23 64 23

DEDICATED HEAT RECOVERY SCROLL WATER CHILLERS

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. Packaged, water-cooled, electric-motor-driven, dedicated heat recovery scroll water chillers.

1.3 DEFINITIONS

A. DHRC: Dedicated Heat Recovery Chiller

B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

D. IPLV: Integrated part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.

E. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

F. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

1.4 SUBMITTALS

A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

1. Performance at ARI standard conditions and at conditions indicated.

2. Performance at ARI standard unloading conditions.
3. Minimum evaporator flow rate.
4. Refrigerant capacity of water chiller.
5. Oil capacity of water chiller.
6. Fluid capacity of evaporator.
7. Fluid capacity of condenser.
8. Characteristics of safety relief valves.
9. Minimum entering condenser-water temperature.
10. Performance at varying capacity with constant design condenser-water temperature. Repeat performance at varying capacity for different condenser-water temperatures from design to minimum in 5 deg F increments.

B. Seismic Qualification Data: Certificates, for water chillers, accessories, and components, from manufacturers.

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

C. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Size and location of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring.

D. Coordination Drawings: Floor 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. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

E. Certificates: For certification required in "Quality Assurance" Article.

F. Source quality-control test reports.

G. Startup service reports.

H. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

I. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. ARI Certification: Certify chiller according to ARI 590 certification program.

B. ARI Rating: Rate water chiller performance according to requirements in ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

C. ASHRAE Compliance:

1. ASHRAE 15 for safety code for mechanical refrigeration.
2. ASHRAE Guideline 3 for refrigerant leaks, recovery, and handling and storage requirements.

D. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.

E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified period.

1. Compressor Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PACKAGED DEDICATED HEAT RECOVERY WATER-COOLED CHILLERS

A. Seismic Performance: Scroll water chillers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Component Importance Factor: [1.5].

B. Manufacturers: Subject to compliance with requirements, or a comparable product by one of the following:

1. ArctiChill.
2. Carrier.
3. Chillit Company.
4. MultiStack.
5. Quantech.
6. Johnson Controls.
7. Water Furnace.

C. Description: Factory-assembled and run-tested water chiller complete with compressor(s), compressor motors and motor controllers, evaporator, condenser where indicated, electrical power, controls, and indicated accessories.

D. Compressors:

1. Description: Positive-displacement direct drive with hermetically sealed casing. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
2. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
3. Capacity Control: On-off compressor cycling.
4. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.

E. Compressor Motors:

1. Hermetically sealed and cooled by refrigerant suction gas.
2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

F. Compressor Motor Controllers:

1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

G. Refrigeration:

1. Refrigerant: R-410a.
2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
3. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

H. Evaporator:

1. Brazed-plate or shell-and-tube design, as indicated.
2. Shell and Tube:

    a. Description: Direct-expansion, shell-and-tube design with fluid flowing through the shell and refrigerant flowing through the tubes within the shell.
    b. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
    c. Shell Material: Carbon steel.
    d. Shell Heads: Removable carbon-steel heads with multipass baffles designed to ensure positive oil return and located at each end of the tube bundle.
    e. Shell Nozzles: Fluid nozzles located along the side of the shell and terminated with mechanical-coupling end connections for connection to field piping.
    f. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.

3. Brazed Plate:

    a. Direct-expansion, single-pass, brazed-plate design.
    b. Type 316 stainless-steel construction.
    c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
    d. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.

I. Condenser:

1. Shell and Tube:

    a. Description: Shell-and-tube design with refrigerant flowing through the shell and fluid flowing through the tubes within the shell.
    b. Provides positive subcooling of liquid refrigerant.
    c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
    d. Shell Material: Carbon steel.
    e. Water Boxes: Removable, of carbon-steel construction, located at each end of the tube bundle with fluid nozzles terminated with mechanical-coupling end connections for connection to field piping.
    f. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.
    g. Provide each condenser with a pressure relief device, purge cock, and liquid-line shutoff valve.

J. Electrical Power:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.
2. House in a unit-mounted, NEMA 250, Type 1 enclosure with hinged access door with lock and key or padlock and key.

3. Wiring shall be numbered and color-coded to match wiring diagram.
4. Install factory wiring outside of an enclosure in a raceway.
5. Field power interface shall be to NEMA KS 1, heavy-duty, non-fused disconnect switch. Minimum short-circuit current rating (SCCR) according to UL 508 shall be as required by electrical power distribution system, but not less than 65,000 A.
6. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:

    a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947- 4-1.
    b. NEMA KS 1, heavy-duty, nonfusible switch.
    c. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short- circuit trip coordinated with motor locked-rotor amperes.

7. Provide each motor with overcurrent protection.
8. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
9. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.
10. Controls Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
11. Control Relays: Auxiliary and adjustable time-delay relays.
12. Indicate the following for water chiller electrical power supply:

    a. Current, phase to phase, for all three phases.
    b. Voltage, phase to phase and phase to neutral for all three phases.
    c. Three-phase real power (kilowatts).
    d. Three-phase reactive power (kilovolt amperes reactive).
    e. Power factor.
    f. Running log of total power versus time (kilowatt hours).
    g. Fault log, with time and date of each.

K. Controls:

1. The DHRC shall be equipped with a micro-processor based controller. The DHRC shall have the capability to operate in response to either heating water or cooling water set points. The selection of these two modes of operation shall be made by the DHRC's Master Controller or, alternatively, this mode may be set manually, or through a binary input to the controller. The Chiller shall operate based on constant primary flow via the manufacturer provided, field installed and wired, pumps for the DHRC's condenser and evaporator flow.
2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:

    a. Date and time.
    b. Operating or alarm status.
    c. Operating hours.
    d. Outside-air temperature if required for chilled-water reset.
    e. Temperature and pressure of operating set points.

f. Entering and leaving temperatures of chilled water.
g. Entering and leaving temperatures of condenser water.
h. Refrigerant pressures in evaporator and condenser.
i. Saturation temperature in evaporator and condenser.
j. No cooling load condition.
k. Elapsed time meter (compressor run status).
l. Pump status.
m. Antirecycling timer status.
n. Percent of maximum motor amperage.
o. Current-limit set point.
p. Number of compressor starts.

4. Control Functions:

a. Manual or automatic startup and shutdown time schedule.
b. Entering and leaving chilled-water temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on return-water temperature.
c. Current limit and demand limit.
d. Condenser-water temperature.
e. External water chiller emergency stop.
f. Antirecycling timer.
g. Automatic lead-lag switching.

5. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:

a. Low evaporator pressure or high condenser pressure.
b. Low chilled-water temperature.
c. Refrigerant high pressure.
d. High or low oil pressure.
e. High oil temperature.
f. Loss of chilled-water flow.
g. Loss of condenser-water flow.
h. Control device failure.

6. Failure to Run Mode (FRM): Chiller shall be capable of operation in the event that the Master Controller has lost communication. FRM provides the ability to switch the chiller into manual mode automatically keeping the chiller online until a replacement Master Controller can be provided. FRM requires a power phase monitor per module.

7. Building Management System Interface: Factory-installed hardware and software to enable building management system to monitor, control, and display water chiller status and alarms.

a. BACnet communication interface with building management system shall enable building management system operator to remotely control and monitor the water chiller from an operator workstation. Control features and monitoring points displayed locally at water chiller control panel shall be available through building management system.

L. Insulation:

1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
2. Thickness: 1 inch
3. Factory-applied insulation over cold surfaces of water chiller components.

    a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.

4. Apply protective coating to exposed surfaces of insulation.

M. Accessories:

1. Each inlet water header shall incorporate a built in 30-mesh (maximum) in-line strainer system to prevent heat exchanger fouling and accommodate 100% flow filtration with a minimum surface area of 475 sq inches per module.
2. Factory-furnished, chilled- and condenser-water flow switches for field installation.
3. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigeration circuit.
4. Factory-furnished neoprene or spring isolators for field installation.
5. Factory furnished field installed and wired condenser and evaporator pumps.
6. Factory furnished field installed and wired head pressure control valves

N. Capacities and Characteristics:

1. Refer to drawing.

2.2 SOURCE QUALITY CONTROL

A. Perform functional test of water chillers before shipping.

B. Factory performance test water chillers, before shipping, according to ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

C. Factory test and inspect evaporator and water-cooled condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.

D. For water chillers located indoors, rate sound power level according to ARI 575 procedure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.

1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

A. Equipment Mounting: Comply with requirements for vibration isolation devices specified in Division 23.

1. Minimum Deflection: 1/4 inch.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Maintain manufacturer's recommended clearances for service and maintenance.

C. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

D. Comply with requirements for vibration isolation and seismic-control devices specified in Division 23.

E. Install separate devices furnished by manufacturer and not factory installed.

3.3 WATER TREATMENT REQUIREMENTS

A. Cycles of concentration shall be controlled such that recirculated water quality for modular Dedicated Heat Recovery Chillers using 316 stainless steel brazed plate heat exchangers and carbon steel headers is maintained within the following parameters:

1.	pH	Greater than 7 and less than 9
2.	Total Dissolved Solids (TDS)	Less than 1000 ppm
3.	Hardness as $CaCO_3$	30 to 500 ppm
4.	Alkalinity as Ca CO_3	30 to 500 ppm
5.	Chlorides	Less than 200 ppm
6.	Sulfates	Less than 200 ppm

3.4 CONNECTIONS

A. Comply with requirements in Division 23 Section "Hydronic Piping" Drawings indicate

general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Division 23 Section "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to chiller to allow service and maintenance.

D. Evaporator Fluid Connections: Refer to detail on drawings.

E. Condenser Fluid Connections Refer to detail on drawings.

F. Refrigerant Pressure Relief Valve Connections: For water chillers installed indoors, extend vent piping to the outside without valves or restrictions. Comply with ASHRAE 15.

G. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
2. Verify that pumps are installed and functional.
3. Verify that thermometers and gages are installed.
4. Operate water chiller for run-in period.
5. Check bearing lubrication and oil levels.
6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
7. Verify proper motor rotation.
8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
9. Verify and record performance of chilled-and condenser-water flow and low-temperature interlocks.
10. Verify and record performance of water chiller protection devices.
11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Prepare a written startup report that records results of tests and inspections.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to

adjust, operate, and maintain water chillers. Video record the training sessions and provide electronic copy to Owner. Provide not less than eight hours of training.

END OF SECTION 23 64 23

SECTION 23 72 23

AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged energy recovery units.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Air-to-air energy recovery equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.

1.3 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
2. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.

a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
b. Wiring Diagrams: For power, signal, and control wiring.

3. Delegated-Design Submittal: For air-to-air energy recovery equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

a. Detail fabrication and assembly of air-to-air energy recovery equipment.
b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

c. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

B. Informational Submittals:

1. Seismic Qualification Data: Certificates, for air-to-air energy recovery equipment, accessories, and components, from manufacturer.

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

2. Field quality-control reports.

C. Closeout Submittals:

1. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

D. Maintenance Material Submittals:

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

a. Filters: One set of each type of filter specified.
b. Fan Belts: One set of belts for each belt-driven fan in energy recovery units.
c. Wheel Belts: One set of belts for each heat wheel.

1.4 PERFORMANCE REQUIREMENTS

A. AHRI Compliance: Comply with applicable sections of the following:

1. AHRI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."
2. AHRI 410, "Forced-Circulation Air- Cooling and Air-Heating Coils."

B. ASHRAE Compliance: Comply with applicable sections of the following:

1. ASHRAE 52.1.
2. ASHRAE 62.1.
3. ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."
4. ASHRAE 90.1.

C. NFPA Compliance: Comply with applicable section of the following:

1. NFPA 70, “National Electric Code.”
2. NFPA 90A, “Standard for the Installation of Air-Conditioning and Ventilating Systems.”

D. UL Compliance: Comply with applicable sections of the following:

1. UL 1812, "Ducted Heat Recovery Ventilators."
2. UL 1815, "Nonducted Heat Recovery Ventilators."
3. UL 1995, "Heating and Cooling Equipment."

E. Seismic Performance: Air-handling units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Component Importance Factor: [**1.5**].

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Packaged Energy Recovery Units: Two years.
2. Warranty Period for Fixed-Plate Total Heat Exchangers: 10 years.

PART 2 - PRODUCTS

2.1 PACKAGED ENERGY RECOVERY UNITS

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

1. Engineered Air.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. Multistack.
5. RenewAire LLC.
6. Trane.

B. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 1-inch thick thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.

1. Inlet: Weatherproof hood, with damper for exhaust and supply.

a. Exhaust: Gravity backdraft damper.
b. Supply: Gravity backdraft damper.

2. Roof Curb: Refer to Division 7 for roof curbs and equipment supports.

D. ENTHALPIC CORE HEAT EXCHANGERS
   1. Provide cross flow flat heat exchanger with performance as scheduled. Counter flow heat exchangers are not acceptable.
   2. Plates: Heat Exchanger shall consist of solid enthalpic core material with no gaps.
      a. Enthalpic core material shall be easily removed for cleaning or replacement.
      b. Corners must be sealed both mechanically and with sealant to limit cross contamination.
      c. Entire heat transfer surface shall be visible for inspection and cleaning without disassembling the heat exchanger.
      d. Provide double sloped stainless steel drain pans under entire heat exchanger.
      e. A (10) year non-prorated parts warranty shall be provided for all flat plate air to air heat exchangers. The warranty shall begin at start up, or six months after shipment, whichever comes first.

E. Supply and Exhaust Fans: Direct Drive EC Motor, Backward Inclined Plenum Fans fan with spring isolators and flexible duct connections.
   1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in other Division 23 sections.
   2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   3. Spring isolators on each fan having minimum 1-inch static deflection.

F. Extended-Surface, Disposable Panel Filters:

   1. Comply with NFPA 90A.
   2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
   3. Factory-fabricated, dry, extended-surface type.
   4. Thickness: 2 inches.
   5. MERV: 8, according to ASHRAE 52.2.
   6. Refer to other Division 23 sections for additional filter requirements.

G. Piping and Wiring: Fabricate units with space within housing for piping and electrical conduits. Wire motors and controls so only external connections are required during installation.

   1. Indoor Enclosure: NEMA 250, Type 12 enclosure contains relays, starters, and terminal strip.
   2. Outdoor Enclosure: NEMA 250, Type 3R enclosure contains relays, starters, and terminal strip.
   3. Include nonfused disconnect switches.

H. Accessories:

   1. Roof Curb: Galvanized steel with gasketing, and factory-installed wood nailer; complying with NRCA standards; minimum height of [**14 inches**].
   2. Intake weather hood with birdscreen and 2-inch-thick filters.

3. Louvered intake weather hood with birdscreen and 2-inch-thick filters in V-bank configuration.
4. Exhaust weather hood with birdscreen.
5. Low-Leakage, Isolation Dampers: Double-skin, airfoil-blade, extruded-aluminum dampers with compressible jamb seals and extruded-vinyl blade edge seals, in opposed-blade arrangement with cadmium-plated steel operating rods rotating in stainless-steel sleeve, sintered bronze or nylon bearings mounted in a single extruded-aluminum frame, with operating rods connected with a common linkage, and electric damper operator factory wired. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.
6. Duct flanges.
7. Rubber-in-shear isolators for ceiling-mounted units.
8. Hinged access doors with quarter-turn latches.
9. Automatic, in-place, spray-wash system.
10. Weatherproofing for tilt-control system.

2.2 CONTROLS

A. Control equipment and sequence of operation are specified in Division 23 and on Drawings.

B. DDC Controller: Unitary DDC controller directing all RTU operations.

1. Controller shall have volatile-memory backup.
2. Safety Control Operation:

    a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire-alarm control panel.
    b. Firestats: Stop fan and close outdoor-air damper if air greater than 130 deg F enters unit. Provide additional contacts for alarm interface to fire-alarm control panel.
    c. Fire-Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Division 28.

C. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet-compatible interface for central HVAC control workstation for the following:

    a. Adjusting set points.
    b. Monitoring supply fan start, stop, and operation.
    c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
    d. Monitoring occupied and unoccupied operations.
    e. Monitoring constant and variable motor loads.
    f. Monitoring variable-frequency drive operation.
    g. Monitoring cooling load.
    h. Monitoring heating load.
    i. Monitoring economizer cycles.

j. Monitoring air-distribution static pressure and ventilation air volume.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixed-plate heat exchangers so supply and exhaust airstreams flow in opposite directions.

1. Install duct access doors in both supply and exhaust ducts, both upstream and downstream, for access to heat exchanger. Access doors and panels are specified in other Division 23 sections.

B. Roof Curb: Install on roof structure or concrete base, level and secure, according to The NRCA "Roofing and Waterproofing Manual - Volume 4: Construction Details - Low-Slope Roofing," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts," ARI Guideline B. Install air-to-air energy recovery equipment on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 7. Secure air-to-air energy recovery equipment to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

C. Install wind and seismic restraints according to manufacturers' written instructions. Wind and seismically restrained vibration isolation roof-curb rails are specified in other Division 23 sections.

D. Install units with clearances for service and maintenance.

E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

F. Pipe drains from drain pans to nearest floor drain; use ASTM B 88, Type M, drawn-temper copper water tubing with soldered joints, same size as condensate drain connection.

3.3 PIPING AND DUCTWORK CONNECTIONS

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

B. Where installing piping or ductwork adjacent to air-handling unit, allow for service and maintenance.

C. Connect piping and ductwork to air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using ASTM B 88, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring according to Division 26.

B. Ground equipment according to Division 26.

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection. Nameplates shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Division 26.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Set initial temperature and humidity set points.
5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION 23 72 23

SECTION 23 82 19

FAN COIL UNITS

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. Ducted fan coil units and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

C. Shop Drawings:

   1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include diagrams for power, signal, and control wiring.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of fan coil unit indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

   1. Suspended ceiling components.
   2. Structural members to which fan coil units will be attached.
   3. Method of attaching hangers to building structure.

4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

6. Perimeter moldings.

B. Seismic Qualification Certificates: For fan coil units, accessories, and components, from manufacturer.

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

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fan coil units to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

    a. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

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. Fan Coil Unit Filters: Furnish 1 spare filters for each filter installed.
2. Fan Belts: Furnish 1 spare fan belts for each unit installed.

1.7 QUALITY ASSURANCE

A. Comply with NFPA 70.

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

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

1.8 COORDINATION

A. Coordinate layout and installation of fan coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate size and location of wall sleeves for outdoor-air intake.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of fan coil units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.2 DUCTED FAN COIL UNITS

A. Manufacturers: Subject to compliance with requirements.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carrier Corporation; a unit of United Technologies Corp.
2. Engineered Air.
3. ENVIRO-TEC; by Johnson Controls, Inc.
4. Greenheck Fan Corporation.
5. IEC (International Environmental Corporation); LSB Industries.
6. Krueger.

7. Titus.
8. Trane Inc.
9. YORK; a Johnson Controls company.

C. Fan Coil Unit Configurations: Row Face split.

1. Number of Heating Coils: One.
2. Number of Cooling Coils: One.

D. Coil Section Insulation: 1/2-inch- 1-inch- Insert dimension thick, coated foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Coil Section Insulation: Insulate coil section according to Section 230616 "HVAC Equipment Insulation."

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

F. Main and Auxiliary Drain Pans: Plastic Stainless steel Insulated galvanized steel with plastic liner. Fabricate pans and drain connections to comply with ASHRAE 62.1.

G. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panel, with powder-coat finish and removable access panel. Floor-mounting units shall have leveling screws.

H. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

1. Supply-Air Plenum: Sheet metal plenum finished and insulated to match the chassis with mill-finish, aluminum, double-deflection grille.
2. Return-Air Plenum: Sheet metal plenum finished to match the chassis.
3. Mixing Plenum: Sheet metal plenum finished and insulated to match the chassis with outdoor- and return-air, formed-steel dampers.
4. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.

I. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.

J. MERV Rating: 8 when tested according to ASHRAE 52.2.

1. Washable Foam: 70 percent arrestance and MERV 3.

2. Glass Fiber Treated with Adhesive: 80 percent arrestance and MERV 5.
3. Pleated Cotton-Polyester Media: 90 percent arrestance and MERV 7.

K. Hydronic Coils: Copper tube with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

1. Standards:

   a. ASTM B 117 for salt spray.
   b. ASTM D 2794 for minimum impact resistance of 100 in-lb
   c. ASTM D-3359 for cross hatch adhesion of 5B.

2. Application: Immersion Spray.
3. Thickness: 1 mil Insert measurement.
4. Gloss: Minimum gloss of 50 gloss units on a single angle 60 degree meter.
5. UV Protection: Spray applied topcoat.

L. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

1. Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

M. Factory, Hydronic Piping Package: ASTM B 88, Type L ASTM B 88, Type M copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.

1. Three-way, modulating control valve for chilled-water coil.
2. Three-way, modulating control valve for heating coil.
3. Hose Kits: Minimum 400-psig working pressure and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.

   a. Length: 24 inches 36 inches Insert dimension.
   b. Minimum Diameter: Equal to fan coil unit connection size.

4. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
5. Calibrated-Orifice Balancing Valves: Bronze body, ball type; 125-psig working pressure, 250 deg F maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and a memory stop to retain set position.
6. Automatic Flow-Control Valve: Brass or ferrous-metal body; 300-psig working pressure at 250 deg F; with removable, corrosion-resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig.
7. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blowdown valve in drain connection.

8. Wrought-Copper Unions: ASME B16.22.

N. Remote condensing units are specified in Section 236200 "Packaged Compressor and Condenser Units."

O. Control devices and operational sequence are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

P. Basic Unit Controls:

1. Control voltage transformer.
2. Wall-mounting thermostat with the following features.

    a. Heat-cool-off switch.
    b. Fan on-auto switch.
    c. Fan-speed switch.
    d. Manual or Automatic changeover.
    e. Adjustable deadband.
    f. Concealed or Exposed set point.
    g. Concealed or Exposed indication.
    h. Degree F indication.

3. Unit-mounted humidistat.

    a. Concealed or Exposed set point.
    b. Concealed or Exposed indication.

4. Wall-mounting temperature sensor.
5. Unoccupied-period-override push button.
6. Data entry and access port.

    a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
    b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

Q. DDC Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied-Period-Override Operation: Two Insert number hours.
3. Unit Supply-Air Fan Operation:

    a. Occupied Periods: Fan runs continuously.
    b. Unoccupied Periods: Fan cycles to maintain room setback temperature.

4. Hydronic-Cooling-Coil Operation:

    a. Occupied Periods: Open Modulate control valve to maintain room temperature.
    b. Unoccupied Periods: Close control valve.

5. Supplemental Heating-Coil Operation:

    a. Occupied Periods: Open control valve Modulate control valve Energize heating coil to provide heating if room temperature falls below thermostat set point.
    b. Unoccupied Periods: Start fan and open control valve modulate control valve energize heating coil if room temperature falls below setback temperature.

6. Controller shall have volatile-memory backup.

R. Interface with DDC System for HVAC Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation.
3. Provide BACnet or LonWorks interface for central DDC system for HVAC workstation for the following functions:

    a. Adjust set points.
    b. Fan coil unit start, stop, and operating status.
    c. Data inquiry, including supply- and room-air temperature and humidity.
    d. Occupied and unoccupied schedules.

S. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, to receive fan coil units for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before fan coil unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fan coil units level and plumb.

B. Install fan coil units to comply with NFPA 90A.

C. Suspend fan coil units from structure with elastomeric hangers. Vibration isolators are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation

E. Install new filters in each fan coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to fan coil unit factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.

    a. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.

B. Connect supply-air and return-air ducts to fan coil units with flexible duct connectors specified in Section 233300 "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION 238219

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section "Identification for Electrical Systems" for color-coding and other identification requirements.

1.3 SUBMITTALS

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

B. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Contractor with qualifications and minimum ten (10) years experience in installation, splicing and testing of low voltage power conductors may be considered at discretion of Architect/Engineer, as acceptable agency.

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 NFPA 70.

D. All products shall be UL listed and labeled.

1.5 COMMISSIONING

A. Commissioning of components, equipment and/or system specified in this division is part of the construction process. Project closeout is dependent on successful completion of all commissioning procedures, documentation and issue closure. See Section 01 91 13 for detailed commissioning requirements.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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

1. Encore Wire Corporation.
2. General Cable Technologies Corporation.
3. Southwire Company.

B. Conductors:

1. Type THHN/THWN-2: UL Listed; NEMA WC70; VW-1; Solid, uncoated copper conductors per ASTM-B3; stranded, uncoated copper conductors per ASTM-B3, ASTM-B787, and ASTM-B8; ROHS compliant; 600-volt rated; color-coded PVC insulation; rated for use in wet or dry locations at temperatures not to exceed 90 deg C.
2. Type XHHW-2: UL listed, NEMA WC70; VW-1; stranded, uncoated copper conductors per ASTM-B3, ASTM B787, and ASTM-B8; ROHS compliant; 600-volt rated; color-coded cross-linked polyethylene insulation; rated for use in wet or dry locations at temperatures not to exceed 90 deg. C.

2.2 CONNECTORS AND SPLICES

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

1. Hubbell Power Systems, Inc.
2. O-Z/Gedney; EGS Electrical Group LLC.
3. 3M; Electrical Products Division.
4. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper, stranded.

B. Branch Circuits:

1. Sizes #10 AWG and smaller: Copper, solid or stranded, but shall be consistent throughout the entire project. Do not mix the use of solid and stranded.
2. Sizes #8 AWG and larger: Copper, stranded.

C. The minimum conductor size shall be #12 AWG.

D. Voltage Drop: Branch circuit conductors shall be sized for a maximum voltage drop of 3 percent to comply with the requirements of ASHRAE Standard 90.1-2007. The following are minimum allowable conductor sizes based on circuit length. The circuit length shall be measured from the branch panelboard to the furthest device in that circuit. The phase and neutral conductors shall be sized as indicated the entire length of that circuit unless a larger size conductor is indicated on the drawings.

1. Conductor sizes for 20A/1-Phase/120V circuits shall be as follows unless noted otherwise:

a. Circuit length of 0 to 95 feet: #12 AWG.
b. Circuit length of 96 to 150 feet: #10 AWG.
c. Circuit length of 151 to 235 feet: #8 AWG.
d. Circuit length 236 to 380 feet: #6 AWG.

2. Conductor sizes for 20A/1-Phase/277V circuits shall be as follows unless noted otherwise:

a. Circuit length of 0 to 200 feet: #12 AWG.
b. Circuit length of 201 to 350 feet: #10 AWG.
c. Circuit length 351 to 550 feet: #8 AWG.
d. Circuit length 551 to 850 feet: #6 AWG.

3.2 CONDUCTOR INSULATION AND WIRING METHODS

A. Feeders:

1. General use: Type THHN/THWN-2, single conductors in raceway.
2. Underground or below slab: Type XHHW-2, single conductors in raceway.
3. Fire pump ATS feeders (normal and emergency): Type XHHW-2 underground, encased in concrete and single conductors in raceway.

B. Branch Circuits:

1. General use: Type THHN/THWN-2, single conductors in raceway.
2. Underground or below slab: Type XHHW-2, single conductors in raceway

C. Control Circuits, Lighting Control Device Wiring, and Other Division 26 Low Voltage Wiring: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. All cables and conductors shall be installed in conduit. The use of exposed (open) wiring will not be permitted. This shall include all lighting control wiring for occupancy sensors, 0-10V control, etc.

B. 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.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

D. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

1. Colors shall be continuous through the insulation from end to end. Field marking is not acceptable.

E. Each branch circuit shall be provided with a dedicated, 100 percent neutral conductor. Sharing of the neutral conductor between multiple circuits will not be allowed. Each neutral shall be clearly identified with its associated phase conductor.

F. A single raceway shall be limited to a maximum of six current carrying conductors.

G. Each branch circuit conduit shall contain a separate green equipment grounding conductor sized per NEC.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors for compliance with requirements.

a. Megger test for insulation integrity.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes electrical identification requirements.

B. Related Sections include the following:

1. Division 26 Section "Electrical System Fault Analysis, Coordination and Arc Flash Study" for labeling requirements.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, 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 installing acoustical ceilings and similar concealment.

1.6 COMMISSIONING

A. Commissioning of components, equipment and/or system specified in this division is part of the construction process. Project closeout is dependent on successful completion of all commissioning procedures, documentation and issue closure. See Section 01 91 13 for detailed commissioning requirements.

PART 2 - PRODUCTS

2.1 RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:

1. Power circuits:

   a. Utility power: Black letters on a white field.
   b. Standby power: White letters on a red field.

2. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, detectable-type, continuous-printed, polyethylene tape.

1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Metal-Backed, Butyrate Warning Signs: Weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple power source warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace clearance warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 42."

2.5 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background for utility power white letters on a red background for standby power. Minimum letter height shall be 3/8 inch.

1. Label shall identify equipment served, source of feed and circuit number.

2.7 DEVICE, RECEPTACLE AND SWITCH LABELS

A. Label shall be self-adhesive vinyl and shall be computer or machine printed. Minimum size shall be 1/4-inch label with 1/8-inch letters.

1. Label background shall be clear or match to device plate.
2. Black lettering.
3. Legend: Indicates panel and circuit number.

B. Special Receptacles:

1. Special purpose receptacles shall include an engraved or embossed legend appropriate for load serviced and labeled as specified in Paragraph A.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum width: 3/16 inch.
2. Tensile strength: 50 pound minimum.
3. Temperature range: Minus 40 to plus 185 deg F (minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.9 PAINTING

A. Refer to Division 09 Section “Painting” for product and material requirements for preparing and painting of exposed electrical raceways and boxes.

PART 3 - EXECUTION

3.1 APPLICATION

A. Accessible Raceways, 600 V or Less, for Feeder and Branch Circuits: Identify with preprinted self-adhesive vinyl label based on voltage contained and as follows:

1. 120/208 volt system: Black letters on a white field for normal power and white letters on a red field for emergency power. Shall read as "120/208 VOLTS."
2. 277/480 volt system: Black letters on a white field for normal power and white letters on a red field for emergency power. Shall read as "277/408 VOLTS."

B. Raceways and Junction Boxes for the Fire Alarm System: All conduits associated with the fire alarm system shall be fire alarm EMT conduit with a bright red topcoat. All junction boxes shall be painted to match the red conduit.

C. Conductors:

1. Feeder wires shall be identified with voltage, phase, and destination at each access point. Each phase conductors shall be identified with colored insulation its entire length.
2. Wiring shall be identified with wrap-on wire markers. Wire markers shall be vinyl cloth with factory painted letters and numbers. Number shall indicate associated terminal in starter, panelboard, etc.
3. All transformers, distribution panels, feeders, power sub-feeds to motors, etc., shall be completely phased out as to sequence and rotation and so labeled.
4. Neutral conductors at each panel, junction box, etc., shall be permanently and effectively identified with its branch circuit conductor taped together and labeled with circuit number. The neutral shall have a colored strip that corresponds to the phase color of the non-grounded conductor.

D. Pull and Junction Boxes, Feeder Bus Taps:

1. Identify by stenciling on the boxes, system use, etc. as directed.
2. Covers for pull and junction boxes shall be marked with felt tip pen or other approved permanent marking means, including system type, i.e., lighting, power, emergency, etc., panel and circuit number, if applicable designation, etc. Example: Room C703, Panel 1-LN-1, Circuit #12.

E. Device Cover Plates:

1. Receptacle cover plates shall be identified by a clear label with black lettering indicating panel and circuit.
2. Switch cover plates shall be identified by a clear label with black lettering indicating panel and circuit.

F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, and control wiring.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Apply to exterior of door, cover, or other access.

1. Equipment with multiple power or control sources: Apply to door or cover of equipment including, but not limited to, the following:

   a. Power transfer switches.
   b. Controls with external control power connections.
   c. Emergency power system.

2. Equipment requiring workspace clearance according to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

I. Arc Flash Labeling: Comply with the requirements of Division 26 Section "Electrical System Fault Analysis, Coordination and Arc Flash Study."

J. Instruction Signs:

1. Operating instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
2. Emergency operating instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels on each power and system equipment/panel power equipment. Label shall include device identification and source.

1. Labeling instructions:

    a. Indoor equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
    b. Outdoor equipment: Engraved, laminated acrylic or melamine label.
    c. Elevated components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to be labeled:

    a. Switchgear.
    b. Switchboards.
    c. Panelboards, electrical cabinets, and enclosures.
    d. Access doors and panels for concealed electrical items.
    e. Transformers.
    f. Disconnect switches.
    g. Enclosed circuit breakers.
    h. Variable frequency controllers.
    i. Motor starters.
    j. Distribution panels.
    k. Contactors.
    l. Fire-alarm control panel and annunciators.
    m. Transfer switches.

3. Equipment schedule:

    a. Panelboards shall include correct, typewritten circuit directory cards identifying load served by branch circuit protective devices.
    b. Panelboards shall include designation label, voltage, phase, wires, ampere, fed from, short circuit ratings, arc flash hazard level and feeder size on exterior cover of the panel door.

4. Distribution panels shall have labeling for each circuit breaker frame/trip size, including spare and spaces/provisions.
5. Motor controllers and disconnect switches: Label each with engraved plastic label with 1/2-inch high letters securely attached to the exterior of device as follows:

    a. Equipment served, voltage, phase and wire.
    b. Source of feed and circuit number. For example, “MS-AHU-1 fed from B-HEQDP-1 Circuit #4 located in Room B053”.
    c. Feeder size.

6. Panelboards:

    a. Provide approximately 5" X 8" frame inside the door with plastic protected typewritten directory card identifying all circuits with Owner's final room number.
    b. Engraved plastic label with 1/2-inch high letters on panel cover identifying panel, voltage, phase, wire, ampere source of feed, short circuit rating, arc flash hazard level and feeder size.

7. Switchgear, switchboards and distribution panels:

    a. Provide an engraved plastic label with 3/4-inch high letters, securely attached, identifying panel, voltage, phase, wire, ampere, source of feed, short circuit rating, arc flash hazard level and feeder size.
    b. Branch devices shall be labeled with engraved plastic label with 3/16-inch high letter securely attached to exterior of device.

8. Transfer switches:

    a. Label "Normal" and "Emergency" poles with engraved plastic tags.
    b. Label with source designations for both sources.
    c. Identify switch, voltage, phase, wire, ampere, short circuit rating, arch flash hazard level and feeder sizes.

L. Emergency Source Sign: Provide a sign complying with the requirements of NEC Article 700 identifying the presence of the on-site emergency power source. Locate in a conspicuous location on the utility source main switchboard near the main breaker. Sign shall read “Standby emergency power source. Diesel emergency generator. Located outdoor west of the facility”.

M. Painting:

1. Refer to Division 09 Section “Painting” for execution requirements related to painting of exposed Division 26 components.
2. Apply field labeling and other identification materials after painting has been completed.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. Accessible Raceway Labeling: Install at a conveniently viewable location. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for feeder and branch-circuit conductors. Colors shall be factory applied and continuous through the insulation from end to end. Field marking is not acceptable.

1. Colors for 208/120-V circuits:

   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   d. Neutral:

      1) Phase A: White with black strip.
      2) Phase B: White with red strip.
      3) Phase C: White with blue strip.

   e. Ground: Green.

2. Colors for 480/277-V circuits:

   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
   d. Neutral:

      1) Phase A: Gray with brown strip.
      2) Phase B: Gray with orange strip.
      3) Phase C: Gray with yellow strip.

   e. Ground: Green.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

END OF SECTION 26 05 53

SECTION 28 35 00

REQUIREMENTS FOR ELECTRONIC SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, general provisions of the Contract, including General and Supplementary Conditions, and Division-1 Specification Sections and other Division-26/28 Specification Sections, apply to work of this Section.

B. Drawings and general provisions of the Contract, including General Conditions, Amendments to the General Conditions and Division-1 Specification Sections, apply to this and other Sections of Division-26/28.

C. Related Sections:

1. Section 26 01 00 - Basic Electrical Requirements

2. Section 26 27 26 - Wiring Devices

1.2 SUMMARY

A. Electronic Systems raceway, cables and equipment shall be installed in accordance with these specifications. The Electrical Contractor and the Electronic Systems Contactor(s) shall cooperate to provide complete and operable systems as specified in the related sections of these specifications.

1. Telephone Systems

2. Television Systems

3. Data

4. Security System

5. Access and Control Systems

6. Temperature controls systems

7. Fire alarm system

B. The Electrical Contractor (Div 26) shall be responsible for the following:

1. Furnishing and installing all conduit, cabling, outlet and junction boxes, etc., as required for a complete raceway system.

2. Providing and pulling all system required cables, testing all cables, installing systems devices, terminating cables at the device and properly tagging all electronic systems cables with identifying addresses as supplied by the Electronic Systems Contactor(s).

3. Providing complete set of A/E prepared bid documents (drawings, specs, and addenda) to the Electronic Systems Contractor for the ESC's use in preparation of shop drawings and rough-in prints, when the ESC is a supplier/subcontractor to the Electrical Contractor.

C. The Electronic Systems Contractor(s) shall be responsible for the following:

1. Preassembling of all headend equipment, racks, and required cabinets and delivering them to the site.

2. Area 'A' only - Furnishing all devices and equipment Installing and making final connections to all electronic systems head end equipment.

3. Area 'B' only - Furnishing all devices and equipment. Providing installation coordination to Div 26 for Div 26's installation and terminations of all devices, cabling and headend equipment.

4. Supplying all electronic systems cables requirements to the Electrical Contractor and directing the installation of those cables for Div 26 to purchase and install

5. Performing all systems tests and making all adjustment as hereinafter specified for individual systems, utilizing ESC owned instruments on which ESC personnel are thoroughly trained.

6. Warranty all equipment and systems as required in Section 26 01 00, "Basic Electrical Requirements."

1.3 SUBMITTALS

A. The Electrical Contractor shall submit manufacturer's data and shop drawings for raceway systems components and materials supplied by him as required in Section 26 01 00, "Basic Electrical Requirements" and as required in related sections of these specifications.

B. The Electronic Systems Contractor(s) shall submit manufacturer's data, shop drawings and wiring diagrams for all electronic systems components and materials supplied by him as required in Section 26 01 00, "Basic Electrical Requirements" including the following:

1. Product data for each type of product specified including dimensioned plans, sections, and elevations showing minimum clearance, installed features and devices, and a list of materials.

2. Shop drawings shall include scaled plans and component locations with interconnecting wiring indicated.

3. Wiring diagrams, detailing wiring for power, signal, and control, differentiating clearly between manufacturer-installed wiring and field-installed wiring. Identify terminals to facilitate installation, operation and maintenance.

4. Maintenance data for materials and products, for inclusion in Operating and Maintenance Manuals specified in Section 26 01 00, “Basic Electrical Requirements.”

5. Coordinating drawings for detailing major elements, components and wiring raceways in relationship with other systems, installation and building components as specified in Section 26 01 00, “Basic Electrical Requirements.”

6. Training for the Owner’s representative(s) in the operation of each system as specified in Section 26 01 00, “Basic Electrical Requirements.”

1.4 QUALITY ASSURANCE

A. Materials furnished as a part of these systems shall comply with the specific requirements for those materials in related sections of the Division-26/28 Specifications.

B. Electrical Component Standard: Provide work complying with applicable requirements of NFPA 70 “National Electrical Code” including, but not limited to:

1. Article 250, Grounding

2. Article 300, Part A. Wiring Method

3. Article 310, Conductors for General Wiring

4. Article 725, Remote Control, Signaling Circuits

5. Article 800, Communication Systems

C. TIA/EIA Compliance: The telephone and data systems wiring and devices shall be installed in accordance with the following:

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle materials as required in Section 26 01 00, “Basic Electrical Requirements.”

1.6 SEQUENCES AND SCHEDULING

A. The Electrical Contractor and the Electronic Systems Contractor(s) shall coordinate their work with each other and with other Work, including General and Mechanical, to properly interface installation of electronic systems and raceway with that work.

B. Sequence the installation of electronic systems and raceways with other work to minimize the possibility of damage and soiling during the remainder of construction.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

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

Mfg/	**Description**
Corning, Optical Cable Corp.	Fiber Box
Corning, Optical Cable Corp.	6 strand MM Module
Panduit, Leviton, Hubbell	48 port plastic patch panel - open
Panduit, Leviton, Hubbell	24 port voice patch to rj21
Panduit, Leviton, Hubbell	vertical cable mgmt
Panduit, Leviton, Hubbell	horizontal cable mgmt
Panduit, Leviton, Hubbell	19" 20 amp rackmount pdu
Panduit, Leviton, Hubbell	cat6 jacks ivory
Panduit, Leviton, Hubbell	6 outlet wall plates
Panduit, Leviton, Hubbell	ultimate id icons - data pkg 100
Panduit, Leviton, Hubbell	ultimate id icons - phone pkg 100
Panduit, Leviton, Hubbell	19" 45u relay rack
Belden, AT&T, General Cable	1000' cat6 yellow riser data twist

B. Raceway Systems

1. Provide products by one or more of the manufacturers listed in related sections of these Division-26/28 Specifications for each specific component or assembly.

2.2 MATERIALS – GENERAL

A. These specifications contemplate a complete and operable system for each electronic system provided. Although each and every minor electronics item required for complete and operative systems may not be specifically mentioned herein or shown on the drawings, it shall be the Electronic Systems Contractor's responsibility to provide and complete the same.

B. Manufacturer's model numbers listed in the various electronic systems are shown as a basis of minimum standards and performance required. Equipment or other manufacturers will be considered only if judged by the Engineer to be equal to or superior to the specified items in all respects as to quality and performance. Features, functions, and performance shall remain the same regardless of equipment manufacturer. (Should any model number be obsolete or superseded, it shall be understood that the newest equivalent model shall be furnished.) Refer to Section 26 01 00, "Basic Electrical Requirements" for requesting approval of additional manufacturers' products.

C. The Electronic Systems Contractor shall be the local authorized distributor of equipment supplied and shall maintain a local service department, stock sufficient replacement parts, and be authorized to provide factory-warranty service.

2.3 CONDUIT AND RACEWAY REQUIREMENTS

A. A raceway system shall be provided from outlet boxes to above accessible, lay-in ceilings. Cables may be installed exposed above accessible ceilings. Provide conduit in walls, under floors and above drywall, plaster or other non-accessible ceilings. Provide sleeves through firewalls, or other walls which extend to the structure and through floors as required to route exposed cables to the terminal equipment.

B. Conduit Size

1. The smallest size conduit used for any electronic system shall be 3/4". Where cables are grouped and routed together, size conduit as indicated on the drawings or as directed by the Electronic Systems Contractor. Install conduits with a minimum bending radius of 6". The electrical contractor shall coordinate with all systems contractor's requirements so to provide all required boxes, conduits and raceways. Only where appropriate or required for proper functioning provide multiple raceway, otherwise consolidate raceways as appropriate. Life safety systems devices and cables shall not share boxes nor conduits with other non-life safety systems.

C. Sleeves

1. Where sleeves are required for routing exposed cables, provide separate sleeves for each system. Sleeves shall be a minimum of 2" and sized for all required cables plus 10 percent (minimum of 1). The Electronic System Contractor shall

be responsible for determining the proper size sleeves and advising the Electrical Contractor who is responsible for installing the proper size sleeves.

D. Pull Boxes

1. Provide a pull box in all conduit runs so that no conduit run exceeds 100 linear feet or has more than two quarter bends (180 degrees, total).

E. Wall Plates

1. Provide wall plates to mount outlets and devices as required in the section on "Wiring Devices" for each wall outlet. Provide blank plates for unused outlets. All plates shall match in size, and shall be Stainless Steel with tamper resistant hardware.

F. Pull Wires

1. All empty conduit for future use shall be provided with a #14 AWG galvanized steel pull wire or a nylon pull cord of equivalent strength.

2.4 CABLES

A. General Requirements

1. Provide cables which are suitable for the specific use. Descriptions are for general use cables. The equivalent plenum rated, riser rated cables shall be provided as required in NEC Article 725, for those applications.

2.5 DATA CABLES

A. Where requirements are not called out elsewhere, Category 6 cable shall be a 22 AWG, 4 pair unshielded cable which has transmission characteristics suitable for data rates above 16 Mbps. Cable shall meet the requirements for Category 6 cable defined by EIA/TIA.

2.6 FIBER OPTIC CABLES

A. Where requirements are not called out elsewhere, Fiber optic cable shall be six strand 62.5/125 type cable with the following specifications:

Core diameter:	62.5 +/- 2.5 micron
Cladding diameter:	125.0 +/1 2.0 micron
Core concentricity:	5% maximum
Refractive index delta:	20% maximum
Numeral sperture:	0.29
Attenuation range:	3.6 – 4.6 dB/Km at825 rm
Mean deviation:	0.15 dB
Bandwidth range:	200 MHz – Km, minimum
Typical splice loss:	0.15 dB (array); 0.28 dB (fusion)
Coating diameter:	245 +/- 20 micron

2.7 TELEPHONE SYSTEM CABLES

A. Individual outlets shall be wired with a cable of 22 AWG, 4 pair solid copper, unshielded, twisted pair construction in a polyvinyl chloride sheath. Cable shall conform to Insulated Cable Engineers Association (ICEA) Standard S-80-576 and EIA/TIA-568 Standard Category 6.

2.8 TELEVISION SYSTEM CABLES

A. Television system cables shall be 75 ohm nominal impedance coaxial cable which have been 100 percent factory sweep tested from 5 to 850 MHz by the structural return loss method. The following types are included:

1. Analog or Digital Video Coax: RG 6, nom.comacitance: 16.2 PF/FT, cellular polyethylene dielectric, bare copper braid shield with 95 percent minimum shielding factor, No. 18 AWG solid copper conductor and PVC jacket.

2.9 TERMINATIONS, CONNECTORS AND DEVICES

A. General Requirements

1. Provide terminations, connectors and devices which are suitable for the specific use on each system.

B. Data

1. Wall outlets shall be RJ45, Category 6 modular jack type outlets.

C. Telephone Systems

1. Wall outlets shall be RJ45 modular receptacles.

D. Television Systems

1. CATV Coaxial Cable Connectors: Type F, 75 ohms.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

A. The Electronic Systems Contractor shall identify originations and destinations for all cable runs to Div 26 where Div 26 is terminating cables.

B. The Electrical Contractor shall leave a minimum of two (2) feet wire tails at each outlet, four (4) feet wire tails at each terminal cabinet and fifteen (15) feet at terminal boards, equipment racks, housings or consoles. (This only applies where the electrical contractor is not providing the terminations.)

C. Materials furnished as a part of these electronic systems and raceways shall comply with the specific requirements for those materials set forth in this and in related sections of these Division-26/28 Specifications.

D. Both the Electrical Contractor and the Electronic Systems Contractor shall examine the areas and conditions under which the raceway systems and electronic systems are to be installed. They shall notify the Architect/Engineer, in writing, of any conditions which may be detrimental to the installation, operation or maintenance of equipment and cables. Work shall not proceed until unsatisfactory conditions have been corrected in a manner acceptable to the Installing Contractor.

3.2 WIRING INSTALLATION

Refer to Conduit and Raceway Requirements for approved wiring methods.

A. Install wiring of power-limited circuits in raceways except that open cables may be routed above accessible ceilings. Provide plenum rated cables in all HVAC air plenum areas and riser rated cables as required in NEC Article 725. Use conduit for all cable through floors, exposed, in shaftways, and in walls.

B. Plenum, riser and open cables (where used) shall be bundled, tied and connected to building structure, with nylon tie-wrap of at least 30 pounds tensile strength, on a maximum of 4 feet spacing. Do not install laid on ceiling grids, on ceilings, or tied to ceiling grid support wires.

C. All electronic cables shall be neatly secured with nylon tie-wraps at not more than 4" intervals. Cables shall be labeled with Brady, or approved equivalent, labels at each end as to circuit designations.

D. Telephone and data systems cables shall be installed in accordance with the recommendations of TIA/EIA for structured cabling. Terminate all pairs of each cable. Do not "split wire" two outlets to one cable. Limit horizontal cabling to 300 feet total length. Terminate cabling in a closet as the area served unless specifically noted otherwise on the drawings. Do not tightly cinch cable bundles and otherwise avoid stress or tension on the cables.

1. Terminate cables on 8 position jack pin/pair assignment in accordance with TIA/ETA-568-B2.

E. AC wiring to convenience outlets within electronics equipment racks shall be installed in conduit in accordance with the latest National Electrical Code, including all supplements. All plugs and receptacles used shall be of the grounding type.

F. No splices (joints) in electronics wiring will be permitted except in terminal cabinets or equipment housings, (i.e., no splicing is permitted in pull boxes).

G. Conduit provided for all electronics cables shall be sized for a maximum fill of 40 percent of the internal area of the conduit. The Electronic System Contractor shall be responsible for assuring that the conduit sizes indicated on the drawings are sufficiently large for the particular cables to be used and shall be responsible for advising the

Electrical Contractor of any necessary increases in size. The Electronic Systems Contractor shall be responsible for any additional costs required to provide any such increases in size not included in the original contract prices.

3.3 EQUIPMENT INSTALLATION

A. Devices shall be installed in quantity and locations indicated on the drawings. Where units are mounted in wall boxes, provide a wall plate as specific for electrical devices.

B. Electronic equipment shall be mounted securely to walls or columns, and the Electrical Contractor shall provide all necessary brackets, mounting devices, structural pieces and expansion type anchor inserts necessary for this purpose. Apparatus shall not be mounted directly to concrete or masonry walls. Structural channels shall be used to mount said apparatus at least 3/4 inch away from concrete or masonry walls.

C. All electronics installation shall be made by skilled communications technicians during regular working hours and concurrent with the progress of other trades, such that all installations will be substantially completed at the same time.

3.4 GROUNDING

A. Unipoint grounding technique shall be employed: All grounding of electronics systems shall be made at the main equipment; the conduit system, building structural system, or building piping systems shall not be used for ground return. The Electrical Contractor shall furnish and install a 6 AWG (minimum) insulted grounding electrode conductor in 3/4 inch PVC to the nearest available effectively grounded structural member, the grounding electrode system, or nearest available effectively grounded metal domestic water pipe. Grounding conductor to be terminated in the equipment racks and housing as directed by the Electronic Systems Contractor.

3.5 FIELD QUALITY CONTROL

A. Upon completion of the installation of raceway systems, inspect interiors of raceways; clear all blockages and remove burrs, dirt and construction debris.

B. Touch-up scratched or marred enclosure surfaces to match original finishes.

C. Protect installed equipment and components from damage during the remainder of the construction period.

3.6 CHECK, TEST AND START-UP

A. Electronic systems connection, set-up, testing and final performance shall be the sole responsibility of the Electronic Systems Contractor(s). Systems shall be tested and demonstrated to equal or exceed the specified system criteria.

B. Pretesting: Upon completing installation of the system, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items

with new and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

C. Report of pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable. The letter shall include the names and titles of the witnesses to the preliminary tests.

D. Final test notice: Provide 10 days minimum notice in writing when the system is ready for final acceptance testing.

E. All measurements shall be made on the job site. Manufacturer published specification data or curves and measurements of typical models will in no case be considered as meeting this portion of the specifications.

F. Retesting: Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense. Verify by the system test that the total systems meets the Specifications and complies with applicable standards.

G. Report of tests and inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.

H. Train Owner's personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and maintaining of each system. Provide a minimum of 4 hours training.

I. Occupancy adjustments: When requested, any time within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

END OF SECTION 28 35 00

SECTION 31 20 00

EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation, filling, backfilling and compacting.
2. Trenching and trench backfilling.
3. Mass earthwork and rough grading.
4. Finish grading, including spreading of topsoil.
5. Dewatering.
6. Soil stabilization.
7. Testing and inspection.

B. Related Sections:

1. Division 00 Section “Geotechnical Data”.
2. Division 02 Section “Selective Site Demolition”.
3. Division 31 Section “Site Clearing”.
4. Division 31 Section “Erosion Control”.

1.2 QUALITY ASSURANCE

A. Testing and Inspection:

1. All testing and inspection shall be performed by an independent Geotechnical Engineering Consultant ("Geotechnical Engineer").
2. The Geotechnical Engineer is responsible for all testing, sampling and inspection.
3. The Geotechnical Engineer is responsible for approving materials, installation and procedures.
4. The Contractor is responsible for providing these services.
5. The Contractor is responsible for all coordination and scheduling with the Geotechnical Engineer.

B. Topsoil:

1. All topsoil shall be tested and approved by the Geotechnical Engineer.
2. Refer to 1.3 Submittals for more information.

C. Any work in public right-of-way or other areas subject to the jurisdiction of any body shall be performed either to the requirements of that jurisdiction or to the requirements of this Specification, whichever is more stringent.

1.3 SUBMITTALS

A. All submittals shall be reviewed approved by Architect/Engineer and Geotechnical Engineer.

B. Product Data and Test Reports:

1. Field and laboratory tests and inspections.
2. Drainage fill: Include material specifications and sieve analysis. Include signed material certificate from manufacturer/supplier.
3. Chemical modification: Include material specifications and signed material certificate from manufacturer/supplier.
4. Geo-synthetic materials: Include material specifications and signed material certificate from manufacturer/supplier.

C. Topsoil:

1. Furnish topsoil analysis performed by the Geotechnical Engineer.
2. Analysis shall state the following: (Refer to Part 2 for minimum requirements)

    a. Percentage of organic matter.
    b. Gradation of sand, silt and clay, Include USDA textural classification.
    c. Cation exchange capacity.
    d. Deleterious material.
    e. pH.
    f. Mineral and plant nutrient content (phosphorus, potassium, magnesium, calcium).

3. Analysis shall state if topsoil is suitable for the intended use and as defined in this Specification, and shall state any requirements or recommendations necessary to make it suitable.
4. Analysis shall state annual nutrient requirements and recommendations.
5. This analysis is required for both on site and off site topsoil.
6. Samples of the topsoil shall be taken under the following conditions:

    a. Within four (4) weeks prior to placing topsoil, take three representative samples of proposed topsoil.
    b. Within one week after placing topsoil, take three representative samples of in-place topsoil.
    c. All samples shall be taken in witness of the Owner, in areas approved by the Owner. Contractor to coordinate with Owner as required.

7. Provide copies of all topsoil analysis and recommendations to Owner and Architect/Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. All soil materials shall be approved by the Geotechnical Engineer.
2. All soil materials shall be suitable for each application.
3. Suitable soils are defined as soils which provide proper strength, compaction and drainage requirements and which are approved by the Geotechnical Engineer.
4. Fill material which is unsuitable due to excess moisture will not be classified as unsuitable if it can be dried to optimum moisture specified herein by manipulation, aeration or blending with other materials satisfactorily as approved by the Geotechnical Engineer.

B. Fill Materials:

1. Note: The following describes fill materials and their application for use. The materials shall be used for the listed applications, unless designated otherwise on the Drawings. If the Contractor has any questions or concerns regarding the materials or intended application, contact the Architect/Engineer for direction. Compaction requirements are the percentage of maximum dry density per ASTM D698 Standard Proctor Test, unless noted otherwise in the Geotechnical Report.
2. General fill:

    a. Suitable on-site or off-site fill material free of debris, roots, organic and frozen materials, and stones having a maximum dimension of 2".
    b. Minimum compaction: 95%.
    c. Application: General filling and backfilling of excavations and trenches outside of the building.

3. Structural fill:

    a. Suitable on-site or off-site fill material free of debris, roots, organic and frozen materials, and stones having a maximum dimension of 2".
    b. Minimum compaction: 100%.
    c. Application: Compacted subgrade under buildings, foundations and areas subject to structural loads.

4. Granular fill:

    a. Clean, natural or manufactured sand per requirements of INDOTSS Type "B" borrow, 4.75mm (No. 4) gradation. Pea gravel is not acceptable.
    b. Minimum compaction: 95%.
    c. Application: Backfilling of excavations and trenches which are under or within 5' of pavement, and underneath exterior concrete pavement, walks, curbs and slabs on grade.

5. Drainage Fill:

    a. General: Clean, washed fill sand with 100% passing the 4.75mm (No.4) sieve and no more than 5% passing the 0.075 mm (No. 200) sieve. Pea gravel or #53 stone are not acceptable.
    b. Minimum compaction: 95%.
    c. Application: Free draining material required for applications such as the outside of basement walls, the back side (earth side) of retaining walls and building slabs on grade.

6. Aggregate fill: Unless otherwise indicated, shall meet the following:

    a. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone and natural or crushed sand.
    b. ASTM D2940, with 100 percent passing a 1 ½ inch sieve and not more than 8 percent passing a No. 200 sieve.
    c. Application: base course under concrete and other items per plans.

C. Topsoil:

1. Topsoil shall be fertile, friable, natural surface soil obtained from well-drained areas and possessing characteristics of representative soils in the project vicinity that produce heavy growths of crops, grass or other vegetation.
2. Topsoil shall consist of friable loam, reasonably free of subsoil, clay lumps, brush, roots, weeds or other objectionable vegetation, stones or similar objects larger than 1-1/2" in any dimension, litter or other materials unsuitable or harmful to plant growth.
3. Supplement on-site topsoil with off-site topsoil as necessary.
4. Unless otherwise indicated, minimum compacted thickness in lawn areas is 4".
5. The mechanical analysis of topsoil shall be as follows:

    a. 1" mesh sieve size; 99%-100% passing.
    b. 1/4" mesh sieve size: 97%-99% passing.
    c. No. 100 mesh sieve size: 40%-60% passing.
    d. No. 200 mesh sieve size: 20%-40% passing.

6. The following minimum requirements shall also be met:

    a. Organic matter: 3-5%.
    b. pH: 6.5 to 7.3.
    c. Sand, silt, clay content: per USDA loam textural classification.
    d. Minerals and nutrients: Per Geotechnical Engineer recommendations and amendments suitable for use in local area.

D. Soil Separator Fabric:

1. Nonwoven, needle-punched geotextile fabric manufactured from polyolefins or polyesters per ASTM M288, suitable for subsurface drainage and other specified applications.
2. Application: subsurface drains and as specified in Contract Documents.
3. Specifications (values based on Mirafi 140N):

    a. Apparent opening size: 70 (U.S. Standard Sieve Size); ASTM D-4751-99A.
    b. Flow rate: 135 gpm/sf; ASTM D-4491-99A.
    c. Puncture strength: 65 lbs; ASTM D-4833-00.
    d. Mullen Burst: 225 lb/sq. in.
    e. Grab tensile/elongation: 155 lbs/50%.
    f. UV Resistance: 70% at 500 hours.

E. Geo-synthetic Reinforcement:

1. General: TriAx Geogrid TX5 as manufactured by Tensar International Corp., Atlanta Georgia.
2. Application: Soil stabilization as required and as recommended by the Geotechnical Engineer.

F. Chemical Modification:

1. General: INDOTSS 215.
2. Materials: Hydrated lime per INDOTSS 913.04(b) and Type I Portland cement per INDOTSS 901-01(b).
3. Quantity: 4.0 +/- 0.5% by dry unit mass of the soils.
4. Application: If Geotechnical report indicates that chemical modification may be needed for soil stabilization, then Contractor shall include provisions for chemical modification in their bid.

G. Other Materials:

1. All other materials not specifically described but not required for proper completion of the Work of this Section, shall be as selected by the Contractor subject to the approval of the Architect/Engineer and Geotechnical Engineer.

PART 3 - EXECUTION

3.1 REQUIREMENTS

A. General:

1. Weather: Do not perform earthwork activities during inclement weather.
2. Dust: Use all necessary and appropriate means, such as water sprinkling, as required to prevent dust from being a nuisance to the Owner, public and concurrent performance of other work on the site.
3. Conflicts: Should the preceding job conditions or other items specified herein because actual or possible conflicts, notify the Architect/Engineer immediately and do not proceed until such conflict has been resolved.
4. Refer to Division 31 Section “Termite Control” for termite protection requirements.

B. Preparation: Verify that the following has been completed prior to beginning earthwork:

1. Protective fencing has been installed for trees and vegetation to remain.
2 Site clearing (clearing and grubbing).
3. Selective site demolition.
4. Erosion and sediment control measures are in place.

C. Protection:

1. For items indicated to remain, provide protection to prevent damage from construction activities. Any damage or destruction to items intended to remain intact shall be repaired or replaced to the satisfaction of the Owner at the Contractor’s expense.

2. Topsoil: Protect placed topsoil from heavy machinery traffic. Remove and replace topsoil that is compacted by heavy machinery traffic.
3. Subgrade: Ditches and drains along the subgrade shall be maintained to drain effectively at all times. Repair subgrade of any ruts that may occur by reshaping and recompacting as required.
4. Utilities: Determine locations of existing utilities and the extent to which they may affect earthwork operations. Where service and utility lines are to remain, provide protection to prevent damage or disruption of services.
5. Damaged utilities shall be repaired immediately at the Contractor's expense.
6. Open excavation:

    a. The Contractor is responsible for ensuring all open excavations are properly barricaded and protected at all times. This includes work such as mass excavation and trenching, and also includes other potentially dangerous conditions such as retention ponds.
    b. Provide and install all necessary and appropriate means such as, but not limited to, signage, fencing, traffic barricades, and lighting to warn, discourage, and prevent danger to adjacent workers and general public.
    c. Unless otherwise indicated, install a minimum 6' 10-guage chain link fence around all open excavations, retention ponds, and other areas of potential danger, and maintain them while such conditions exist. Increase measures as required per site conditions.

3.2 LAYOUT

A. Surveyor: Secure the services of a licensed land surveyor, acceptable to the Architect/Engineer and Owner, to layout locations of building, parking areas, drive, walks, curbs, finish elevations and other work, including mechanical and electrical items that are to be installed on the project site.

B. References: Establish and maintain lines, corners, elevations and general reference points. Verify dimensions indicated on Drawings. If conflicts exist, immediately notify the Architect/Engineer before continuing work.

3.3 EXCESS WATER CONTROL

A. Excess moisture: If excess moisture is present in soils, do not resume operations until moisture content and density are reported to be satisfactory by the Geotechnical Engineer.

B. Flooding: Provide berms or channels to prevent flooding of subgrade. Promptly remove all water collecting in depressions.

C. Softened subgrade: Where soil has been softened or eroded by flooding or placement during inclement weather, remove all damaged areas and recompact as specified for fill and compaction.

D. Dewatering:

1. Provide and maintain ample means and devices with which to promptly remove and dispose of all water from every source entering the excavations or other parts of the work at all times during construction.
2. Dewater by means which will ensure dry excavations and the preservation of the final lines and grades at bottom of excavations, such as sump pumps, trenching, etc.
3. Do not use extreme measures or durations as to cause adverse effects to Project Site or adjoining properties.

3.4 CHEMICAL MODIFICATION

A. General:

1. Scarify and/or disc area to a depth of 12" prior to distributing modifiers.
2. Utilize screw type, cyclone, or pressure manifold type distributors to apply modifier.
3. Do not apply when wind conditions create potential hazards or transference of material to adjacent areas.
4. Mix modifiers with rotary speed mixers or disc harrow, and continue until a homogenous layer of the required thickness is obtained.
5. Compaction:

    a. Lime modified soils shall be compacted within 3 days.
    b. Cement modified soils shall be compacted within 30 minutes.

6. Observation and testing: Quantities of materials, placing, mixing, and compacting shall be, as recommended, observed and tested by the Geotechnical Engineer.

3.5 STOCKPILING

A. General:

1. See drawings for designated stockpiling areas. If Drawings do not designate specific areas, or areas shown are insufficient, contact Architect/Engineer for direction.
2. Stockpile earth materials in manners that will prevent intermixing of different materials and intrusion of trash, debris and organic materials.
3. Slope stockpiled materials to provide adequate surface drainage.
4. Install and maintain erosion control measures. Refer to drawings and Division 31 Section "Erosion Control". At a minimum, silt fence shall be installed around all stockpiled areas. Seed areas which are to remain stockpiled for extended periods of time.
5. Storage or stockpiling of materials on the subgrade is prohibited.

3.6 EXCAVATION

A. General:

1. Excavation shall conform to OSHA and all other applicable safety regulations.
2. Excavation shall conform to the dimensions and elevations indicated on the Drawings, except as specified herein.

3. Excavation shall extend sufficient distance from walls and footings to allow for placing and removal of forms, installation of services and inspection.
4. Remove unsuitable material below indicated depths and replace with suitable, compacted material or lean concrete, at the Architect/Engineer discretion.
5. Topsoil stripping: Strip topsoil to its depth from areas to be covered by building, by walks and by other work and where existing surface areas required grading in order to establish new elevations.
6. Subgrade: Unless otherwise indicated, excavate to following subgrades:

    a. Slab-on-grade: Sub-grade at bottom of drainage fill or at bottom of existing topsoil, whichever is lower.
    b. Drives and paving: Sub-grade at bottom of aggregate base.
    c. Footing: Sub-grade at indicated bottom of footing.
    d. Lawn area: Sub-grade 4” below indicated surface elevation.

3.7 TRENCHING

A. General:

1. All trenching shall conform to OSHA and all other applicable safety standards.
2. Verification:

    a. Contractor shall verify all existing grades, inverts, utilities, obstacles and topographical conditions prior to any trenching, excavation or underground installations.
    b. In the event existing conditions are such as to prevent installations in accordance with the Contract Documents, immediately notify the Architect/Engineer and await decision before continuing work.
    c. Architect/Engineer decision will be final and binding upon the Contractor, and installations shall be in accordance with same.

3. Saw cut existing pavements to proper width for trenching.
4. Legally dispose materials unsuitable for trench backfilling off-site.

B. Width:

1. Trenches for piping shall be not less than 12” wide or more than 16” wider than the outside diameter of the pipe to be laid therein, and shall be excavated true-to-line, so that a clear space not less than 6” or more than 8” in width is provided on each side of the pipe.
2. For sewers, the maximum width of trench specified shall apply to the width at and below the level at the top of the pipe. The width of the trench above that level may be made as wide as necessary for sheeting and bracing, and proper installation of the Work.
3. Trenches shall be open vertical construction.

C. Depth:

1. Trench as required to provide the elevations shown on the drawings.

2. Where elevations are not shown on the drawings, trench to sufficient depth to give a minimum of 36" of fill above the top of the pipes measured from the adjacent finish grade.
3. Where trench excavation is inadvertently carried below proper elevation, backfill with approved material and then compact to provide a firm and unyielding subgrade and/or foundation at no additional cost to the Owner.

D. Trench Bracing:

1. Properly support all trenches in strict accordance with all pertinent rules and regulations.
2. Brace, sheet, and support trench walls in such a manner that they will be safe and that the ground alongside the excavation will not slide or settle, and that all existing improvements of every kind, whether on public or private property, will be fully protected from damage.
3. In the event of damage to such improvements, immediately make all repairs and replacements necessary at no additional cost to the Owner.
4. Arrange all bracing, sheeting, and shoring so as to not place stress on any portion of the completed Work until the general construction thereof has proceeded far enough to provide sufficient strength.
5. All shoring and sheeting required to perform and protect the excavation and as required for the safety of employees and abutting structures shall be performed. All workmen performing work in 48" or deeper trench or excavation shall be protected by use of a welded sheet steel "safety box."
6. Removal: Exercise care in the drawing and removal of sheeting, shoring, bracing, and timbering to prevent collapse or caving of the excavation faces being supported.

E. Bedding:

1. Where pipes or conduits are to be installed, excavate below the proposed alignment of the pipe and backfill with clean sand to provide uniform support unless otherwise noted on the drawings.
2. Unless shown otherwise on Drawings, minimum bedding to be 4" below pipe.
3. Storm sewer pipes are to be bedded with stone.
4. Refer to drawings and details for further information and requirements.

F. Grading and Handling of Trenched Material:

1. During excavation, material shall be stacked in an orderly manner a sufficient distance back from edges of trenches to avoid overloading and prevent slides or cave-ins.
2. Control the temporary stockpiling of trenched material in a manner to prevent water from running into the excavations.
3. Do not obstruct the surface drainage but provide means whereby stormwater is diverted into existing gutters, surface drains or other temporary drains.
4. Any water accumulated in the trenches shall be removed by pumping or by other approved methods.

3.8 FILLING, BACKFILLING AND COMPACTING

A. Prior to filling, backfilling and compacting, proof-roll and remediate subgrade per Part 3 Quality Assurance.

B. Unless otherwise indicated, maximum lift thickness is 8” of un-compacted material.

C. Moisture:

1. Thoroughly mix each layer to assure uniformity of material.
2. Supplement mixing with wetting or drying as required to obtain the moisture content required for the indicated percentages of compaction.
3. All fill shall be placed so that the moisture content is within +/- 2% of the optimum moisture content according to ASTM D698.
4. Do not use frozen materials in the fill or allow the fill to be placed upon frozen materials.

D. Compaction:

1. Compaction shall be accomplished by approved means and shall meet the following densities for various parts of the Work. See Part 2 for density requirements of individual soil materials.
2. Compaction by flooding is not acceptable.
3. In cut areas where pavement is planned, scarify the upper 12” of subgrade prior to compaction.

E. Equipment:

1. Tracked equipment shall not be used as compaction equipment.
2. The static weight of compaction equipment utilized for the compaction of backfill materials near walls as defined in No.3 below shall not exceed 2,000 lbs. for non-vibratory equipment and 1,000 lbs. for vibratory equipment.
3. All heavy equipment, including compaction equipment heavier than noted herein, shall not be allowed closer to walls than 3 feet plus the vertical distance from backfill surface to the bottom of the wall.

3.9 GRADING

A. General:

1. After filling and backfilling operations are complete, neatly and evenly grade areas to be seeded or sodded.
2. Scarify subgrade to a depth of 6” and place minimum 4” topsoil (6” maximum).
3. Grade to obtain the elevations indicated within a tolerance of plus or minus 0.1 foot.
4. Slope finished subgrade surface to provide drainage away from building walls.

B. Treatment After Completion of Grading:

1. After grading is completed and inspected, permit no further excavation, filling, or grading except with the review of and the inspection by the Owner.
2. Use all necessary means to prevent the erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

3.10 QUALITY ASSURANCE

A. Coordination:

1. A representative from the Geotechnical Engineer shall be present to observe and perform tests at all times earthwork is in progress.
2. Contractor shall provide minimum 72 hour notice to Geotechnical Engineer before each operation requiring testing or inspection.

B. Testing:

1. To verify adequacy of compaction, the Geotechnical Engineer shall perform field density tests.
2. A grid pattern shall be established with a maximum area of 1,000 square feet.
3. For each grid, provide minimum one test per each lift of compacted material.

C. Proofrolling:

1. Proofrolling shall be supervised by the Geotechnical Engineer.
2. Since standard test procedures are not available for proofrolling, the necessary scope and method of testing shall be determined by the Geotechnical Engineer, subject to review by the Architect/Engineer.
3. In areas to be covered by buildings and other site improvements, and other areas deemed necessary by the Geotechnical Engineer or Architect/Engineer, prepare and test subgrade as follows:

    a. Using a loaded tri-axle dump truck or other approved method, the Contractor shall proof-roll the exposed subgrade under the observation of the Geotechnical Engineer.
    b. Based on this observation, plus supplemental testing as required, the Geotechnical Engineer shall determine when and where soft, loose or other undesirable materials are to be removed and replaced.

D. Approval and Remediation:

1. When testing and proofrolling indicate proper compaction has been obtained, and after approval from Geotechnical Engineer has been given, continue fill and backfill work until the indicated elevation is achieved.
2. If required density has not obtained, the Contractor shall remove the defective material and repeat operations until the required density is obtained and approval is given by the Geotechnical Engineer.
3. Cost of material removal, replacement, compaction and re-testing shall be the responsibility of the Contractor.

3.11 SURPLUS SOIL MATERIALS

A. Unless otherwise indicated or directed by Owner, remove excess soil materials and legally dispose of off-site.

3.12 JOB COMPLETION

A. Upon completion of the Work of this Section:

1. Remove all trash and debris from earthwork operations.
2. Remove surplus equipment and tools.
3. Leave the site in a neat and orderly condition.
4. Restore all adjacent areas disrupted by earthwork activities to their original condition.

END OF SECTION 31 20 00

SECTION 31 23 17

TRENCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavating trenches for utilities from 5 feet outside building to utility service.
   2. Compacted fill from top of utility bedding to subgrade elevations.
   3. Backfilling and compaction.

1.2 REFERENCES

A. ASTM International:
   1. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

B. Indiana Department of Transportation (INDOT) Publication: Standard Specifications latest edition.

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

C. Product Data: Submit data for geotextile fabric indicating fabric and construction.

D. Materials Source: Submit name of imported fill materials suppliers.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with local standards.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.7 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. Fill: Material free of lumps, frozen soil, wood, topsoil or other deleterious material.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. All work shall conform to the requirements of all local, State and Federal agencies having jurisdiction and the requirements of these specifications.

B. Unless otherwise directed or permitted, not more than one hundred feet (100') of any trench shall be open at any time.

C. Surface encumbrances, located so as to create a hazard to employees involved in excavation work or in the vicinity thereof at any time during operations, shall be removed or made safe before excavating is begun.

D. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench sufficient to avoid overloading and to prevent slides and cave-ins. Adequate drainage shall be provided for the stockpiles and surrounding areas by means of ditches, dikes, or other approved methods. The stockpiles shall also be protected from contamination with unsatisfactory excavated material or other material that may destroy the quality and fitness of the suitable stockpiled material.

   If the Contractor fails to protect the stockpiles and any material becomes unsatisfactory as a result, such material, if directed by the Owner, shall be removed and replaced with satisfactory on-site or imported material from approved sources at no additional cost.

E. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed so that the stability of the bottom and sides of the excavation is maintained. In wet trenches dewatering equipment shall be operated ahead of pipe laying and the water level kept below the pipe invert.

F. The trench shall be excavated as shown on the Drawings or as recommended by the manufacturer of the pipe to be installed, whichever is more stringent. Trench walls below and above the top of the pipe shall be sloped, or made vertical, as recommended in the manufacturer's installation manual. The trench width below an

elevation one foot above the top of pipe shall not exceed that recommended in the installation manual. Where no manufacturer's installation manual is available, trench walls below an elevation one foot above the top of pipe shall be vertical and trench walls one foot or more above the top of pipe shall be adequately sloped as required to prevent slides and cave-in unless proper precautions, as stipulated by OSHA, are taken. If adequate trench slopes are not or cannot be provided in the available contract limits, then use of sheeting and shoring and/or a trench box is mandatory.

G. Unless otherwise indicated, excavation shall be by open cut. However, sections of sewer lines under pavement or in locations where surface conditions make it difficult or impractical to excavate open trenches, installation shall be made by boring or jacking as a Contractor operation and subject to the Owner's review. All sewer pipes smaller than 36 inches in diameter which is installed by boring or jacking shall be installed in steel pipe casing.

H. Dust conditions shall be kept to a minimum by the use of water, salt, calcium chloride, or other means.

3.2 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.
   1. Architect/Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.3 PREPARATION

A. Call Local Utility Line Information service not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum locations.

C. Protect plant life, lawns, and other features remaining as portion of final landscaping.

D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

F. Establish temporary traffic control when trenching is performed in public right-of-way. Relocate controls as required during progress of Work.

3.4 TRENCHING

A. Excavate subsoil required for utilities to utility service.

B. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Hand trim excavation as necessary. Hand trim for bell and spigot pipe joints. Remove loose matter.

E. Remove lumped subsoil, boulders, and rock.

F. Correct areas over excavated.

G. As trenches are backfilled, the Contractor shall removal all surplus material, regrade and leave clear, free, and in good order all roadways and sidewalks affected by the construction of the work. During the progress of and until the expiration of the guarantee period, he shall maintain in good and safe conditions the surface or any street over the trenches and promptly fill all depressions over and adjacent to trenches caused by settlement of backfilling.

H. Stockpile excavated material in area designated on site and remove excess material not being used, from site.

3.5 COVERING ENDS

A. Before leaving the work for the night, during a storm, or for any other reason, care must be taken that the unfinished end of any pipe is securely closed with a tightly fitting cover or plug. Any earth or other material that may find entrance into the pipe, through any such open end of an unplugged pipe shall be removed at the Contractor's expense.

3.6 STABILIZATION

A. If portions of the bottom of trenches or excavations consist of material unstable to such a degree that, in the opinion of the Owner, it cannot adequately support the pipe or structure, the bottom shall be over excavated and stabilized with coarse aggregate Size No. 9 gravel in compliance with Section 904.02 of the INDOT Standard Specifications latest edition. Depth of stabilization shall be as directed by the Owner.

3.7 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Coarse Aggregate Size No. 9 and 11 gravel shall comply with Section 904.02 of the INDOT Standard Specifications latest edition.

D. Granular material, which is noted on the drawings as granular material or B-borrow, shall comply with Article 211.02 of the INDOT Standard Specifications latest edition. Maximum stone size shall not exceed 1 inch or the maximum size recommended by the pipe manufacturer, whichever is smaller.

E. Earth backfill material shall contain no more than 5% organic material, no particles larger than four inches and shall be free of trash, rubble and debris. The Plastic Index of the fraction passing the No. 40 sieve shall not be more than 25.

F. Crushed stone material shall be No. 53 complying with Section 904.02 of the INDOT Standard Specifications latest edition.

G. Employ placement method that does not disturb or damage utilities in trench.

H. Maintain optimum moisture content of fill materials to attain required compaction density.

I. Remove surplus fill materials from site.

J. Leave fill material stockpile areas completely free of excess fill materials.

K. Trenches shall be backfilled to existing grade or grades as shown on the Drawings.

L. Pipe bedding, haunching and initial backfill for aluminized type 2 corrugated steel pipe and reinforced concrete pipe shall be structural backfill or "B" borrow to a depth shown on the drawings. Such backfill shall be placed in lifts of a maximum of 6 inches thickness.

The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. Care shall be taken to ensure thorough compaction of the fill under pipe haunches.

M. Backfill for the remainder of the trenches shall be as follows:
1. Backfill for trenches in turfed or seeded areas and in miscellaneous areas shall be of approved earth material and contain no stones over four (4") in their largest dimensions. Stones that are used in backfilling shall be distributed among the earth backfill so that all interspace are filled with fine material. All such backfilling shall be deposited in lifts of a maximum 12 inches lose thickness and compacted by hand tamping or approved mechanical tamping devices. Excess earth to the amount required to replace settlement shall be neatly rounded over the trench and the remainder stockpiled where designated on the drawings or hauled off site. The Contractor shall maintain Trenches until settlement has ceased and trenches remain level with the adjacent ground.
2. Backfill of all trenches under structures and paved areas shall be structural backfill as classified. In addition, the top six inches (6") below the base of the pavement shall be backfilled with No. 53 stone. The backfill shall be placed in six-inch (6") maximum lifts and the method of placing and compacting the backfill shall comply with Article 211.04 of the INDOT Standard Specifications latest edition, as applicable.

3.8 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1inch from required elevations.

C. Top Surface of General Backfilling: Plus or minus 1inch from required elevations.

3.9 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform laboratory material tests in accordance with ASTM D1557.

C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

3.10 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution Requirements: Protecting finished work.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for providing and installing galvanized steel chain link fencing and gates.

B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 03 31 00 - Cast-in-Place Concrete
2. Section 05 05 13 - Galvanizing
3. Section 08 71 00 - Finish Hardware
4. Section 09 96 00 - High Performance Coatings

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM F 669 - Specification for Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence

2. ASTM F 1083 - Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

3. ASTM F 1234 - Protective Coatings on Steel Framework for Fences

4. ASME B36.10M - Welded and seamless wrought steel pipe

5. FS RR-F-191 - Fencing, Wire and Post, Metal

1.3 DESIGN

A. General: Provide fencing of the chain-link type eight feet high with seven feet of diamond mesh woven wire fabric topped by extension arms with a vertical height of approximately one foot above the top of the fabric. Design the extension arms slanted out at an angle of 45 degrees and provide the arms to carry three double strands of barbed wire. Locate the fence as shown.

B. Fabric, Supports and Fittings: Provide steel fabric, supports and fittings except as specified.

C. Pipe Sizes and Weights: Provide pipe sizes and weights meeting the requirements of ASME B 36.10, Table 2 and ASTM A 53, Table 1. All pipe sizes listed are nominal, unless otherwise indicated.

PART 2 PRODUCTS

2.1 FABRIC

Provide fabric that is a one piece woven 2-inch mesh chain link of 6-gauge steel wire with a minimum break load of 2170 lbs/ft. and which is interwoven to form a continuous fabric with no splices and is hot-dip galvanized after weaving. Provide the top selvage knuckled for fabric 60 inches high and under, and the bottom selvage twisted and barbed for fabric over 60 inches high. Clean the fabric of all grease and foreign matter before shipping. Stretch the fabric tightly approximately two inches above grade level and attach the fabric to the terminal or gate posts using beveled tension bands and tension bars.

2.2 TENSION WIRE

A. For the tension wire for the fence bottom use minimum 6-gauge galvanized coil spring steel.

2.3 TOP AND BRACE RAILS

A. General: Furnish the top rail in approximately 20-foot lengths with couplings approximately 6 inches long for each joint. Provide one coupling in each 5 with an expansion spring. Provide the rail continuous from end-to-end for each run of fence. Provide brace rails at all terminal posts, locate the rails midway between the top and bottom of the fabric and extend from the terminal post to the first adjacent line post. Securely fasten rails at both ends. Provide top and brace rails that are galvanized steel.

B. Pipe Type: For galvanized steel top and brace rails, use 1-1/4-inch, Schedule 40 pipe or a 1.625- by 1.25-inch roll-formed section with minimum bending strength of 192 pounds on 10-foot span.

2.4 POSTS

A. General: Provide all posts that are galvanized steel pipe or roll-formed section.

B. Pipe Posts: Provide pipe posts as follows:

1. For end, corner and pull posts use 2-1/2-inch, Schedule 40 pipe

2. For line posts use 2-inch, Schedule 40 pipe

3. For gate posts use the following pipes for different leaves:

    a. For leaves up to 6 feet wide, use 2-1/2-inch Schedule 40 pipe

    b. For leaves over 6 feet to 12 feet wide, use 3-1/2-inch Schedule 40 pipe

    c. For leaves over 12 feet to 18 feet wide, use 6-inch Schedule 40 pipe

C. Bending Strength: Provide materials with the minimum bending strength based on a 6-foot cantilever for rolled formed or tube posts as follows:

	Minimum Bending Strength (lbs)
	Galvanized Steel
1. End, Corner and Pull Posts:	
2.875" O.D. roll formed or	444
2-1/2-inch square tube	547
2. Line Posts:	
For fences 8 feet maximum height 1.875- by 1.625-inch C-Section	245
For fences over 8 feet high 2.25- by 1.703-inch C-Section	347
3. Gate Posts:	
For leaves up to 6 feet wide (2.875-inch O.D. roll formed or	444
2-1/2-inch square tube	645

2.5 GATES

A. General: For the perimeter construction of gates with leaves up to 6 feet wide, use 1-1/2-inch Schedule 40 pipe or 1-1/2-inch square steel tube, and for gates with leaves greater than 6 feet wide, use 2-inch Schedule 40 pipe or 2-inch square steel tube.

B. Braces: Provide the gates with sufficient horizontal and vertical members and bracing to ensure structural stability to prevent sagging and to provide for the attachment of fabric, hardware and accessories. Provide gates with diagonal cross

bracing consisting of 3/8-inch diameter adjustable length truss rods where necessary to provide frame rigidity without sag or twist.

C. Cantilever Sliding Gates: Furnish cantilever overhang as follows:

Gate Leaf Size	Overhang
6'-0" to 10'-0"	6'-6"
11'-0" to 14'-0"	7'-6"
15'-0" to 22'-0"	10'-0"
12'-0" to 30'-0"	12'-0"

1. For gates leaf sizes 23'-0" to 30'-0", add one additional 2-inch square lateral support rail welded adjacent to the top horizontal rail. Make the bottom rail of 2" x 4" tubing weighing 1.71 pounds per foot.

2. Provide all cantilever overhang frames having 3/8-inch galvanized steel brace rods.

3. Provide the enclosed track made of a combined track and rail aluminum extrusion having a total weight of 3.72 pounds per foot and designed to withstand a reaction load of 2,000 pounds.

4. Provide each gate leaf with two swivel type zinc die cast trucks having four sealed lubricant ball-bearing wheels, 2-inch in diameter by 9/16-inch in width, with two side rolling wheels to insure alignment of the truck in the track. Hold trucks to post brackets by 7/8-inch diameter ball bolts with 1/2-inch shank. Design truck assemblies to take the same reaction load as the track.

5. Install gates on 4-inch OD Schedule 40 galvanized posts weighing 9.1 pounds per foot. Use three posts for single slide gate and four posts for double slide gate.

6. Provide guide wheel assemblies for each supporting post. Provide each assembly consisting of two rubber wheels 4 inches in diameter attached to a post so that the bottom horizontal member will roll between the wheels which can be adjusted to maintain gate frames plumb and in proper alignment.

D. Gate Accessories: Equip gates with hinges, latches, center stops, hasps, holdbacks, and padlocks. Provide hinges, latches, center stops, hasps, and holdbacks that are cast iron, malleable iron, or pressed steel hot-dip galvanized after fabrication. Provide double gates with a center drop bar and gate holdbacks.

E. Latches: Provide gate latches that are positive locking, pivoting type with the padlocking arrangement accessible from either side of the gate.

F. Padlocks: Provide padlocks as specified in Section 08 71 00.

G. Hinges: Hang all gates on offset hinges to permit swinging the gate through a 180-degree arc to lie, when not obstructed, along and parallel to the line of the fence.

2.6 ATTACHMENTS

A. General: Provide all attachments fabricated of galvanized carbon steel.

B. Tension Bars: Provide 3/16-inch by 3/4-inch galvanized carbon steel tension bars attached to the terminal posts by means of beveled edge bands.

C. Truss Rods: Provide 3/8-inch diameter galvanized carbon steel truss rods. Securely mount truss rods between the line post end of the brace rail and the base of the terminal post.

D. Post Tops: Provide post tops of galvanized pressed steel or malleable iron to form weathertight caps for post or tube post. Make provisions for installation or passage of the top rail.

E. Brace and Tension Bands: Provide galvanized steel brace bands and tension bands, of the "unclimbable" beveled edge type with 3/8-inch diameter square shouldered aluminum carriage bolts, nonremovable from outside of the fence.

F. Rail Couplings: Provide rail couplings of the outside sleeve type, not less than six inches long, self-centering, which allows for expansion and contraction. Provide galvanized steel rail couplings.

G. Fabric Ties: Provide 11-gauge galvanized steel fabric ties.

H. Hog Rings: Provide 11-gauge wire, aluminum alloy, Type 6061-T6 hog rings.

I. Extension Arms: Provide galvanized pressed steel extension arms for supporting the barbed wire. Design the arms with an adequate cross section to withstand without failure or permanent deflection a perpendicular force of 250 pounds applied at the end of the arm when the arm is securely attached to the post. Construct extension arms to be slanted out.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Install all fencing and accessories according to the manufacturer's recommendations. Do not begin installation and erection before final grading is completed, unless otherwise approved.

B. Excavation: Drill or hand excavate (using post hole digger) holes for posts to the diameter and spacing indicated, in firm, undisturbed or compacted soil.

1. If not indicated, excavate holes for each post to the minimum diameter recommended by the fence manufacturer, but not less than four times the largest cross-section of the post.

2. Unless otherwise indicated excavate the hole depths approximately 3 inches lower than the post bottom, with the bottom of posts set not less than 36 inches below the finished grade surface.

C. Tension Wire: Attach the tension wire to the bottom of the fabric by hog rings spaced at 24-inch intervals and to terminal posts by brace bands.

D. Posts: Set posts plumb in concrete encasement at not more than 10-foot centers in the line of the fence with the tops properly aligned. Extend concrete encasement for line posts a minimum of three feet below finish grade with a minimum diameter of ten inches. Extend concrete encasement for terminal, corner and gate posts 40 inches below finished grade, except gate posts for leaves greater than 6 feet, for which extend the encasement 54 inches below grade. Provide the minimum diameter of encasement for terminal, corner and gate posts to be sufficient to provide not less than four inches between any part of the post and the face of the concrete and in no case provide the diameter to be less than 12 inches. Set line posts 32 inches into the concrete and set all other posts 36 inches, except gate posts for leaves greater than 6 feet wide, which are to be set 48 inches into the concrete. Slope the top exposed surface of the concrete to shed water and provide a neat appearance.

1. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold posts in position during placement and finishing operations.

    a. Unless otherwise indicated, extend the concrete footing 2 inches above grade and trowel to a crown to shed water.

2. Where aluminum is in contact with concrete, coat the aluminum as specified in Section 09 96 00.

E. Fabric Ties: Space fabric ties approximately 14 inches apart on the line posts and 24 inches apart on the rails. (For clips used with C-section posts, use galvanized 11-gauge steel wire.)

F. Fabric: Leave approximately 2 inches between finished grade and the bottom selvage, unless otherwise indicated. Pull the fabric taut and tie to posts, rails, and tension wires. Install the fabric on the security side of the fence and anchor the fabric to the framework so that the fabric remains in tension after the pulling force is released.

G. Fasteners: Install nuts for tensions bands and hardware bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent nut removal.

END OF SECTION

SECTION 33 05 13

MANHOLES AND STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Monolithic concrete manholes with transition to cover frame, covers, anchorage, and accessories.
2. Modular precast concrete manhole with tongue-and-groove joints, covers, anchorage, and accessories.
3. Monolithic FRP manholes with transition to cover frame, covers, anchorage, and accessories.
4. Masonry manholes with masonry transition to cover frame, covers, anchorage, and accessories.
5. Bedding and cover materials.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 318 - Building Code Requirements for Structural Concrete.
2. ACI 530/530.1 - Building Code Requirements for Masonry Structures and Specifications for Masonry Structures.

B. ASTM International:
1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM C55 - Standard Specification for Concrete Brick.
4. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
5. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
6. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
7. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
8. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
9. ASTM D3753 - Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells.

1.3 DESIGN REQUIREMENTS

A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.

B. Design of Lifting Devices for Precast Components: In accordance with ASTM C913.

C. Design of Joints for Precast Components: In accordance with ASTM C913; maximum leakage of 0.025 gallons per hour per foot of joint at 3 feet of head.

1.4 SUBMITTALS

A. None required.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes.

C. Store precast concrete manholes to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.

D. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

PART 2 PRODUCTS

2.1 MANHOLES

1. Structures per INDOT Standards

B. Manhole Sections: Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923.

2.2 FRAMES AND COVERS

A. Manufacturers:
1. As noted on drawings or equal.

2. Substitutions: Section 01 60 00 - Product Requirements.

2.3 COMPONENTS

A. Manhole Steps: Formed FRP rungs; 3/4 inch diameter. Formed integral with manhole sections.

B. Base Pad: Cast-in-place concrete of type specified in Section 03 30 00 leveled top surfaces.

2.4 CONFIGURATION

A. Shaft Construction: Concentric with eccentric cone top section; lipped male/female dry joints; sleeved to receive pipe sections.

B. Shape: Cylindrical.

C. Clear Inside Dimensions: As required.

D. Design Depth: As indicated on Drawings.

E. Clear Cover Opening: As indicated on Drawings.

F. Pipe Entry: Furnish openings as indicated on Drawings.

G. Steps: 12 inches wide, 16 inches on center vertically, set into manhole wall.

2.5 BEDDING AND COVER MATERIALS

A. Bedding: As shown on drawings.

2.6 FINISHING - STEEL

A. Galvanizing: ASTM A123/A123M; hot dip galvanize after fabrication.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify items provided by other sections of Work are properly sized and located.

C. Verify built-in items are in proper location, and ready for roughing into Work.

D. Verify correct size of manhole excavation.

3.2 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.

C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3.3 INSTALLATION

A. Excavation and Backfill:
   1. Excavate for manholes in accordance with Section 31 23 16 in location and to depth shown. Provide clearance around sidewalls of structure for construction operations.
   2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes in dry trench.
   3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.

B. Place base pad, trowel top surface level.

C. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.

D. Backfill excavations for manholes in accordance with Section 31 23 16.

E. Form and place manhole cylinder plumb and level, to correct dimensions and elevations.

F. Cut and fit for pipe.

G. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour to form continuous drainage channel as indicated on Drawings.

H. Set cover frames and covers level without tipping, to correct elevations.

I. Coordinate with other sections of Work to provide correct size, shape, and location.

3.4 PRECAST CONCRETE MANHOLE INSTALLATION

A. Lift precast components at lifting points designated by manufacturer.

B. When lowering manholes into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.

C. Set precast structures bearing firmly and fully on crushed stone bedding, compacted in accordance with provisions of Section 31 23 16 or on other support system shown on Drawings.

D. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.

E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.

F. Joint sealing materials may be installed on site or at manufacturer’s plant.

G. Verify manholes installed satisfy required alignment and grade.

H. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with mortar.

I. Cut pipe to finish flush with interior of structure.

J. Shape inverts through manhole as shown on Drawings.

3.5 CAST-IN-PLACE CONCRETE MANHOLE INSTALLATION

A. Prepare crushed stone bedding or other support system shown on Drawings, to receive base slab as specified for precast structures.

B. Erect and brace forms against movement in accordance with Section 03 10 00.

C. Install reinforcing steel as indicated on Drawings and in accordance with Section 03 20 00.

D. Place and cure concrete in accordance with Section 03 30 00.

3.6 FRAME AND COVER INSTALLATION

A. Set frames using mortar and masonry. Install radially laid concrete brick with 1/4 inch thick vertical joints at inside perimeter. Lay concrete brick in full bed of mortar and completely fill joints. Where more than one course of concrete brick is required, stagger vertical joints.

B. Set frame and cover 2 inches above finished grade for manholes with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Test concrete manhole and structure sections in accordance with ASTM C497.

C. Test cast-in-place concrete in accordance with Section 03 30 00.

D. Vertical Adjustment of Existing Manholes:
   1. Where required, adjust top elevation of existing manholes to finished grades shown on Drawings.
   2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.
   3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated Drawings.
   4. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete in accordance with Section 03 30 00.

END OF SECTION

SECTION 33 12 19

WATER UTILITY DISTRIBUTION FIRE HYDRANTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire hydrants.

1.2 REFERENCES

A. American Water Works Association:
   1. AWWA C502 - Dry-Barrel Fire Hydrants.
   2. AWWA C503 - Wet-Barrel Fire Hydrants.
   3. AWWA C550 - Protecting Epoxy Interior Coating for Valves and Hydrants.
   4. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

B. National Sanitation Foundation:
   1. NSF 61 - Drinking Water System Components - Health Effects

C. National Fire Protection Association:
   1. NFPA 281 - Recommended Practice for Fire Flow Testing and Marking of Hydrants

1.3 SUBMITTALS

A. None required

1.4 QUALITY ASSURANCE

A. Provide uniform color scheme for fire hydrants in accordance with NFPA 281.

1.5 QUALIFICATIONS

A. Manufacturer: company specializing in manufacturing Products specified in this section with minimum three years' experience.

B. Installer: Company specializing in performing work of this section with minimum three years' experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing and protecting products.

B. Prepare hydrants and accessories for shipment according to AWWA Standards and seal hydrant and ends to prevent entry of foreign matter into product body.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.8 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate work with local standards and utilities within construction area.

PART 2 PRODUCTS

2.1 FIRE HYDRANTS

A. Manufacturers:
1. Mueller Company
2. Clow Eddy - Iowa
3. American Flow Control
4. Or equal.
5. Substitutions: Section 01 60 00 - Product Requirements.

B. Dry-barrel Break-away Type: AWWA C502; cast-iron body, compression type valve.
1. Bury Depth: As indicated on the Drawings.
2. Inlet Connection: 6 inches.
3. Valve Opening: 5-1/4 inches diameter.
4. Ends: Mechanical Joint or Bell End.
5. Bolts and Nuts: Corrosion resistant.
6. Coating: AWWA C550; interior.
7. Direction of Opening: Counterclockwise unless otherwise indicated.

C. Wet-Barrel Type: AWWA C503; cast-iron body.
1. Valve Openings: Individual for pumper and hose nozzles.
2. Ends: Mechanical joint or bell end.
3. Bolts and Nuts: Corrosion resistant.
4. Coating: AWWA C550; interior.

D. One pumper, two hose nozzles.
1. Obtain thread type and size from local fire department.
2. Attach nozzle caps by separate chains.

E. Finish: Primer and two coats of enamel color in accordance with utility company requirements.

2.2 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type specified in Section 03 30 00.

B. Aggregate: Aggregate for hydrant drainage specified in Section 32 11 23.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Determine exact location and size of hydrants from Drawings; obtain clarification and directions from Architect/Engineer prior to execution of work.

C. Verify invert elevations of existing work prior to excavation and installation of fire hydrants.

3.2 PREPARATION

A. Identify required lines, levels, contours and datum locations.

B. Locate, identify, and protect utilities to remain from damage.

C. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.
   1. Notify Owner not less than 7 days in advance of proposed utility interruption.
   2. Do not proceed without written permission from the Architect/Engineer.

D. Perform trench excavation, backfilling and compaction in accordance with Section 31 23 17.

3.3 INSTALLATION

A. Install fire hydrants; provide support blocking and drainage gravel; do not block drain hole.

B. Set hydrants plumb with pumper nozzle facing roadway; set hydrants with centerline of pumper nozzle 18 inches above finished grade and safety flange not more than 6 inches nor less than 2 inches above grade.

C. Paint hydrants in accordance with local color scheme.

D. Install Work in accordance with local standards.

3.4 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform pressure test on domestic site water distribution system in accordance with AWWA C600.

END OF SECTION

SECTION 33 13 00

DISINFECTION OF WATER DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes disinfection of potable water distribution system; and testing and reporting results.

1.2 REFERENCES

A. American Water Works Association:
   1. AWWA C651 - Disinfecting Water Mains.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit procedures, proposed chemicals, and treatment levels for review.

C. Test Reports: Indicate results comparative to specified requirements.

D. Certificate: Certify cleanliness of water distribution system meets or exceeds specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution Requirements: Requirements for submittals.

B. Disinfection Report:
   1. Type and form of disinfectant used.
   2. Date and time of disinfectant injection start and time of completion.
   3. Test locations.
   4. Name of person collecting samples.
   5. Initial and 24 hour disinfectant residuals in treated water in ppm for each outlet tested.
   6. Date and time of flushing start and completion.
   7. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological Report:
   1. Date issued, project name, and testing laboratory name, address, and telephone number.
   2. Time and date of water sample collection.
   3. Name of person collecting samples.
   4. Test locations.
   5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
   6. Coliform bacteria test results for each outlet tested.

7. Certify water conforms, or fails to conform, to bacterial standards of authority having jurisdiction.

D. Water Quality Certificate: Certify water conforms to quality standards of authority having jurisdiction, suitable for human consumption.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C651.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Calcium Hypochlorite shall contain 70% available chlorine by weight. Table or granular forms are acceptable.

B. Sodium Hypochlorite shall be supplied in strengths ranging from a minimum of 5% to a maximum of 16%. Product shall be supplied in manufacturer's containers and shall not have undergone any significant deterioration.

C. Liquid Chlorine shall be used only when suitable equipment is available and only under the supervision of a person familiar with the physiological, chemical, and physical properties of this element.

D. Use of any other agent must be approved by the Owner prior to execution.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify piping system has been cleaned, inspected, and pressure tested.

C. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 PRELIMINARY PROCEDURE

A. After pressure and leakage tests have been completed, all units shall be thoroughly flushed to remove all foreign material. Entrapped air shall be released at high points and the unit shall be completely filled with water to allow the disinfection agent to come in contact with all interior surfaces. In the event that complete venting cannot be accomplished through available outlets, the Contractor shall furnish and install necessary corporation cocks and vent piping, at his own expense.

3.3 CHLORINE PREPARATION

A. Liquid Chlorine - A chlorine gas-water solution shall be applied by means of a solution-feed chlorinating device, or, if approved by the Architect/Engineer, the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the unit being treated. Chlorinating devices for feeding solutions of the chlorine gas shall provide means to prevent the backflow of water into the chlorine cylinder.

B. Calcium Hypochlorite - Granular calcium hypochlorite shall be prepared as a water mixture before introduction into the unit. The dry powder shall first be made into a past and then thinned to approximately a one percent chlorine solution. To prepare a one percent chlorine solution, add one pound of calcium hypochlorite to 7-1/2 gallons of water.

C. Sodium Hypochlorite - Water solution shall be prepared by adding hypochlorite to water.

3.4 CHLORINE APPLICATION

A. Point of Application - Chlorinating agent shall be applied at the supply end of the unit being disinfected. For pipes, disinfectant shall be applied through a corporation cock installed in the top of the pipe.

B. Rate of Application - Water shall be introduced at a controlled rate in order to regulate the chlorine dosage. The rate of chlorine mixture flow shall be proportioned to the rate of water entering the unit so the chlorine dose applied shall produce at least 50-mg/l chlorine residual after a period of 24 hours. The Consultant shall approve the method of determining the rate of flow of water into the unit being disinfected.

C. Isolating Systems - Valves shall be manipulated to keep the strong chlorine solution and/or contaminated water from flowing into units that have been previously chlorinated and/or flushed.

D. Quality - The chlorinated water shall be retained in the unit long enough to destroy all nonspore-forming bacteria. The minimum retention period shall be 24 hours with chlorine residual at the end of this period of not less than 50 mg/l (ppm).

E. Disinfecting Valves - All valves and appurtenances shall be operated while the line or unit is being disinfected to insure that all surfaces of the valves are disinfected.

F. Swabbing - Disinfection of pipe, fittings or valves that must be placed in service immediately shall be accomplished by thoroughly flushing and swabbing with a 5 percent solution of calcium hypochlorite immediately prior to assembly. Approval must be secured from the Designer before this method of disinfection will be accepted.

G. Final Flushing and Test - Following chlorination, the unit shall be flushed with potable water until the replacement water in the system is proven to be comparable in quality to the water which will enter that unit or system. This acceptable condition of water delivered by each unit or system shall continue for at least two days, as

demonstrated by laboratory bacteriological examination of samples. Laboratory tests shall also show chlorine residual after final flushing of less than one mg/l (ppm).

H. Repetition of Flushing and Testing - If the initial treatment results in an unsatisfactory bacteria test, disinfection shall be repeated by the Contractor at no additional cost until satisfactory bacteriological test results are obtained.

END OF SECTION

SECTION 23 64 23.13

AIR-COOLED, SCROLL WATER CHILLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes packaged, air-cooled, electric-motor-driven, scroll water chillers.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product.

a. Include refrigerant, rated capacities, operating characteristics, and furnished specialties and accessories.
b. Performance at AHRI standard conditions and at conditions indicated.
c. Performance at AHRI standard unloading conditions.
d. Minimum evaporator flow rate.
e. Refrigerant capacity of water chiller.
f. Oil capacity of water chiller.
g. Fluid capacity of evaporator.
h. Characteristics of safety relief valves.
i. Force and moment capacity of each piping connection.
j. Minimum entering condenser-water temperature.
k. Performance at varying capacity with constant design condenser-water temperature. Repeat performance at varying capacity for different condenser-water temperatures from design to minimum in 5 deg F increments.

2. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:

a. Assembled unit dimensions.
b. Weight and load distribution.
c. Required clearances for maintenance and operation.
d. Size and location of piping and wiring connections.
e. Diagrams for power, signal, and control wiring.

B. Informational Submittals:

1. Certificates: For certification required in "Quality Assurance" Article.
2. Seismic Qualification Data: Certificates, for water chillers, accessories, and components, from manufacturers.

a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

3. Installation instructions.
4. Source quality-control reports.
5. Startup service reports.
6. Sample Warranty: For special warranty.

C. Closeout Submittals:

1. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.
2. Spare Parts List: Recommended spare parts list with quantity for each.
3. Touchup Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.
4. Instructional Videos: Including those that are prerecorded and those that are recorded during training.

1.3 EXTRA MATERIALS

A. Tool kit to include the following:

1. A tool kit specially designed by chiller manufacturer for use in servicing chiller(s) furnished.
2. Special tools required to service chiller components not readily available to Owner service personnel in performing routine maintenance.
3. Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Chiller Tool Kit." Text size shall be at least 1 inch high.
4. A list of each tool furnished. Permanently attach the list to underside of case cover. Text size shall be at least 1/2 inch high.

B. Touchup Paint: 32 oz. container of paint used for finish coat. Label outside of container with detailed description of paint to allow for procurement of a matching paint in the future.

1.4 QUALITY ASSURANCE

A. AHRI Certification: Rate and certify chiller according to AHRI 550/590 certification program.

B. ASHRAE Compliance:

1. ASHRAE 15.
2. ASHRAE 90.1.
3. ASHRAE 147.

C. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, as applicable to chiller design. For chillers charged with R-134a refrigerant, include and ASME U-stamp and nameplate certifying compliance.

D. Comply with NFPA 70.

E. Comply with UL 465 at the specified short circuit rating.

F. Comply with requirements of UL 1995, "Heating and Cooling Equipment," and include label by a qualified testing agency showing compliance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant and oil.

B. Deliver chiller with protective crating or other covering.

1.6 WARRANTY

1. Extended warranties include, but are not limited to, the following:

   a. Complete chiller including refrigerant and oil charge.
   b. Parts and labor.

2. Warranty Period: Five (5) years from the date of substantial completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Outdoor Installations:

1. Chiller shall be suitable for outdoor installation indicated. Provide adequate weather protection to ensure reliable service life over a 25-year period with minimal degradation due to exposure to outdoor ambient conditions.
2. Chillers equipped to provide safe and stable operation while achieving performance indicated when operating at extreme outdoor temperatures encountered by the installation. Review historical weather database and provide equipment that can operate at extreme outdoor temperatures recorded over past 30-year period.

2.2 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Carrier.

2. Daikin Applied.
3. MultiStack.
4. Quantech.
5. Trane.
6. York; a Johnson Controls company.

2.3 MANUFACTURED UNITS

A. Description: Factory-assembled and run-tested water chiller complete with compressor(s), compressor motors and motor controllers, evaporator, condenser with fans, electrical power, controls, and indicated accessories.

B. Fabricate water chiller mounting base with reinforcement strong enough to resist water chiller movement during a seismic event when water chiller is anchored to field support structure.

C. Fabricate water chiller mounting base with reinforcement strong enough to resist water chiller movement during a seismic event when water chiller is anchored to field support structure.

2.4 CABINET

A. Base: Galvanized- or stainless-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.

B. Frame: Rigid galvanized- or stainless-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.

C. Casing: Galvanized- or stainless-steel.

D. Finish: Coat galvanized-steel base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B 117.

2.5 COMPRESSOR-DRIVE ASSEMBLIES

A. Compressors:

1. Description: Positive-displacement direct drive with hermetically sealed casing.
2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in lieu of each compressor.
3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
4. Capacity Control: On-off compressor cycling with hot-gas bypass, if necessary, to achieve performance indicated. Digital compressor unloading is an acceptable alternative to achieve capacity control.
5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug or removable magnet in sump, and initial oil charge. Manufacturer's other standard methods of providing positive lubrication are acceptable in lieu of an automatic pump.

6. Vibration Isolation: Mount individual compressors on vibration isolators. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in lieu of each compressor.

B. Compressor Motors:

1. Hermetically sealed and cooled by refrigerant suction gas.
2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

C. Compressor Motor Controllers:

1. Across the Line: NEMA ICS 2, Class A, full voltage, non-reversing.

2.6 REFRIGERATION

A. Refrigerant: R-410A. Classified as Safety Group A1 according to ASHRAE 34.

B. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.

C. Refrigerant Circuit: Each circuit shall include an electronic-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.

D. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

1. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in each circuit in lieu of each compressor.

E. Pressure Relief Device:

1. Comply with requirements in ASHRAE 15, ASHRAE 147, and applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Select and configure pressure relief devices to protect against corrosion and inadvertent release of refrigerant.
3. ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger.

2.7 EVAPORATOR

A. Brazed-plate or shell-and-tube design, as indicated.

B. Shell and Tube:

1. Description: Direct-expansion, shell-and-tube design with fluid flowing through the shell and refrigerant flowing through the tubes within the shell.

2. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
3. Shell Material: Carbon steel.
4. Shell Heads: Removable carbon-steel heads with multi-pass baffles designed to ensure positive oil return and located at each end of the tube bundle.
5. Shell Nozzles: Fluid nozzles located along the side of the shell and terminated with mechanical-coupling end connections for connection to field piping. Furnish flange adapters to mate to flanged piping.
6. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.

C. Brazed Plate:

1. Direct-expansion, single-pass, brazed-plate design.
2. Type 304 or 316 stainless-steel construction.
3. Code Compliance: Tested according to ASME Boiler and Pressure Vessel Code.
4. Fluid Nozzles: Terminate with flange or mechanical-coupling end connections for connection to field piping.
5. Inlet Strainer: Factory-furnished, 40 mesh strainer for field installation in supply piping to evaporator. Manufacturer has option to factory install strainer.

D. Flow Switch: Factory-furnished, thermal-type flow switch wired to chiller operating controls.

E. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F.

F. Remote-Mounting Kit: Designed for remote field mounting where indicated. Provide kit for field installation.

2.8 AIR-COOLED CONDENSER

A. Coils with integral subcooling on each circuit.

B. Plate Fin Coils: Construct coils of copper tubes mechanically bonded to aluminum fins.

C. Aluminum Microchannel Coils:

1. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
2. Single- or multiple-pass arrangement.
3. Construct fins, tubes, and header manifolds of aluminum alloy treated with a corrosion-resistant coating.

D. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

E. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.

F. Fan Motors: Totally enclosed non-ventilated or totally enclosed air over enclosure, with sealed and permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.

1. Overcurrent- and thermal-overload protection not integral to motor is acceptable if provided with chiller electrical power package.

G. Fan Guards: Removable steel safety guards with corrosion-resistant coating.

2.9 INSULATION

A. Closed-cell, flexible, elastomeric thermal insulation complying with ASTM C 534/C 534M, Type I for tubular materials and Type II for sheet materials.

1. Thickness: 3/4 inches.

B. Adhesive: As recommended by insulation manufacturer.

C. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.

1. Apply adhesive to 100 percent of insulation contact surface.
2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
3. Seal seams and joints to provide a vapor barrier.
4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.
5. Manufacturer has option to factory or field insulate chiller components to reduce potential for damage during installation.
6. Field-Applied Insulation:

    a. Components that are not factory insulated shall be field insulated to comply with requirements indicated.
    b. Manufacturer shall be responsible for chiller insulation whether factory or field installed to ensure that manufacturer is the single point of responsibility for chillers.
    c. Manufacturer's factory-authorized service representative shall instruct and supervise installation of field-applied insulation.
    d. After field-applied insulation is complete, paint insulation to match factory-applied finish.

2.10 ELECTRICAL

A. Factory installed and wired, and functionally tested at factory before shipment.

B. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.

C. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key.

D. Wiring shall be numbered and color-coded to match wiring diagram.

E. Factory wiring outside of an enclosure shall be in raceway. Terminal connections shall be made with not more than a 24-inch length of liquid-tight or flexible metallic conduit.

F. Single-Point Circuit Breaker – A unit mounted circuit breaker with external, lockable handle (in compliance with NEC Article 440-14), can be supplied to isolate the power voltage for servicing. This option includes the Single-Point Power connection. Minimum short-circuit current rating (SCCR) according to UL 508 shall be as required by electrical power distribution system, but not less than 65,000 A.

G. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:

1. NEMA KS 1, heavy-duty, non-fusible switch.

H. Each motor shall have overcurrent protection.

I. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.

J. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.

K. Controls Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

L. Control Relays: Auxiliary and adjustable time-delay relays, or an integral to water chiller microprocessor.

2.11 CONTROLS

A. Factory installed and wired, and functionally tested at factory before shipment.

B. The chiller shall be equipped with a micro-processor based controller. The chiller shall have the capability to operate in response to either heating water or cooling water set points. The selection of these two modes of operation shall be made by the chiller's Master Controller or, alternatively, this mode may be set manually, or through a binary input to the controller. The Chiller shall operate based on constant primary flow via the manufacturer provided, field installed and wired, pumps for the chiller's condenser and evaporator flow.

C. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.

D. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, digital display. Display the following:

1. Date and time.
2. Operating or alarm status.

3. Operating hours.
4. Outside-air temperature if required for chilled-water reset.
5. Temperature and pressure of operating set points.
6. Chilled-water entering and leaving temperatures.
7. Heating Hot-water entering and leaving temperatures.
8. Refrigerant pressures in evaporator and condenser.
9. Saturation temperature in evaporator and condenser.
10. No cooling load condition.
11. Elapsed time meter (compressor run status).
12. Antirecycling timer status.
13. Percent of maximum motor amperage.
14. Current-limit set point.
15. Number of compressor starts.
16. Alarm history with retention of operational data before unit shutdown.
17. Superheat.

E. Control Functions:

1. Manual or automatic startup and shutdown time schedule.
2. Capacity control based on evaporator leaving-fluid temperature.
3. Capacity control compensated by rate of change of evaporator entering-fluid temperature.
4. Chilled-water entering and leaving temperatures, control set points, and motor load limit.
5. Heating Hot-water entering and leaving temperatures, control set points, and motor load limit.
6. Current limit and demand limit.
7. Condenser-water temperature.
8. External water chiller emergency stop.
9. Antirecycling timer.
10. Automatic lead-lag switching.

F. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:

1. Low evaporator pressure or high condenser pressure.
2. Low chilled-water temperature.
3. Refrigerant high pressure.
4. High or low oil pressure.
5. High oil temperature.
6. Loss of chilled-water flow.
7. Loss of heating hot-water flow.
8. Control device failure.

G. BAS/DDC System Interface: Factory-install hardware and software to enable system to monitor, control, and display chiller status and alarms.

1. Communication Interface: ASHRAE 135 (BACnet) communication interface shall enable control system operator to remotely control and monitor the water chiller from an operator workstation. Control features and monitoring points displayed locally at water chiller control panel shall be available through DDC system for HVAC.

H. Factory-installed wiring outside of enclosures shall be in NFPA 70-compliant raceway. Make terminal connections with liquid-tight or flexible metallic conduit.

2.12 ACCESSORIES

A. Factory-furnished vibration isolators with seismic restraints for field installation.

2.13 SOURCE QUALITY CONTROL

A. Perform functional test of water chillers before shipping.

B. Factory performance test water chillers before shipping.

C. Factory test and inspect evaporator according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.

D. Rate sound power level according to AHRI 370 procedure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine chillers before installation. Reject chillers that are damaged.

B. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.

1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

A. Coordinate sizes and locations of bases with actual equipment provided. Cast anchor-bolt inserts into concrete bases.

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures with actual equipment provided.

C. Install water chillers on support structure indicated.

D. Equipment Mounting:

1. Install water chillers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 03.

2. Comply with requirements for vibration isolation and seismic-control devices specified in Division 23.

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Maintain clearances required by governing code.

G. Chiller manufacturer's factory-trained service personnel shall charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

H. Install separate devices furnished by manufacturer and not factory installed.

1. Chillers shipped in multiple major assemblies shall be field assembled under the direct supervision of chiller manufacturer's factory-trained service personnel.

3.3 WATER TREATMENT REQUIREMENTS

A. Cycles of concentration shall be controlled such that recirculated water quality for modular Air- Chillers using 316 stainless steel brazed plate heat exchangers and carbon steel headers is maintained within the following parameters:

1.	pH	Greater than 7 and less than 9
2.	Total Dissolved Solids (TDS)	Less than 1000 ppm
3.	Hardness as $CaCO_3$	30 to 500 ppm
4.	Alkalinity as Ca CO_3	30 to 500 ppm
5.	Chlorides	Less than 200 ppm
6.	Sulfates	Less than 200 ppm

3.4 PIPING CONNECTIONS

A. Comply with requirements in Division 23 “Hydronic Piping”. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to chillers, allow space for service and maintenance.

C. Make connections to water chiller with flanges or mechanical couplings.

3.5 ELECTRICAL POWER CONNECTIONS

A. Connect wiring according to Division 26 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems."

C. Provide nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch high. Locate nameplate where easily visible.

3.6 CONTROLS CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between chillers and other equipment to interlock operation as required to provide a complete and functioning system.

C. Connect control wiring between chiller control interface and DDC system for remote monitoring and control of chillers. Comply with requirements in Division 23 "Direct Digital Control (DDC) System for HVAC."

D. Provide nameplate on face of chiller control panel indicating control equipment designation serving chiller and the I/O point designation for each control connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch high.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Visually inspect chiller for damage before starting. Repair or replace damaged components, including insulation. Do not start chiller until damage that is detrimental to operation has been corrected.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

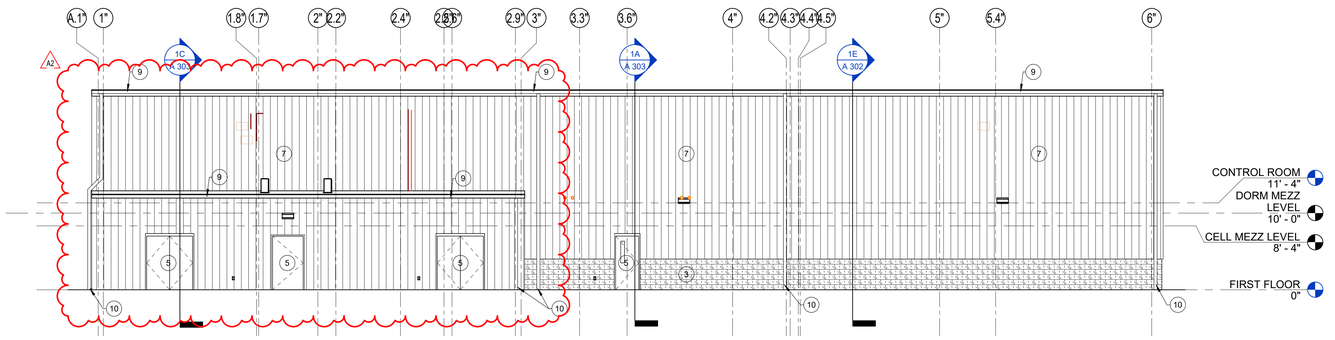
1. Verify that refrigerant charge is sufficient and water chiller has been leak-tested.
2. Verify that pumps are installed and functional.
3. Verify that thermometers and gages are installed.
4. Operate water chiller for run-in period.
5. Check bearing lubrication and oil levels.
6. Verify that refrigerant pressure relief device is properly vented outside.
7. Verify proper motor rotation.
8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
9. Verify and record performance of chilled-water flow and low-temperature interlocks.
10. Verify and record performance of water chiller protection devices.
11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Prepare a written startup report that records results of tests and inspections.

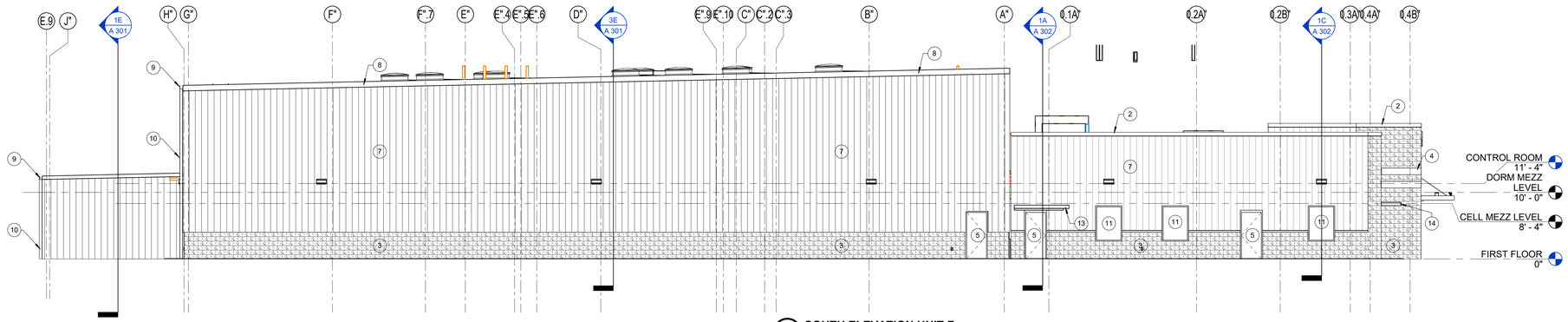
3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers. Video record the training sessions and provide electronic copy to Owner. Provide not less than eight hours of training.

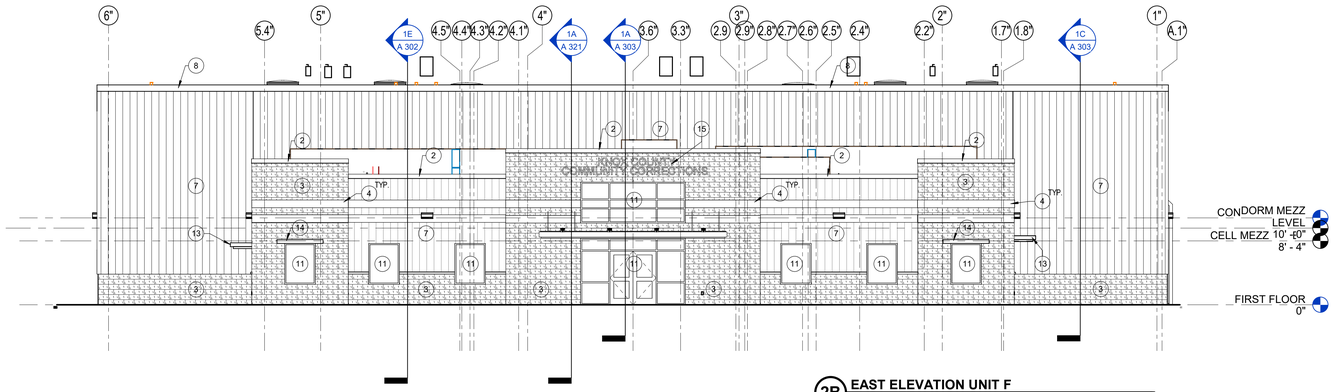
END OF SECTION 23 64 23.13



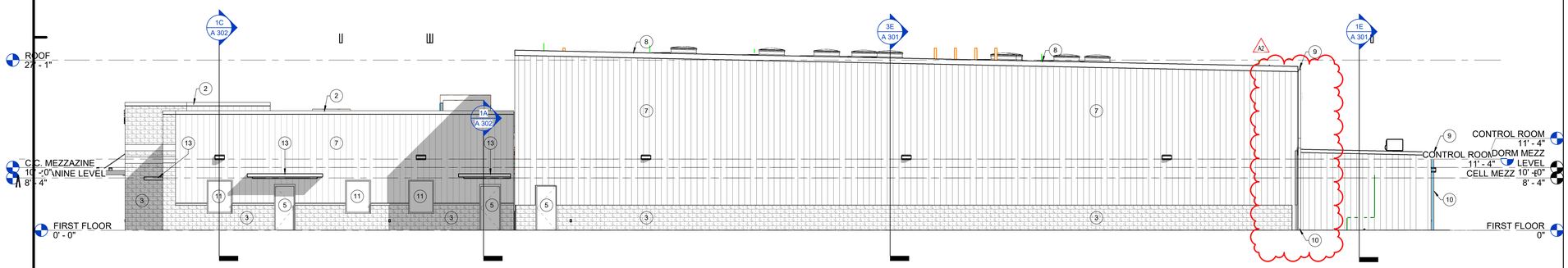
2E **WEST ELEVATION UNIT F**
1/8" = 1'-0"



2D **SOUTH ELEVATION UNIT F**
1/8" = 1'-0"



2B **EAST ELEVATION UNIT F**
1/8" = 1'-0"



2A **NORTH ELEVATION UNIT F**
1/8" = 1'-0"

5.4.200 - ELEVATION NOTES

Key	Note
1	OVERHEAD COILING DOOR, FINISH AS SELECTED BY ARCHITECT
2	07 71 00 - MANUFACTURED METAL COPING
3	04 20 00 - SPLIT FACE CMU, FINISH AS SELECTED BY ARCHITECT. PROVIDE CONTROL JOINT AT 2'-8" OF EACH CORNER AND 20'-0" O.C.
4	SMOOTH FACE CMU VENEER INTEGRAL COLOR
5	08 11 13 - HOLLOW METAL DOOR AND FRAME. SEE DOOR SCHEDULE
6	SECURITY HOLLOW METAL DOOR AND FRAME. SEE DOOR SCHEDULE
7	13 34 49 - PREENGINEERED METAL BUILDING, PREFINISHED METAL PANEL, FINISH TYPE - A
8	13 34 49 - PREENGINEERED METAL BUILDING TYPICAL ROOF EDGE RAKE DETAIL
9	13 34 49 - PREENGINEERED METAL BUILDING TYPICAL GUTTER
10	13 34 49 - PREENGINEERED METAL BUILDING TYPICAL DOWNSPOUT
11	08 41 13 - PREFINISHED ALUMINUM STOREFRONT SYSTEM
12	EXISTING BUILDING TO REMAIN, PROTECT DURING CONSTRUCTION. ANY DAMAGED CAUSED DURING CONSTRUCTION IS TO BE REPAIRED AT CONTRACTORS EXPENSE
13	MANUFACTURED METAL CANOPY MAPES STYLE OR EQUAL
14	ENGINEERED METAL CANOPY LOUVER SUN SHADES
15	MANUACTURED DIMENSIONAL CAST ALUMINUM LETTERS
16	WALL TO WALL EXTERIOR EXPANSION JOINT COVER, PROVIDE AIR/WEATHER BARRIER AND STUFF CAVITY WITH BATT INSULATION RATED

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

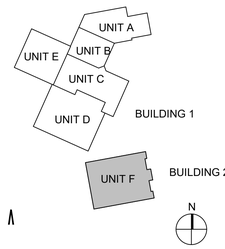
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
2	Addendum #2	02.21.2022

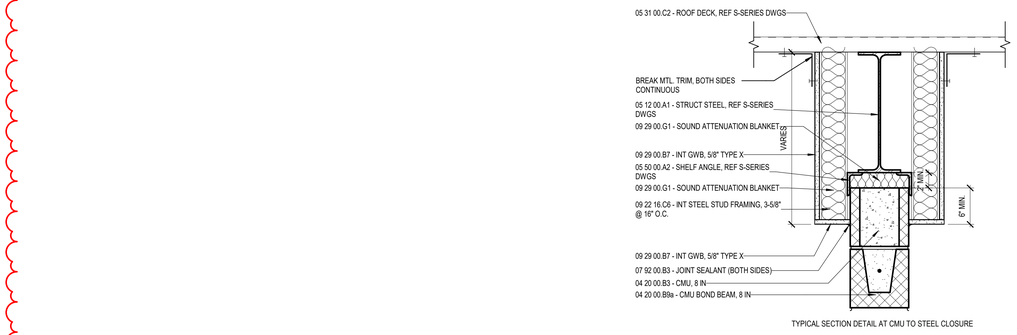
Project #: 20-700-151-2
Designed By: LD
Drawn By: WD
Checked By: LD/EV
Date: 02.21.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT

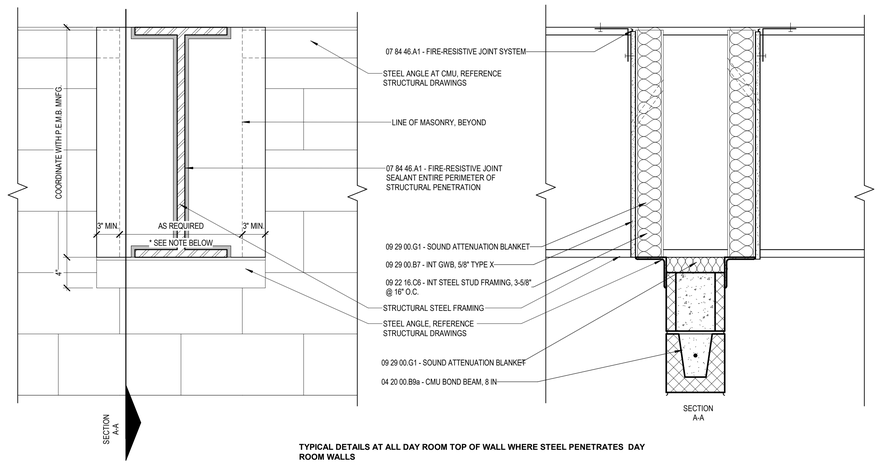


BUILDING ELEVATIONS

A 212



TYPICAL SECTION DETAIL AT CMU TO STEEL CLOSURE

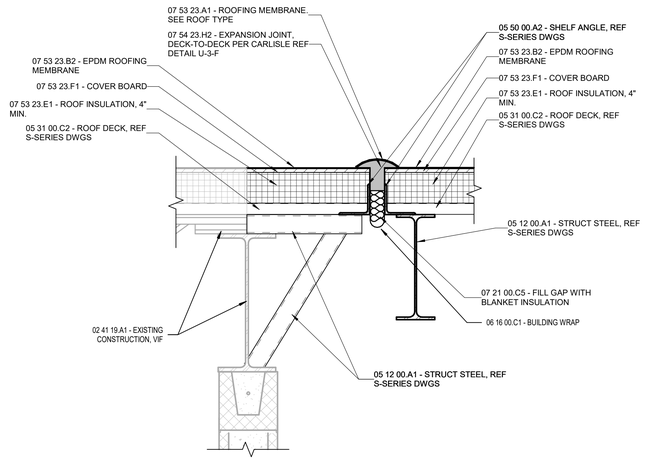


TYPICAL DETAILS AT ALL DAY ROOM TOP OF WALL WHERE STEEL PENETRATES DAY ROOM WALLS

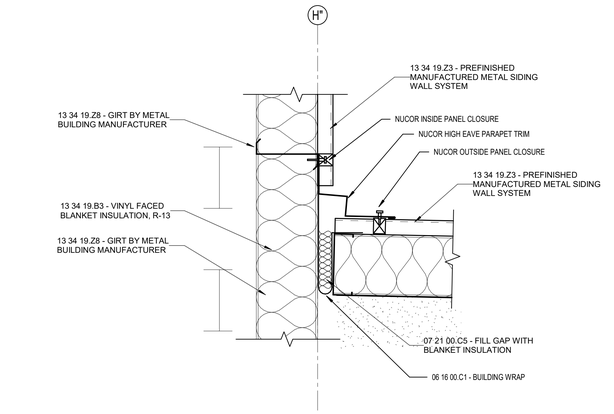
*** NOTE:**
TYPICAL MASONRY OPENINGS IN MASONRY SHALL BE AS REQUIRED FOR STEEL PENETRATION (VERIFY IN FIELD JOIST PENETRATION QUANTITIES).

DETAILS ARE FOR TOP OF WALL CONDITIONS IN ALL DAYROOMS. VERIFY IN FIELD CONDITION FOR APPLICABLE DETAIL

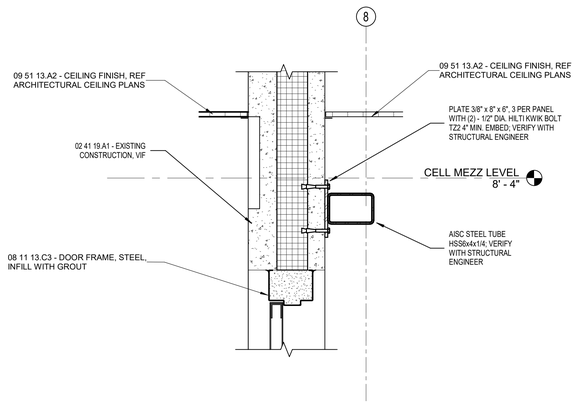
5D TOP OF WALL DETAIL BETWEEN DAYROOMS
1 1/2" = 1'-0"



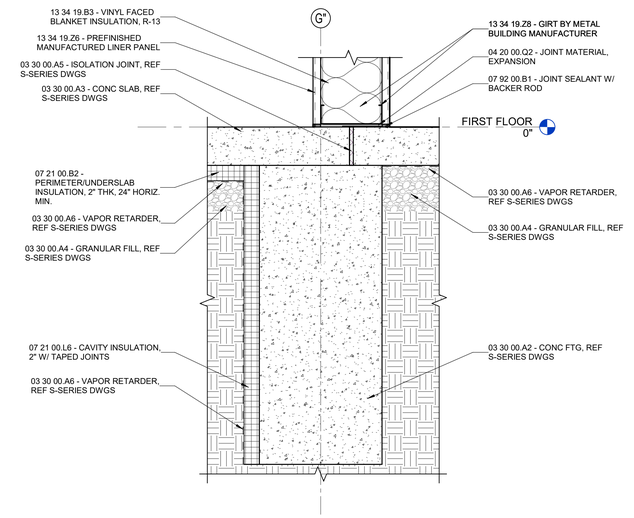
1E BOOK-IN CENTER WALL SECTION DETAIL
1 1/2" = 1'-0"



1D WALL SECTION DETAIL 15.1.2
1 1/2" = 1'-0"



3A WALL SECTION DETAIL 8.2.1
1 1/2" = 1'-0"



1A WALL SECTION DETAIL 15.1.1
1 1/2" = 1'-0"

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

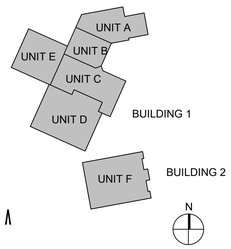
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
2	Addendum #2	02.21.2022

Project #: 20-700-151-2
Designed By: Designer
Drawn By: Author
Checked By: Checker
Date: 02.21.2022

ERIC S. WEFLEN REGISTERED No. AR11500138 STATE OF INDIANA ARCHITECT



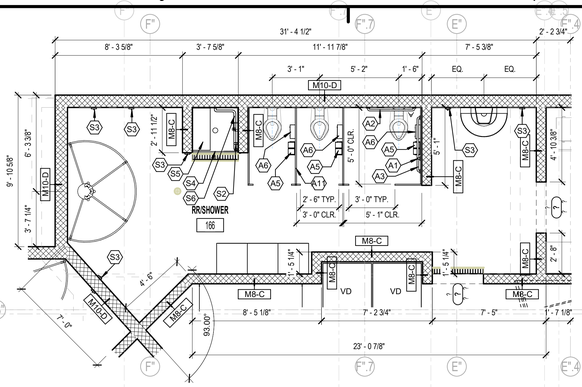
WALL SECTION DETAILS

A 335

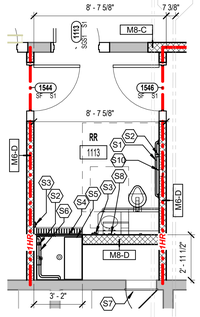
5.4.401 - RESTROOM ACCESSORY SCHEDULE

Type Mark	Keynote	Description	Mounting	Furnished By	Installed By
A1	10 28 00	GRAB BAR - 18" VERTICAL	BOTTOM @ 40" AFF	CONTRACTOR	CONTRACTOR
A2	10 28 00	GRAB BAR - 36" HORIZONTAL	TOP @ 2'-11" AFF	CONTRACTOR	CONTRACTOR
A3	10 28 00	GRAB BAR - 42" HORIZONTAL	TOP @ 2'-11" AFF	CONTRACTOR	CONTRACTOR
A4	10 28 00	MIRROR - 24" X 36"	BOTTOM @ 4" ABOVE FIXTURE	CONTRACTOR	CONTRACTOR
A5	10 28 00	TOILET TISSUE DISPENSER - DOUBLE	BOTTOM @ 1'-6 AFF	CONTRACTOR	CONTRACTOR
A6	10 28 00	SANITARY NAPKIN DISPOSAL - SURFACE	TOP @ 30" AFF	CONTRACTOR	CONTRACTOR
A7	10 28 00	SOAP DISPENSER	BOTTOM @ 4" ABOVE FIXTURE	CONTRACTOR	CONTRACTOR
A8	10 28 00	SANITARY NAPKIN DISPOSAL - SURFACE	TOP @ 30" AFF	CONTRACTOR	CONTRACTOR
A9	08 31 13	ACCESS DOOR - 16" X 16"	BOTTOM @ 40" AFF	CONTRACTOR	CONTRACTOR
A10	10 28 00	HAND DRYER - SLIM	BOTTOM @ 42" AFF	CONTRACTOR	CONTRACTOR
A11	10 21 13	TOILET PARTITION	BOTTOM @ 12" AFF	CONTRACTOR	CONTRACTOR
S1	11 19 10	SECURITY GRAB BAR - 42" HORIZONTAL, LIGATURE PROOF	TOP @ 2'-11" AFF	CONTRACTOR	CONTRACTOR
S2	11 19 10	ADA SECURITY GRAB BAR - 18" VERTICAL, LIGATURE PROOF	BOTTOM @ 40" AFF	CONTRACTOR	CONTRACTOR
S3	11 19 10	SECURITY ROBE HOOKS WITH SUICIDE PREVENTION, LIGATURE PROOF	CENTER @ 4'-6" AFF	CONTRACTOR	CONTRACTOR
S4	11 19 10	SECURITY SHOWER CURTAIN ROD	MOUNTED TO SOFFIT OF SHOWER UNIT	CONTRACTOR	CONTRACTOR
S5	11 19 10	ADA LOOSE FURNITURE SHOWER SEAT, BY OWNER	TOP @ 1'-6" AFF	OWNER	OWNER
S6	11 19 10	ADA SECURITY SHOWER GRAB BAR - 48" HORIZONTAL	TOP @ 2'-11" AFF	CONTRACTOR	CONTRACTOR
S7	11 19 10	SECURITY ACCESS DOOR - 24" X 32"	BOTTOM @ 40" AFF	CONTRACTOR	CONTRACTOR
S8	11 19 10	ADA DOUBLE SECURITY MIRROR, STAINLESS STEEL		CONTRACTOR	CONTRACTOR
S9	11 19 10	SECURITY MIRROR, STAINLESS STEEL		CONTRACTOR	CONTRACTOR
S10	11 19 10	SECURITY TYPE FULLY RECESSED TOILET PAPER HOLDER		CONTRACTOR	CONTRACTOR

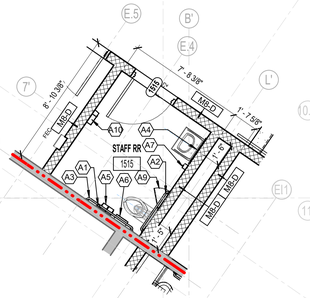
NOTE: PROVIDE A 1/4" STAINLESS STEEL FINISH PANEL ABOVE ALL SECURITY SHOWERS, SPANING VERTICALLY FROM SHOWER TO DECK/STRUCTURE ABOVE, AND HORIZONTALLY FROM STAINLESS STEEL PARTITION TO ADJACENT WALL, SEE TYPICAL DETAILS ON 9A/A-311. COORDINATE WITH MECHANICAL DRAWINGS FOR PERFERATION LOCATIONS.



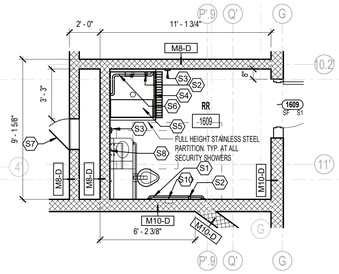
5E UNIT F - ENLARGED PLAN RESTROOM/SHOWER 166
1/4" = 1'-0"



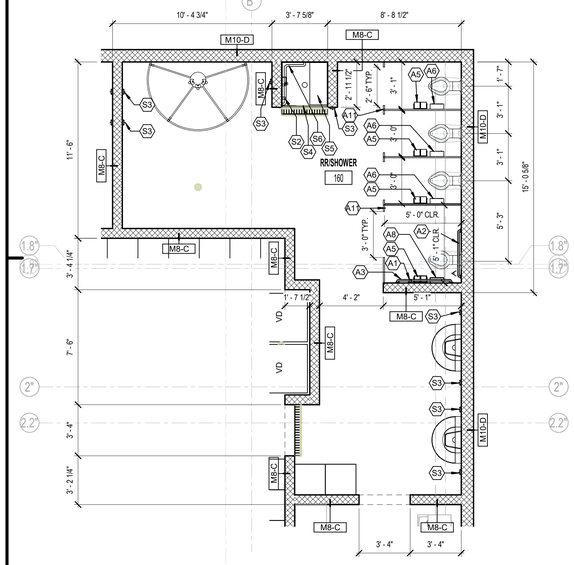
3D UNIT B - ENLARGED PLAN RESTROOM 1113
1/4" = 1'-0"



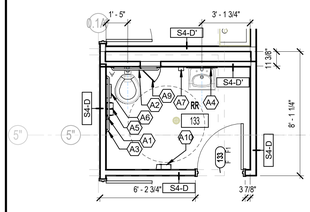
2D UNIT A - ENLARGED PLAN STAFF RESTROOM 1515
1/4" = 1'-0"



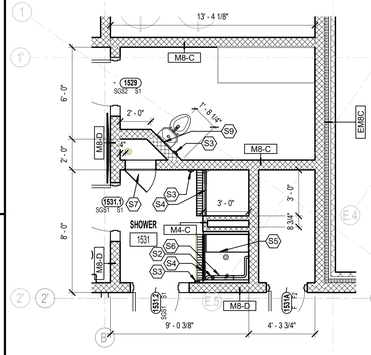
1D UNIT D - ENLARGED PLAN RESTROOM 1609
1/4" = 1'-0"



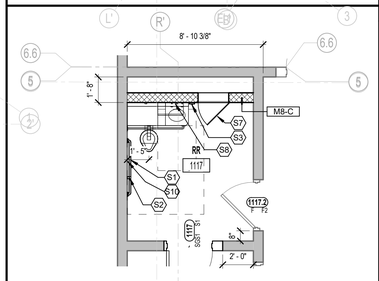
6C UNIT F - ENLARGED PLAN RESTROOM/SHOWER 160
1/4" = 1'-0"



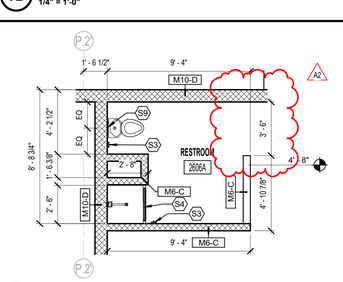
4D UNIT F - ENLARGED PLAN RESTROOM 133
1/4" = 1'-0"



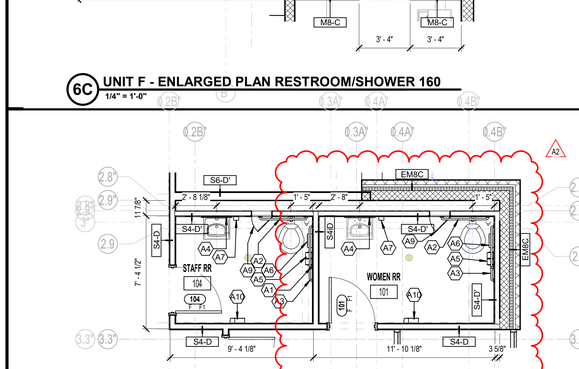
3C UNIT A - ENLARGED PLAN SHOWER 1531
1/4" = 1'-0"



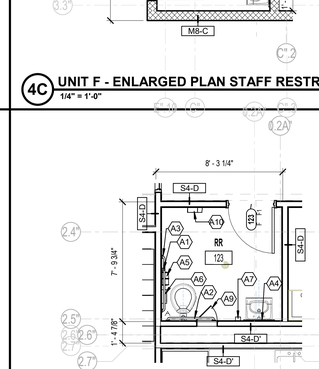
2C UNIT B - ENLARGED PLAN RESTROOM 1117
1/4" = 1'-0"



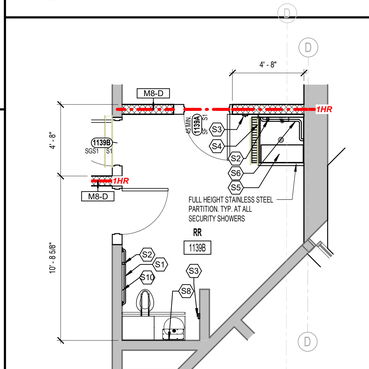
1C UNIT D - ENLARGED PLAN RESTROOM 2606A
1/4" = 1'-0"



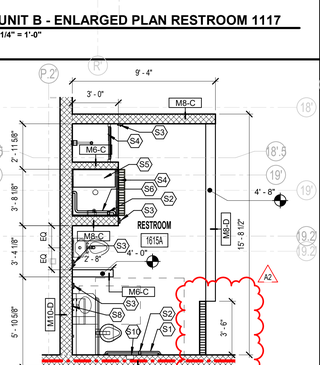
6B UNIT F - ENLARGED PLAN WOMEN RESTROOM 101 & STAFF RESTROOM 104
1/4" = 1'-0"



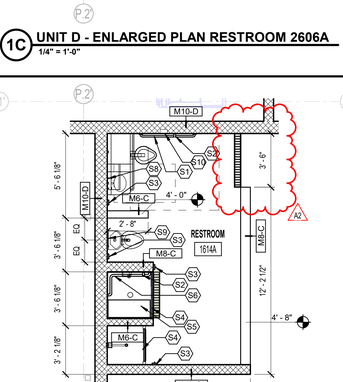
4B UNIT F - ENLARGED PLAN RESTROOM 123
1/4" = 1'-0"



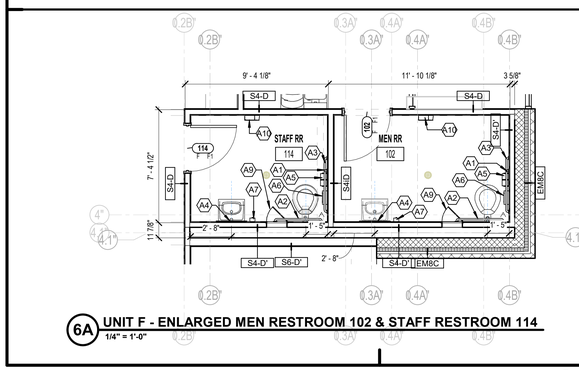
3B UNIT B - ENLARGED PLAN RESTROOM 1139B
1/4" = 1'-0"



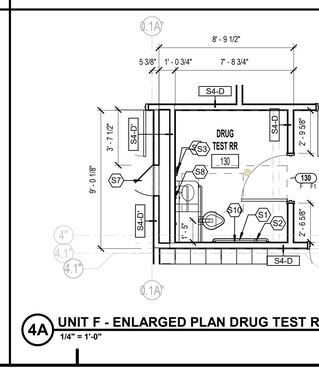
2B UNIT D - ENLARGED PLAN RESTROOM 1615A
1/4" = 1'-0"



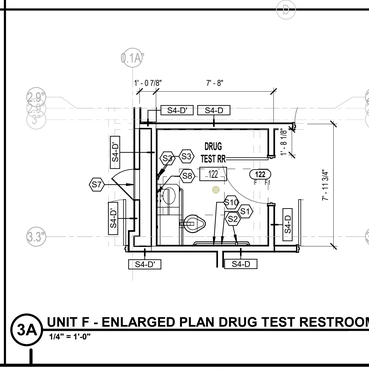
1B UNIT D - ENLARGED PLAN RESTROOM 1314A
1/4" = 1'-0"



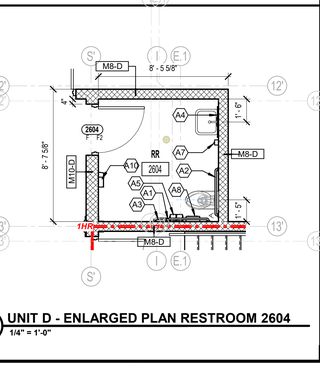
6A UNIT F - ENLARGED MEN RESTROOM 102 & STAFF RESTROOM 114
1/4" = 1'-0"



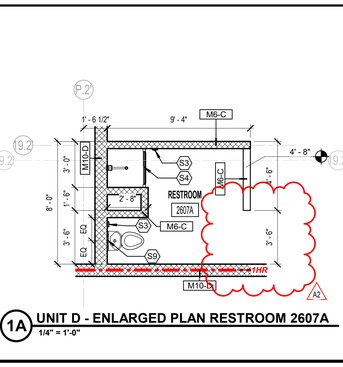
4A UNIT F - ENLARGED PLAN DRUG TEST RESTROOM 130
1/4" = 1'-0"



3A UNIT F - ENLARGED PLAN DRUG TEST RESTROOM 122
1/4" = 1'-0"



2A UNIT D - ENLARGED PLAN RESTROOM 2604
1/4" = 1'-0"



1A UNIT D - ENLARGED PLAN RESTROOM 2607A
1/4" = 1'-0"

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
2	Addendum #2	02.21.2022

Project #: 20-700-151-2

Designed By: LD/SP

Drawn By: CW

Checked By: LD/EV

Date: 02.21.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT

UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
BUILDING 1
UNIT F
BUILDING 2
N

ENLARGED BATHROOM PLANS

A 406

2D FIRST FLOOR CEILING PLAN UNIT D
1/8" = 1'-0"

REFL. CEILING PLAN NOTES

1. All grids are centered in rooms, unless noted otherwise.
2. Coordinate bulkhead sizes w/ mechanical ductwork.
3. Refer to MEP drawings for ceiling fixtures/equipment and coordinate w/ all trades.
4. All exposed ductwork, piping etc. shall be painted. Color selected by Architect.
5. Locate sprinkler heads in center of ceiling panel - where applicable.
6. All ceilings are at 9'-0" AFF, unless noted otherwise.
7. All bulkheads are at 8'-10" AFF, unless noted otherwise.
8. All new ceiling system shall be APC-1 unless noted otherwise.
9. All room that have moisture to have moisture resistant drywall.
10. All detention area acoustical ceilings shall have retention clips unless noted otherwise.

A1

5.4.120 - CEILING PLAN NOTES

Key	Note
1	OPEN TO STRUCTURE
2	RETENTION CLIPS, 2 PER EACH CEILING TILE.
3	EXISTING CEILING TO REMAIN
4	SKYLIGHT WITH SECURITY BARS, DUCTED SHAFT (INTERIOR TO BE PAINTED). POLYCARBONATE LENS AT CEILING LEVEL. SEE ROOF PLAN FOR SKYLIGHT SIZE. FINAL SKYLIGHT LOCATION TO ADJUST AS REQUIRED TO COORDINATE WITH STRUCTURAL AND MEP SYSTEMS
6	18 IN CEILING MOUNTED DOMED MIRROR
7	PROVIDE A 5-1/4" SLAB ON TOP OF CELLULAR METAL DECK TO ACHIEVE 1-HR RATED LID ASSEMBLY.
8	OVERHEAD COILING DOOR ASSEMBLY WITH ELECTRICALLY MOTORIZED OPERATOR.
9	CEILING MOUNTED 42" MONITORS. FINAL INSTALLATION TO BE COORDINATED WITH CONTROL STATION INSTALLATION.

REFLECTED CEILING PLAN LEGEND

APC-1	2' X 2' Acoustical Panel Ceiling (09 51 13)	Light Fixture (Reference E-Series Dwgs)	
		Emergency Light Fixture (Reference E-Series Dwgs)	
APC-2	2' X 2' Washable Acoustical Panel Ceiling (09 51 13)	Return Air (Reference M-Series Dwgs)	
APC-3	2' x 2' High Humidity Ceiling Panel with Aluminum Grid	Supply Air (Reference M-Series Dwgs)	
APC-4	2' x 2' Special NRC (0.7 min.) Ceiling Panel with Aluminum Grid	Exit Light (Reference E-Series Dwgs)	
SCL1	2' X 2' Security metal lay-in with hold down clips	Recessed Light Fixture Suspended Fixture in Areas with Exposed Ceilings (Reference E-Series Dwgs)	
SCL2	Cellular Metal Deck, see Structural	SOUND SYSTEM SPEAKER (REFERENCE E-SERIES/T-SERIES DWGS)	S
SCL3	Concrete Slab on Cellular Metal Deck, total depth of 5-1/4" Cap to achieve 1-HR rating, see Structural	Walls to Deck	
GWB	Gypsum Wall Board, 5/8" on 3 5/8" Metal Stud (09 29 00)	PLASTER Plaster on metal wire mesh lathe on 3-5/8" metal stud	
GWB-2	5/8" High-Impact drywall on metal wire mesh lathe on 3-5/8" metal stud	MTL 1/4" Steel Plate on engineered framing	

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
2	Addendum #2	02.21.2022

Project #: 20-700-151-2

Designed By: LD/SP

Drawn By: CW

Checked By: LD/EV

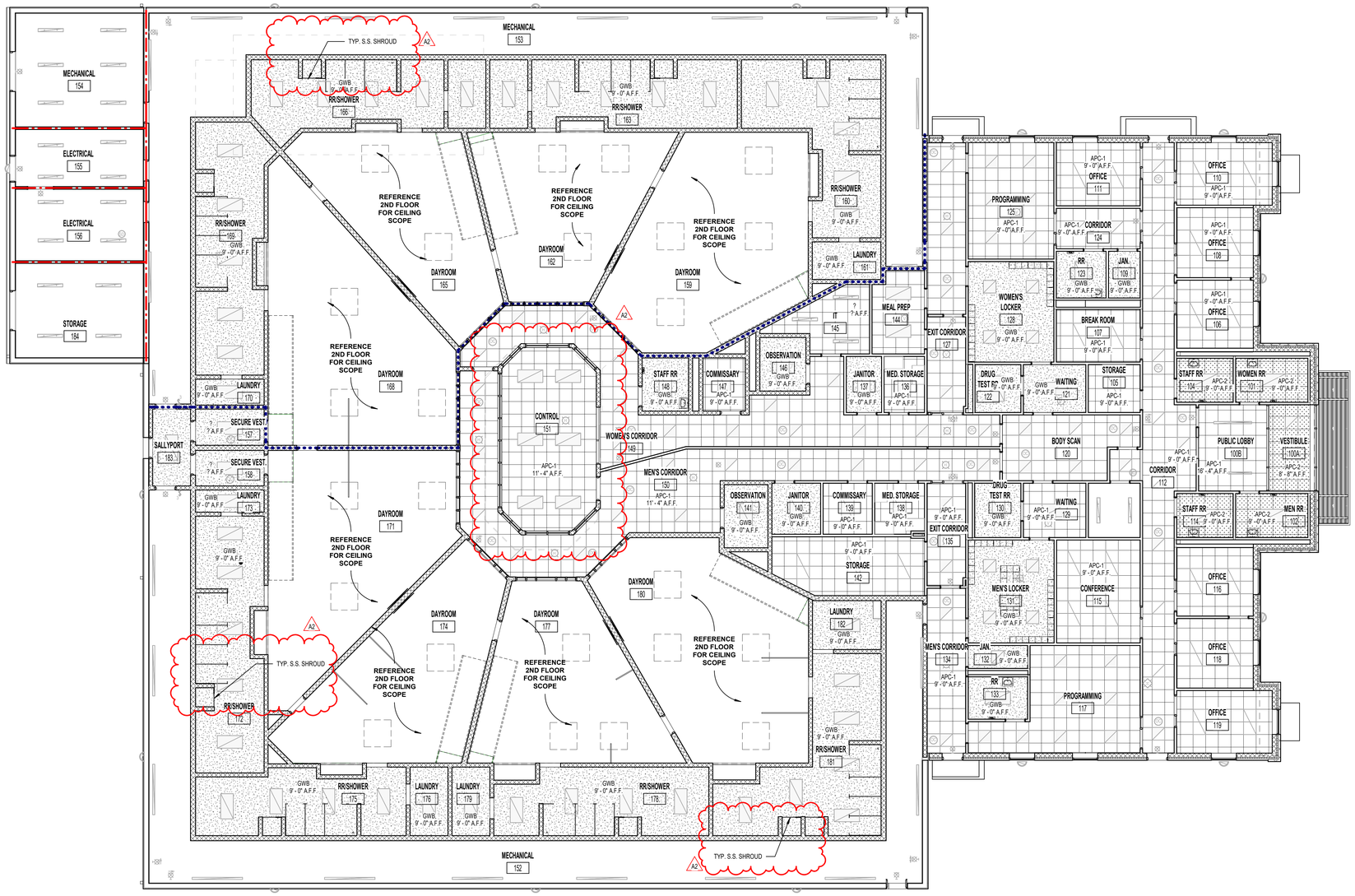
Date: 02.21.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT

UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
UNIT F
BUILDING 1
BUILDING 2
N

FIRST FLOOR CEILING PLAN UNIT D

AC 1D1



6A FIRST FLOOR CEILING PLAN UNIT F

1/8" = 1'-0"

REFL. CEILING PLAN NOTES

1. All grids are centered in rooms, unless noted otherwise.
2. Coordinate bulkhead sizes w/ mechanical ductwork.
3. Refer to MEP drawings for ceiling fixtures/equipment and coordinate w/ all trades.
4. All exposed ductwork, piping etc. shall be painted. Color selected by Architect.
5. Locate sprinkler heads in center of ceiling panel - where applicable.
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A1

5.4.120 - CEILING PLAN NOTES

Key	Note
1	OPEN TO STRUCTURE
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6	18 IN CEILING MOUNTED DOMED MIRROR
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9	CEILING MOUNTED 42" MONITORS. FINAL INSTALLATION TO BE COORDINATED WITH CONTROL STATION INSTALLATION.

REFLECTED CEILING PLAN LEGEND

APC-1	2' X 2' Acoustical Panel Ceiling (09 51 13)	Light Fixture (Reference E-Series Dwgs)	
		Emergency Light Fixture (Reference E-Series Dwgs)	
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APC-3	2' x 2' High Humidity Ceiling Panel with Aluminum Grid	Supply Air (Reference M-Series Dwgs)	
APC-4	2' x 2' Special NRC (0.7 min.) Ceiling Panel with Aluminum Grid	Exit Light (Reference E-Series Dwgs)	
SCL1	2' X 2' Security metal lay-in with hold down clips	Recessed Light Fixture Suspended Fixture in Areas with Exposed Ceilings (Reference E-Series Dwgs)	
SCL2	Cellular Metal Deck, see Structural	SOUND SYSTEM SPEAKER (REFERENCE E-SERIES/T-SERIES DWGS)	S
SCL3	Concrete Slab on Cellular Metal Deck, total depth of 5-1/4" Cap to achieve 1-HR rating, see Structural	Walls to Deck	
GWB	Gypsum Wall Board, 5/8" on 3 5/8" Metal Stud (09 29 00)	PLASTER Plaster on metal wire mesh lathe on 3-5/8" metal stud	
GWB-2	5/8" High-Impact drywall on metal wire mesh lathe on 3-5/8" metal stud	MTL 1/4" Steel Plate on engineered framing	

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
2	Addendum #2	02.21.2022

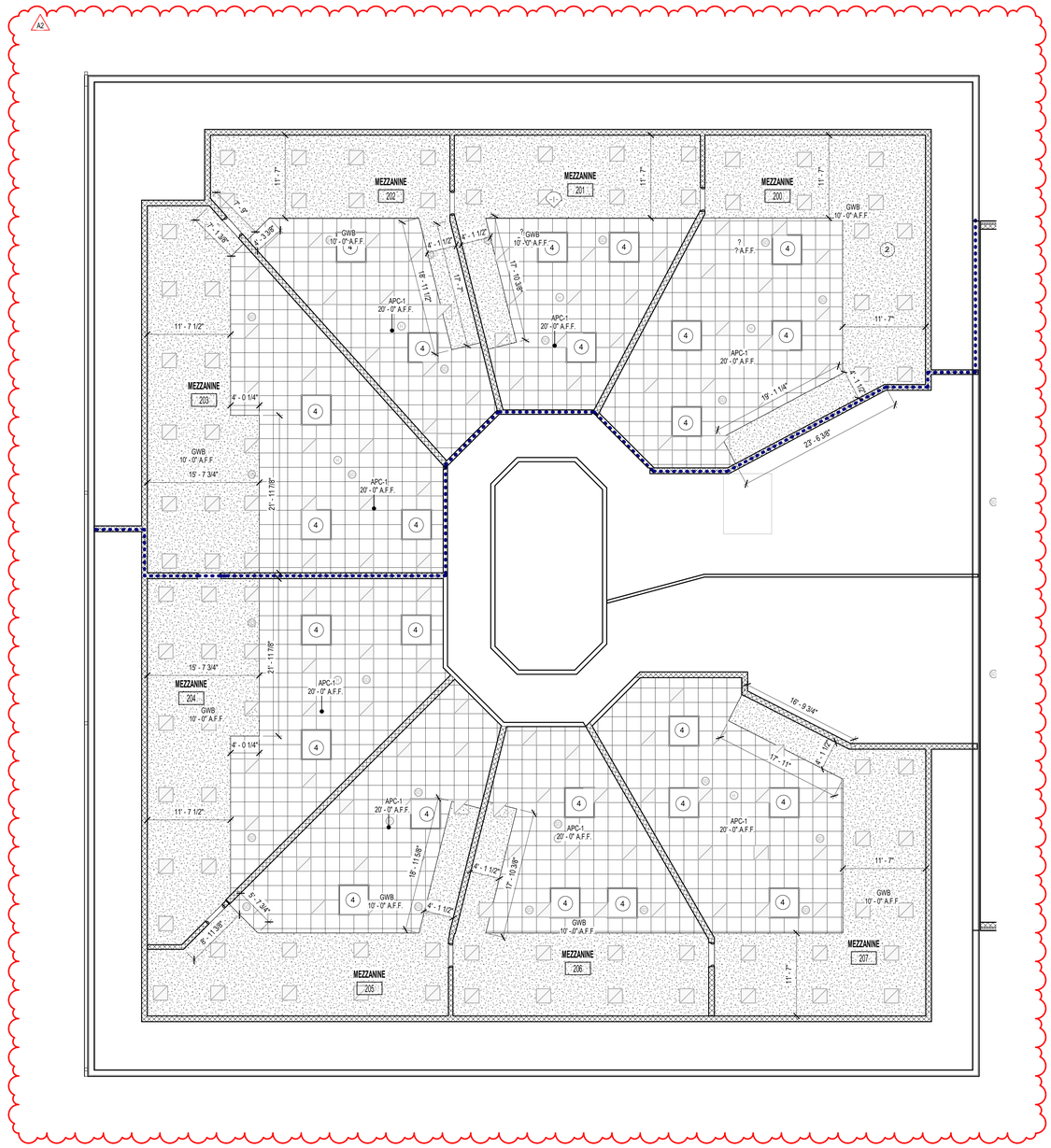
Project #: 20-700-151-2
Designed By: LD/SP
Drawn By: WD
Checked By: LD
Date: 02.21.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT

UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
BUILDING 1
UNIT F
BUILDING 2
N

FIRST FLOOR CEILING PLAN UNIT F

AC 2F1



3B **SECOND FLOOR CEILING PLAN UNIT D**
1/8" = 1'-0"

REFL. CEILING PLAN NOTES

1. All grids are centered in rooms, unless noted otherwise.
2. Coordinate bulkhead sizes w/ mechanical ductwork.
3. Refer to MEP drawings for ceiling fixtures/equipment and coordinate w/ all trades.
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5. Locate sprinkler heads in center of ceiling panel - where applicable.
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A1

5.4.120 - CEILING PLAN NOTES

Key	Note
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6	18 IN CEILING MOUNTED DOMED MIRROR
7	PROVIDE A 5-1/4" SLAB ON TOP OF CELLULAR METAL DECK TO ACHIEVE 1-HR RATED LID ASSEMBLY.
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REFLECTED CEILING PLAN LEGEND

APC-1	2' X 2' Acoustical Panel Ceiling (09 51 13)	Light Fixture (Reference E-Series Dwgs)	
		Emergency Light Fixture (Reference E-Series Dwgs)	
APC-2	2' X 2' Washable Acoustical Panel Ceiling (09 51 13)	Return Air (Reference M-Series Dwgs)	
APC-3	2' x 2' High Humidity Ceiling Panel with Aluminum Grid	Supply Air (Reference M-Series Dwgs)	
APC-4	2' x 2' Special NRC (0.7 min.) Ceiling Panel with Aluminum Grid	Exit Light (Reference E-Series Dwgs)	
SCL1	2' X 2' Security metal lay-in with hold down clips	Recessed Light Fixture Suspended Fixture in Areas with Exposed Ceilings (Reference E-Series Dwgs)	
SCL2	Cellular Metal Deck, see Structural	SOUND SYSTEM SPEAKER (REFERENCE E-SERIES/T-SERIES DWGS)	S
SCL3	Concrete Slab on Cellular Metal Deck, total depth of 5-1/4" Cap to achieve 1-HR rating, see Structural	Walls to Deck	
GWB	Gypsum Wall Board, 5/8" on 3 5/8" Metal Stud (09 29 00)	PLASTER	Plaster on metal wire mesh lathe on 3-5/8" metal stud
GWB-2	5/8" High-Impact drywall on metal wire mesh lathe on 3-5/8" metal stud	MTL	1/4" Steel Plate on engineered framing

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

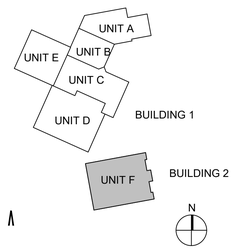
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
2	Addendum #2	02.21.2022

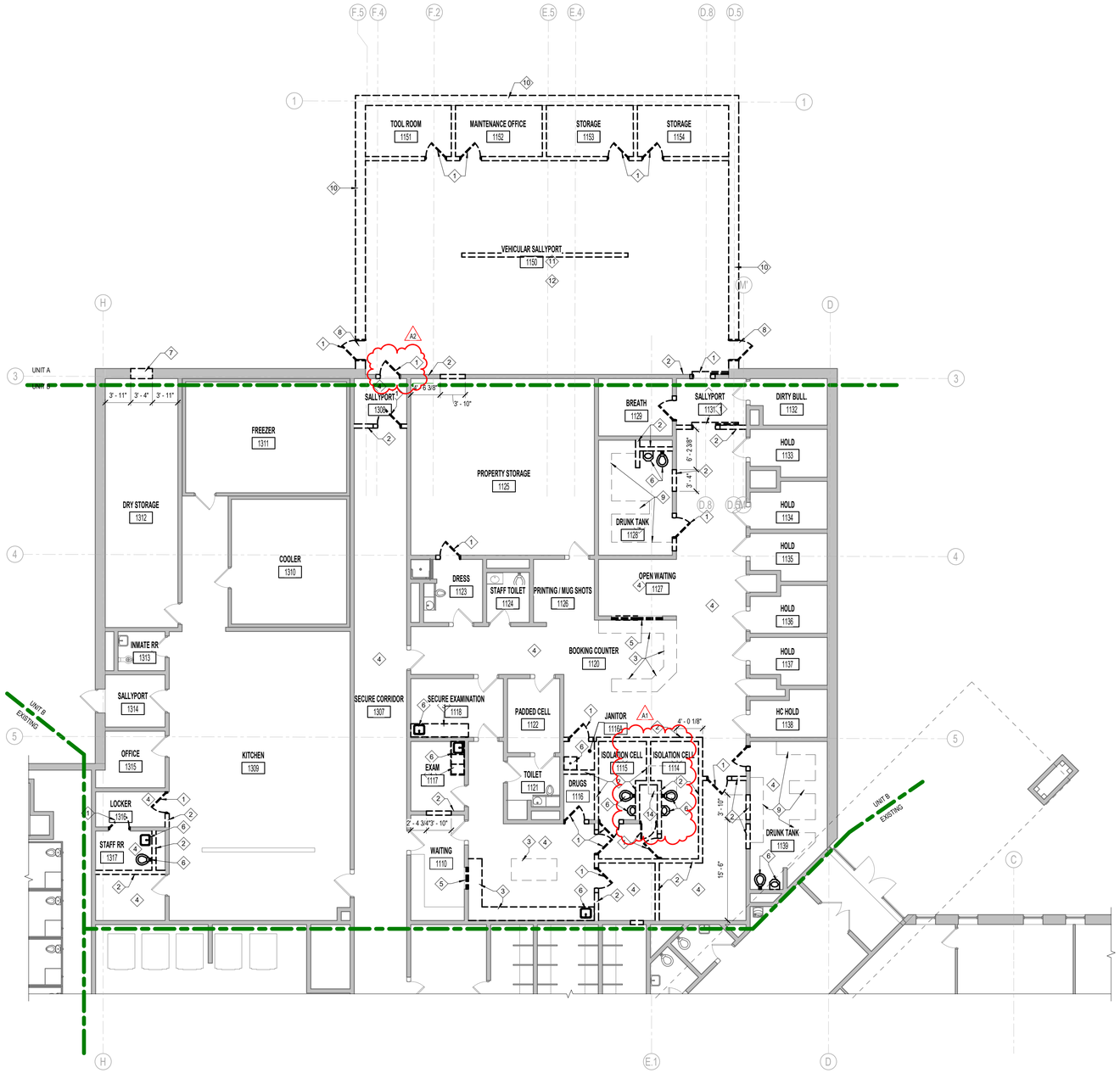
Project #: 20-700-151-2
Designed By: LD
Drawn By: WD
Checked By: LD/EV
Date: 02.21.2022

ERIC S. WEFLEN REGISTERED No. AR11500138 STATE OF INDIANA ARCHITECT



SECOND FLOOR CEILING PLAN UNIT F

AC 2F2



2B **DEMOLITION PLAN UNIT B**
1/8" = 1'-0"

5.4.092 - DEMO FLOOR PLAN...

Key	Note
1	REMOVE EXISTING DOOR AND FRAME IN ITS ENTIRETY, INCLUDING ALL ACCESSORIES AND ANCHORS. PATCH EXISTING SURFACES TO REMAIN AND PREP TO RECEIVE NEW CONSTRUCTION. MATCH EXISTING WALL TYPE.
2	REMOVE EXISTING INTERIOR WALL CONSTRUCTION TO LIMITS INDICATED INCLUDING, BUT NOT LIMITED TO, DOORS, FRAMES, WINDOW SYSTEMS, BULKHEADS AND MISCELLANEOUS FRAMING. FIELD VERIFY ALL EXISTING WALL CONSTRUCTION AND CONDITIONS. REFER TO ARCHITECTURAL FLOOR PLANS FOR FINISH CONDITIONS AND DIMENSIONS. NEW CONSTRUCTION TO TOOTH-IN TO EXISTING MASONRY COURSING WHERE APPLICABLE. PATCH AND REPAIR EXISTING SURFACES TO REMAIN.
3	REMOVE EXISTING CASEWORK TO LIMITS INDICATED, INCLUDING BUT NOT LIMITED TO ANY ADHESIVES AND ANCHORS. PATCH AND PREP SURFACES TO REMAIN TO RECEIVE NEW CONSTRUCTION.
4	REMOVE EXISTING CEILING SYSTEM IN ITS ENTIRETY, INCLUDING ALL ACCESSORIES, ANCHORS AND ADHESIVES. PATCH EXISTING SURFACES TO REMAIN TO RECEIVE NEW CONSTRUCTION.
5	REMOVE EXISTING WINDOW ASSEMBLY IN ITS ENTIRETY, INCLUDING ALL ASSOCIATED HARDWARE, ANCHORS AND BRACING. PREPARE OPENING FOR NEW CONSTRUCTION. REFERENCE ARCHITECTURAL FLOOR PLAN(S) FOR NEW CONSTRUCTION.
6	REMOVE EXISTING PLUMBING FIXTURES IN ITS ENTIRETY, INCLUDING ALL ANCHORS, ADHESIVES, AND ACCESSORIES. PREP SURFACES TO REMAIN TO RECEIVE NEW CONSTRUCTION. ADJUST EXISTING PLUMBING AS REQUIRED TO RECEIVE NEW CONSTRUCTION. COORDINATE WITH PLUMBING DRAWINGS.
7	REMOVE EXISTING EXTERIOR WALL CONSTRUCTION TO LIMITS INDICATED INCLUDING, BUT NOT LIMITED TO, DOORS, FRAMES, WINDOW SYSTEMS, BULKHEADS AND MISCELLANEOUS FRAMING. FIELD VERIFY ALL EXISTING WALL CONSTRUCTION AND CONDITIONS. REFER TO ARCHITECTURAL FLOOR PLANS FOR FINISH CONDITIONS AND DIMENSIONS. NEW CONSTRUCTION TO TOOTH-IN TO EXISTING MASONRY COURSING WHERE APPLICABLE. PATCH AND REPAIR EXISTING SURFACES TO REMAIN.
8	REMOVE ALL EXTENTS OF EXISTING TRANSITION STRIP
9	REMOVE EXISTING CONCRETE BENCH IN ITS ENTIRETY, INCLUDING ALL ACCESSORIES, ADHESIVES, AND ANCHORS. PATCH EXISTING SURFACES TO REMAIN AND PREP TO RECEIVE NEW CONSTRUCTION.
10	REMOVE EXISTING EXTERIOR WALL CONSTRUCTION IN IT'S ENTIRETY TO 8" BELOW GRADE. INCLUDING, BUT NOT LIMITED TO, DOOR, FRAMES, WINDOW SYSTEMS. FIELD VERIFY EXISTING WALL CONSTRUCTION AND CONDITIONS.
11	REMOVE EXISTING CONCRETE SLAB IN IT'S ENTIRETY.
12	REMOVE EXISTING ROOF AND ROOF STRUCTURE IN IT'S ENTIRETY
13	EXTENTS OF CEILING DEMOLITION. REMOVE TO NEAREST CEILING GRID LINE. PROTECT REMAINING CEILING.
14	REMOVE EXISTING ROOF AND ROOF STRUCTURE AS REQUIRED FOR NEW SKYLIGHT.

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

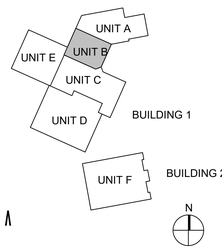
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	Addendum #1	02.14.2022
2	Addendum #2	02.21.2022

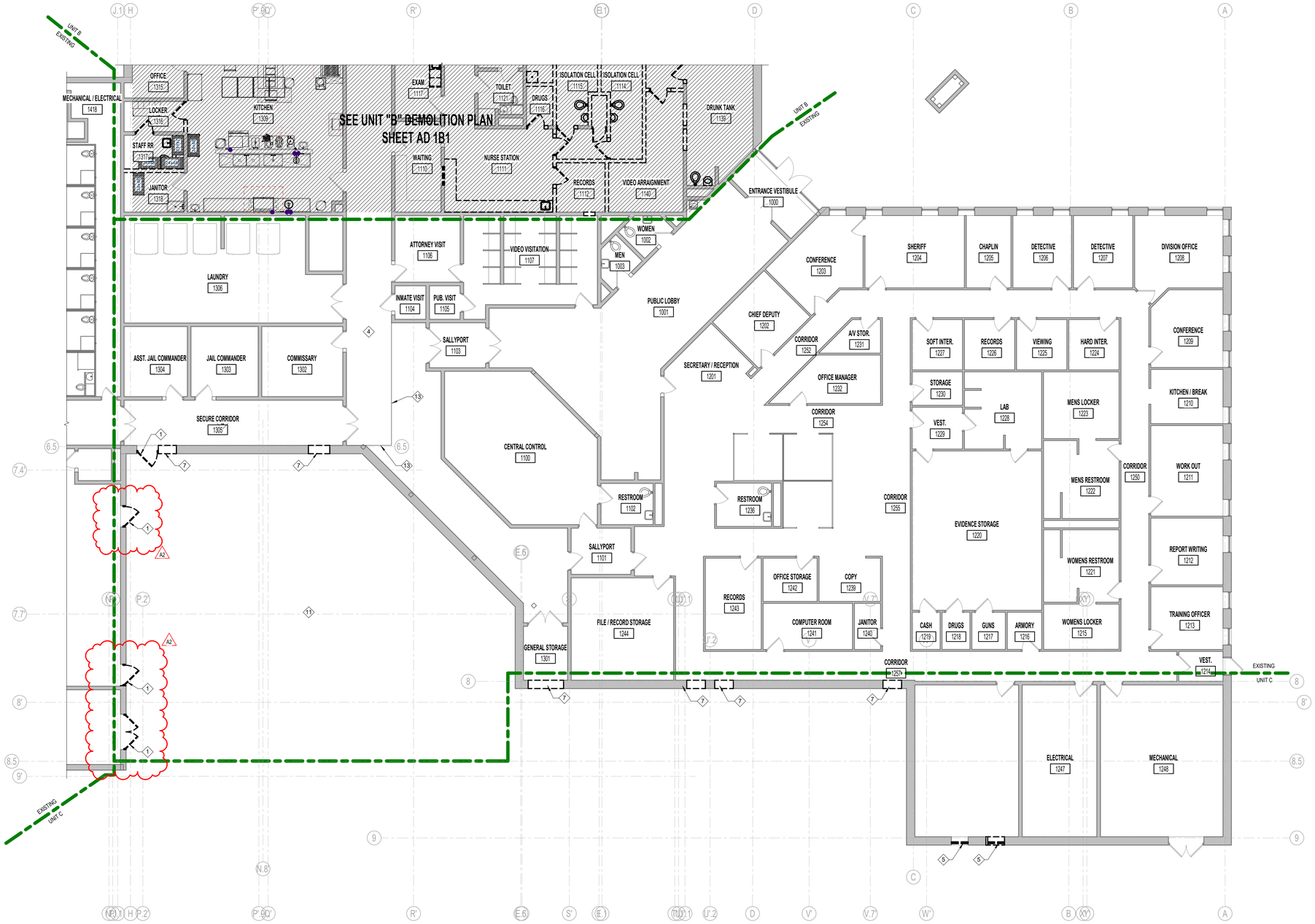
Project #: 20-700-151-2
Designed By: LD/SP
Drawn By: CW
Checked By: LD/EV
Date: 02.21.2022

ERIC S. WEFLEN REGISTERED No. AR11500138 STATE OF INDIANA ARCHITECT



DEMOLITION PLAN UNIT B

AD 1B1



2A **DEMOLITION PLAN UNIT C**
1/8" = 1'-0"

5.4.092 - DEMO FLOOR PLAN...

Key	Note
1	REMOVE EXISTING DOOR AND FRAME IN ITS ENTIRETY, INCLUDING ALL ACCESSORIES AND ANCHORS. PATCH EXISTING SURFACES TO REMAIN AND PREP TO RECEIVE NEW CONSTRUCTION. MATCH EXISTING WALL TYPE.
2	REMOVE EXISTING INTERIOR WALL CONSTRUCTION TO LIMITS INDICATED INCLUDING, BUT NOT LIMITED TO, DOORS, FRAMES, WINDOW SYSTEMS, BULKHEADS AND MISCELLANEOUS FRAMING. FIELD VERIFY ALL EXISTING WALL CONSTRUCTION AND CONDITIONS. REFER TO ARCHITECTURAL FLOOR PLANS FOR FINISH CONDITIONS AND DIMENSIONS. NEW CONSTRUCTION TO TOOTH-IN TO EXISTING MASONRY COURSING WHERE APPLICABLE. PATCH AND REPAIR EXISTING SURFACES TO REMAIN.
3	REMOVE EXISTING CASEWORK TO LIMITS INDICATED, INCLUDING BUT NOT LIMITED TO ANY ADHESIVES AND ANCHORS. PATCH AND PREP SURFACES TO REMAIN TO RECEIVE NEW CONSTRUCTION.
4	REMOVE EXISTING CEILING SYSTEM IN ITS ENTIRETY, INCLUDING ALL ACCESSORIES, ANCHORS AND ADHESIVES. PATCH EXISTING SURFACES TO REMAIN TO RECEIVE NEW CONSTRUCTION.
5	REMOVE EXISTING WINDOW ASSEMBLY IN ITS ENTIRETY, INCLUDING ALL ASSOCIATED HARDWARE, ANCHORS AND BRACING. PREPARE OPENING FOR NEW CONSTRUCTION. REFERENCE ARCHITECTURAL FLOOR PLAN(S) FOR NEW CONSTRUCTION.
6	REMOVE EXISTING PLUMBING FIXTURES IN ITS ENTIRETY, INCLUDING ALL ANCHORS, ADHESIVES, AND ACCESSORIES. PREP SURFACES TO REMAIN TO RECEIVE NEW CONSTRUCTION. ADJUST EXISTING PLUMBING AS REQUIRED TO RECEIVE NEW CONSTRUCTION. COORDINATE WITH PLUMBING DRAWINGS.
7	REMOVE EXISTING EXTERIOR WALL CONSTRUCTION TO LIMITS INDICATED INCLUDING, BUT NOT LIMITED TO, DOORS, FRAMES, WINDOW SYSTEMS, BULKHEADS AND MISCELLANEOUS FRAMING. FIELD VERIFY ALL EXISTING WALL CONSTRUCTION AND CONDITIONS. REFER TO ARCHITECTURAL FLOOR PLANS FOR FINISH CONDITIONS AND DIMENSIONS. NEW CONSTRUCTION TO TOOTH-IN TO EXISTING MASONRY COURSING WHERE APPLICABLE. PATCH AND REPAIR EXISTING SURFACES TO REMAIN.
8	REMOVE ALL EXTENTS OF EXISTING TRANSITION STRIP
9	REMOVE EXISTING CONCRETE BENCH IN ITS ENTIRETY, INCLUDING ALL ACCESSORIES, ADHESIVES, AND ANCHORS. PATCH EXISTING SURFACES TO REMAIN AND PREP TO RECEIVE NEW CONSTRUCTION.
10	REMOVE EXISTING EXTERIOR WALL CONSTRUCTION IN IT'S ENTIRETY TO 8" BELOW GRADE. INCLUDING, BUT NOT LIMITED TO, DOOR, FRAMES, WINDOW SYSTEMS. FIELD VERIFY EXISTING WALL CONSTRUCTION AND CONDITIONS.
11	REMOVE EXISTING CONCRETE SLAB IN IT'S ENTIRETY.
12	REMOVE EXISTING ROOF AND ROOF STRUCTURE IN IT'S ENTIRETY
13	EXTENTS OF CEILING DEMOLITION. REMOVE TO NEAREST CEILING GRID LINE. PROTECT REMAINING EXISTING CEILING.
14	REMOVE EXISTING ROOF AND ROOF STRUCTURE AS REQUIRED FOR NEW SKYLIGHT

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

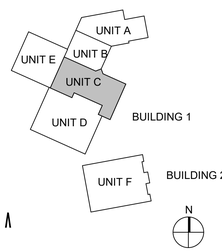
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
2	Addendum #2	02.21.2022

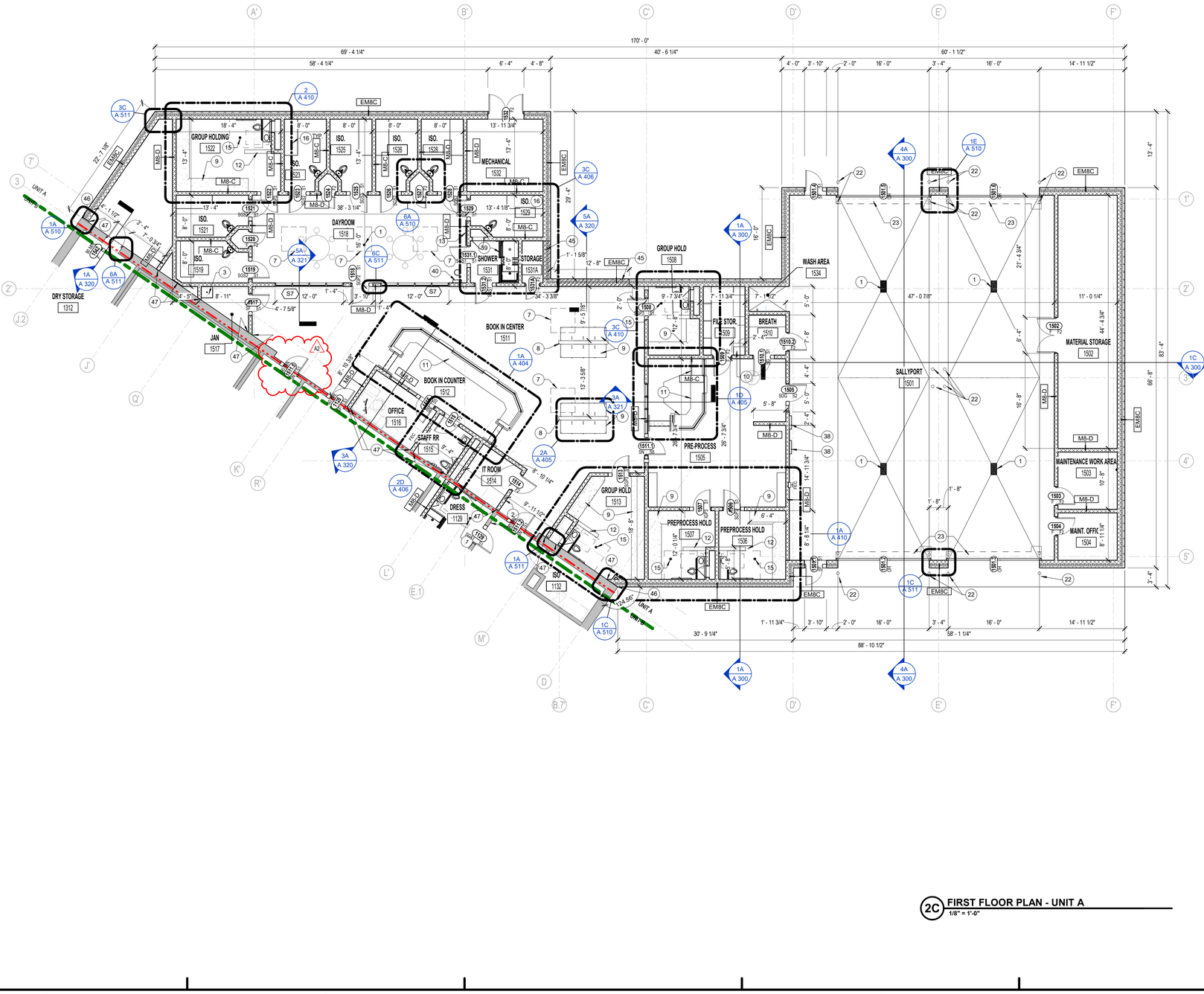
Project #: 20-700-151-2
Designed By: LD/SP
Drawn By: CW
Checked By: LD
Date: 02.21.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT



DEMOLITION PLAN UNIT C

AD 1C1



2C **FIRST FLOOR PLAN - UNIT A**
1/8" = 1'-0"

5.4.110 - FLOOR PLAN NOTES

Key	Note
1	FLOOR DRAIN, SEE PLUMBING DRAWINGS. SLOPE ALL NEW FLOOR TO DRAIN AT 1/16" PER 12"
2	ALIGN NEW WALL CONSTRUCTION WITH EXISTING. COORDINATE WITH ALL TRADES.
3	MOP BASIN, SEE PLUMBING DRAWINGS. PROVIDE A 48" TALL STAINLESS STEAL BACKSPLASH 24" PAST BASIN EDGE.
4	MANUFACTURED SIX COMPARTMENT GUN LOCKER
5	INFILL EXISTING OPENING WITH NEW WALL ASSEMBLY TO MATCH EXISTING. TOOTH IN NEW CMU INTO EXISTING.
6	EXPOSED STRUCTURAL STEEL TO BE PRIMED AND PAINTED
7	LINE OF OVERHEAD SKYLIGHT, SEE CEILING AND ROOF PLANS FOR SCOPE
8	HALF HEIGHT WALL, PROVIDE DOUBLE BULLNOSE CORNER UNIT ON TOP
9	CONCRETE BENCH SEE DETAIL1C/A 500
10	BUILT IN CASEWORK AND COUNTERTOP. SEE INTERIOR DRAWINGS FOR SCOPE AND MATERIAL
11	BOOK IN COUNTER BUILT-IN SEE A-401 FOR DETAILS
12	HALF HEIGHT WALL @ 40" A.F.F. WALL TYPE M8-C
13	FLAT SCREEN TV MOUNTING BRACKET @ 6'-0" A.F.F.
14	OWNER PROVIDED MARKER BOARD
15	FLOOR DRAIN. REFERENCE PLUMBING DRAWINGS
16	MANUFACTURED FULLY WELDED SECURITY BUNK SYSTEM - DOUBLE BUNK. BASIS OF DESIGN NORIX MODEL BS10-222 OR EQUAL
20	OWNER PROVIDED SECURITY-TYPE WALL-MOUNTED PHONE KIOSK. COORDINATE POWER/DATA LOCATIONS W/ OWNER.
21	WOVEN WIRE SECURITY SCREEN AND FRAME. PREFINISHED AS SELECTED BY ARCHITECT
22	6" STEEL BOLLARD. CONCRETE FILLED. TO BE PRIMED AND PAINTED SAFETY YELLOW
23	OVERHEAD COILING DOOR OPERATOR AND MOTOR
31	OWNER PROVIDED STACKABLE WASHER & DRYER UNIT.
32	OWNER PROVIDED VENDING MACHINES.
33	NEW 2-HIGH BUNK STACK. REFER TO SPEC. 11 19 10
34	NEW 15"W x 18"D x 6'-0"H LOCKER
35	NEW 36"W x 12"D x 6'-0"H (3) WIDE LOCKERS
36	EXISTING 24"W x 24"D x 6'-0"H LOCKER
37	EXISTING 2-HIGH BUNK STACK
38	MANUFACTURED METAL 6 COMPARTMENT GUN LOCKER SURFACE MOUNTED
39	TRENCH DRAIN. SEE PLUMBING DRAWINGS
40	DETENTION VIDEO VISITATION STATION. CONTRACTOR TO PROVIDE ROUGH-INS. EQUIPMENT BY OWNER
41	ENGINEERED MANUFACTURED METAL OPEN GRATE SECURITY GRADE STAIR. OPEN RISER. STRINGERS TO BE PRIMED AND PAINTED. TREADS TO BE GALVANIZED. ALL CUT "SHARP" EDGES TO BE REMOVED OR PROVIDE AN ANGLE TO COVER CUT EDGES, TYPICAL.
42	MANUFACTURED METAL PAN STAIR. CONCRETE FILLED
43	ELEVATED CONTROL ROOM ACCESS FLOOR SYSTEM. 7". PROVIDE PLASTIC LAMINATE FLOOR AS SELECTED BY ARCHITECT. PROVIDE TOE GUARD AT THE ENTIRE PERIMETER
44	STEEL COVER PLATE. SECURE WITH SECURITY FASTENERS AND SECURITY CAULKING, AT ALL CELL LOCATIONS
45	KNOCK OUT MASONRY PANEL. CONSTRUCTION TO MATCH ADJACENT WALL CONSTRUCTION. TO LIMITS INDICATED TO 7'-4" AFF. PROVIDE MASONRY LINTELS PER STRUCTURAL LINTEL SCHEDULE.
46	EXTERIOR WALL TO WALL 2" EXPANSION JOINT COVER. PROVIDE AIR/WEATHER BARRIER AND STUFF CAVITY WITH BATT INSULATION RATED
47	INTERIOR WALL TO WALL 2" EXPANSION JOINT COVER. PROVIDE 12 GA SECURITY TYPE COVERS IN DETENTION SPACES
48	EXTERIOR WALL TO WALL 4" EXPANSION JOINT COVER. PROVIDE AIR/WEATHER BARRIER AND STUFF CAVITY WITH BATT INSULATION RATED
49	INTERIOR WALL TO WALL 4" EXPANSION JOINT COVER.
50	6-PERSON GAMETOP TABLE REFER TO SPEC SECTION 11 19 10
51	4-PERSON GAMETOP TABLE REFER TO SPEC SECTION 11 19 10

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

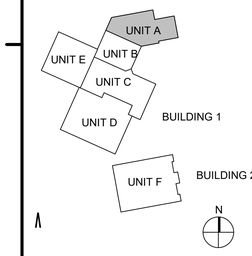
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
2	Addendum #2	02.21.2022

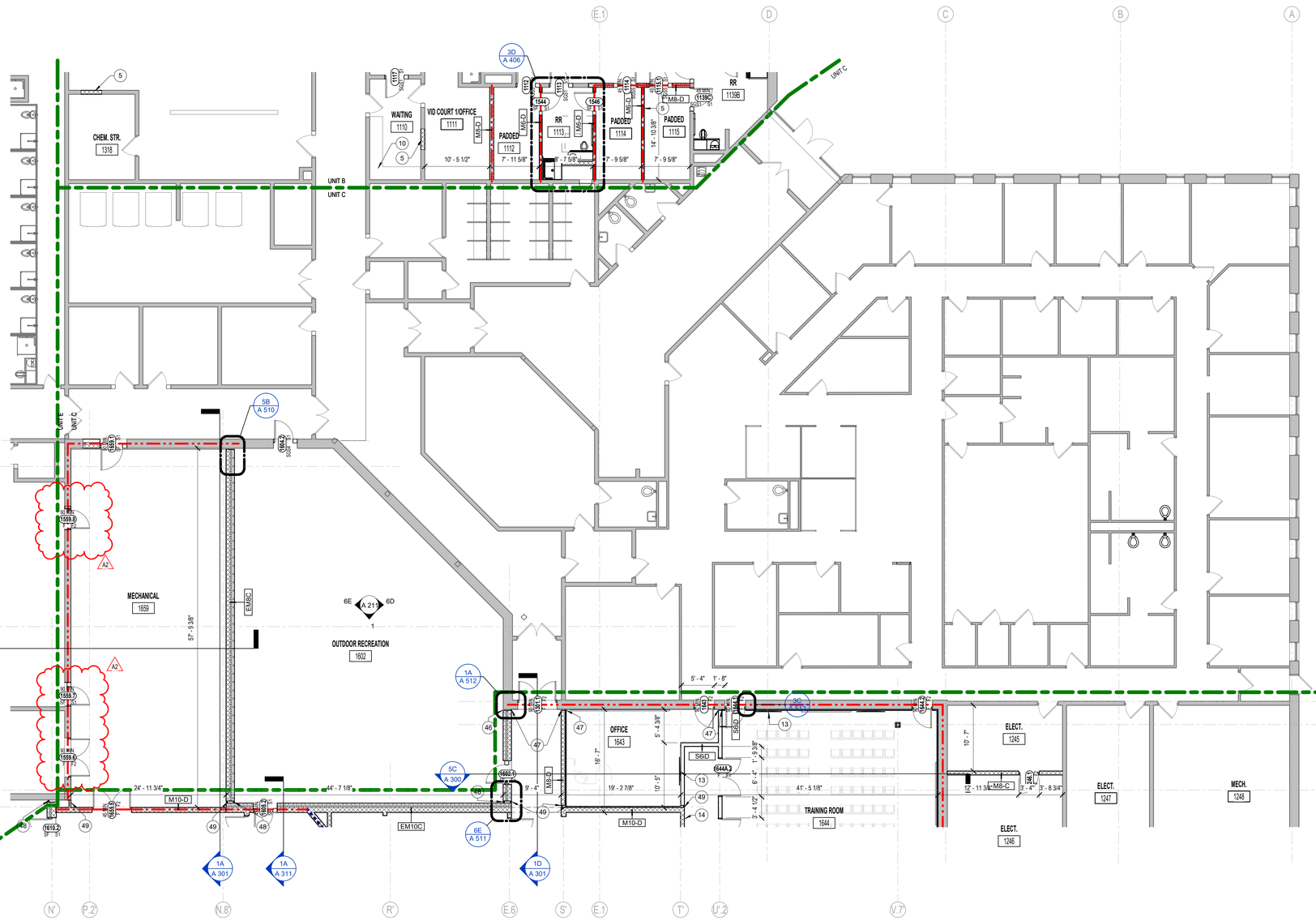
Project #: 20-700-151-2
Designed By: LD/SP
Drawn By: CW
Checked By: LD/EV
Date: 02.21.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT



FIRST FLOOR PLAN UNIT A

AF 1A1



2B FIRST FLOOR PLAN - UNIT C

1/8" = 1'-0"

5.4.110 - FLOOR PLAN NOTES

Key	Note
1	FLOOR DRAIN, SEE PLUMBING DRAWINGS. SLOPE ALL NEW FLOOR TO DRAIN AT 1/16" PER 12"
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RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
2	Addendum #2	02.21.2022

Project #: 20-700-151-2

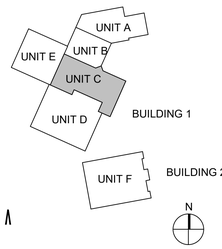
Designed By: LD/SP

Drawn By: CW

Checked By: LD/EV

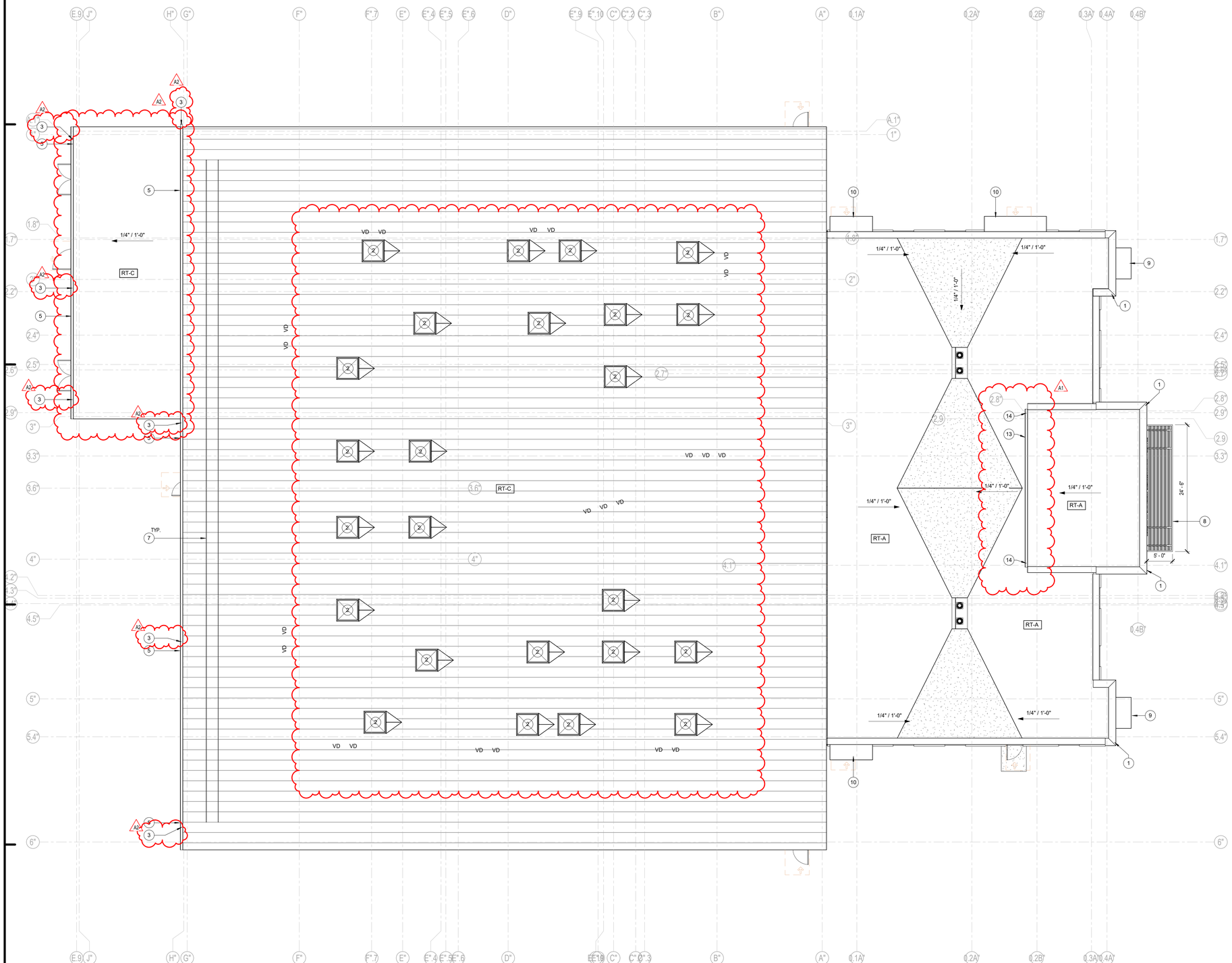
Date: 02.21.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT



FIRST FLOOR PLAN UNIT C

AF 1C1



2B ARCHITECTURAL ROOF PLAN UNIT F
1/8" = 1'-0"

GENERAL ROOF PLAN NOTES

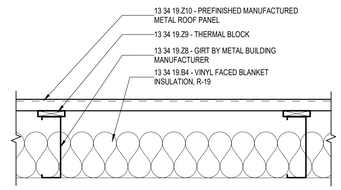
1. Roof to be installed to achieve positive drainage with a minimum resultant slope of 1/4" per foor, unless indicated otherwise. Provide "crickets or saddles" at all roof curbs to allow for positive drainage
2. Low slope roof areas shall have a minimum of 4" rigid insulation over roof deck. Saddles, crickets, and slope portions of flat roof deck shall be formed by tapered insulation. Areas where tapered insulation is anticipated have been indicated, but shall not be considered all inclusive. It is Contractor's responsibility to provide sloped surfaces to achieve proper drainage.
3. Roof penetrations and equipment shown shall not be considered all inclusive. Coordinate with Mechanical, Plumbing and Electrical Documents to confirm penetrations and equipment locations. Flash all roof penetrations in accordance with roofing manufacturer's recommendations. Provide crickets to allow for proper drainage around units.
4. Roof walkway pads or blocks shall be installed in accordance with roofing manufacturer's recommendation where indicated and around other perimeter of rooftop equipment.

A1

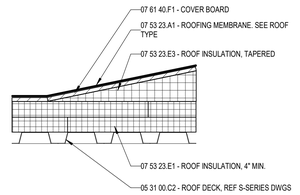
5.4.140 - ROOF PLAN NOTES

Key	Note
1	MANUFACTURED METAL COPING FINISH AS SELECTED BY ARCHITECT
2	08 62 00 - MANUFACTURED PLASTIC UNIT SKYLIGHT - 4'-0" X 4'-0"
3	13 34 49 - PREENGINEERED METAL BUILDING TYPICAL CANOPY
4	08 62 00 - MANUFACTURED PLASTIC UNIT SKYLIGHT - 8'-0" X 4'-0"
5	13 34 49 - PREENGINEERED METAL BUILDING TYPICAL GUTTER
6	ENGINEERED MANUFACTURED METAL CANOPY, MAPES STYLE OR EQUAL
7	ICE AND SNOW GUARDS BY ROOF MANUFACTURER, TWO ROWS
8	PREENGINEERED CUSTOM CANOPY FINISH AS SELECTED BY ARCHITECT
9	ENGINEERED METAL CANOPY LOUVER SUN SHADES
10	MANUFACTURED METAL CANOPY MAPES STYLE OR EQUAL
11	MANUFACTURED ROOF TO WALL EXPANSION JOINT, 4"
12	MANUFACTURED ROOF TO WALL EXPANSION JOINT, 8"
13	MANUFACTURED METAL GUTTER 6"
14	MANUFACTURED METAL DOWNSPOUT 6"x5" TO SPLASH BLOCK ON LOWER ROOF
15	CONCRETE BENCH SEE DETAIL ##/##

A1



1B ROOF TYPE - RT-C
1 1/2" = 1'-0"



NOTE: PROVIDE 2 LAYERS OF 2" BOARD WITH STAGGERED JOINTS, TYPICAL

1A ROOF TYPE - RT-A
1 1/2" = 1'-0"

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

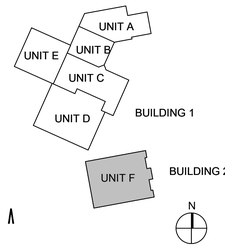
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	Addendum #1	02.14.2022
2	Addendum #2	02.21.2022

Project #: 20-700-151-2
Designed By: LD
Drawn By: WD
Checked By: LD/EV
Date: 02.21.2022

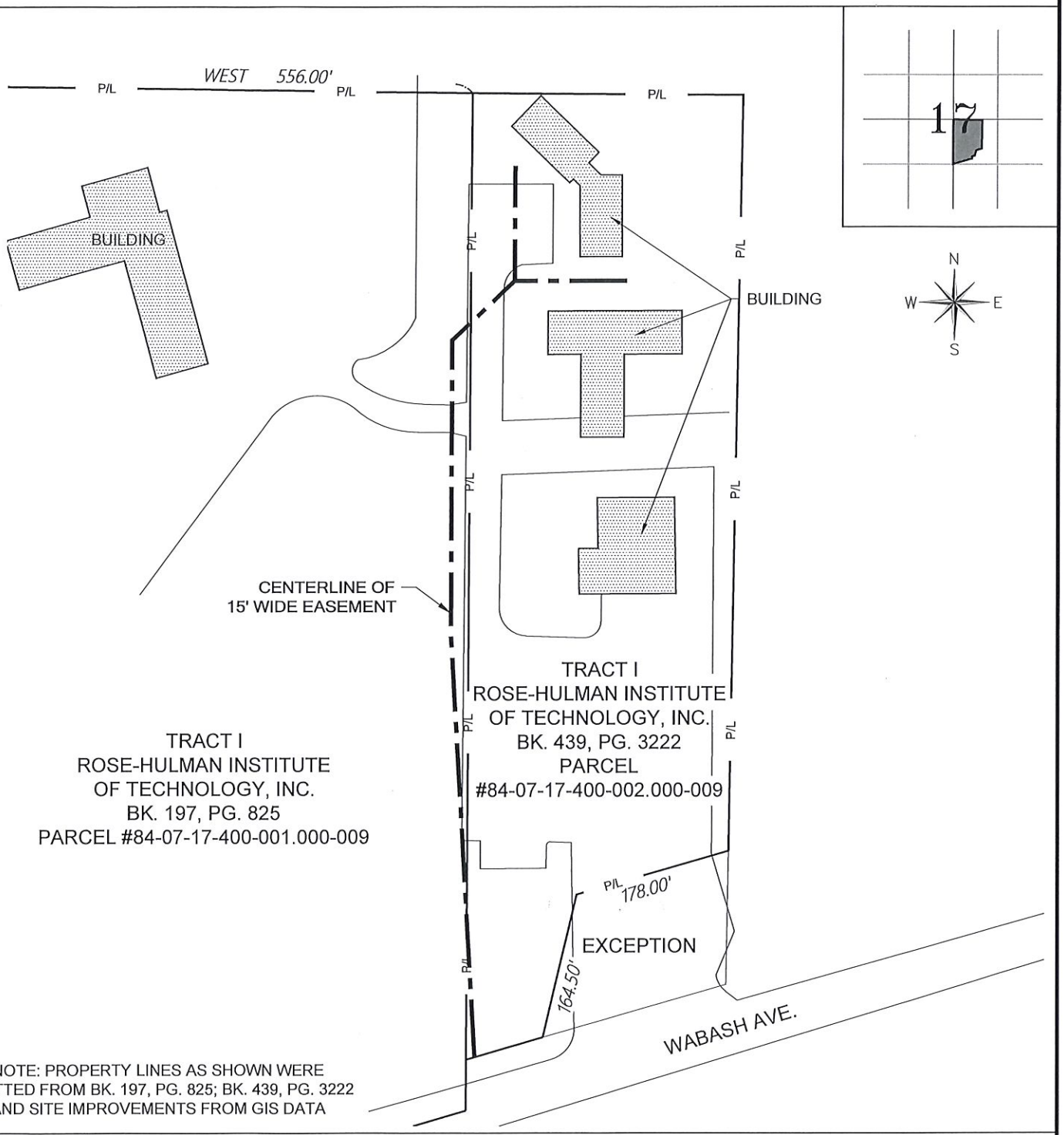
ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT



ARCHITECTURAL ROOF PLAN UNIT F

AR 2F1

THIS IS NOT A SURVEY. LOCATIONS SHOWN ARE APPROXIMATE. THE ACTUAL CENTERLINE LOCATION OF THE UTILITY LINE IS THE CENTERLINE OF THE EASEMENT.



NOTE: PROPERTY LINES AS SHOWN WERE PLOTTED FROM BK. 197, PG. 825; BK. 439, PG. 3222 AND SITE IMPROVEMENTS FROM GIS DATA

VIGO COUNTY, INDIANA

SITE NAME: LOST CREEK TOWNSHIP SECTION 17 TOWNSHIP 12N RANGE 8W

DUKE ENERGY®	DR. AM	EXHIBIT MAP OF: EASEMENT	
	CK. MT	LOCATION 5500 WABASH AVE, TERRE HAUTE, IN	
	DATE 07/19/2021	EXHIBIT MAP FOR: ROSE-HULMAN INSTITUTE OF TECHNOLOGY, INC.	EXHIBIT 'A'
			EMAX #40279221

Prepared by: Duke Energy Indiana, LLC
Return to: Duke Energy Indiana, LLC
Attn: Jamie Stevens
1000 E Main St Mail Code: WP989
Plainfield, IN 46168

Parcel # 84-07-17-400-001.000-009
84-07-17-400-002.000-009

EASEMENT

State of Indiana

County of Vigo

THIS EASEMENT ("**Easement**") is made this 27th day of July 20 21, from **ROSE-HULMAN INSTITUTE OF TECHNOLOGY, INC., A/K/A ROSE HULMAN INSTITUTE OF TECHNOLOGY**, an Indiana non-profit corporation ("**Grantor**", whether one or more), to **DUKE ENERGY INDIANA, LLC**, an Indiana limited liability company ("**Grantee**").

Grantor, for and in consideration of the sum of One and 00/100 Dollar ($1.00) and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, does hereby grant unto Grantee a perpetual and non-exclusive easement, to construct, reconstruct, operate, patrol, maintain, repair, replace, relocate, add to, modify, and remove electric and communication lines including, but not limited to, all necessary supporting structures, and all other appurtenant apparatus and equipment for the transmission and distribution of electrical energy, and for technological purposes related to the operation of the electric facilities and for the communication purposes of Incumbent Local Exchange Carriers (collectively, "**Facilities**"). Grantor is the owner of that certain property described in Section 17, Township 12 North, Range 8 West, Lost Creek Township, Vigo County, State of Indiana; being a part of two tracts as recorded in **Book 197, Page 825**, and also **Book 439, Page 3222**, in the Office of the Recorder of Vigo County, Indiana ("**Property**"). The Facilities shall be underground, except as needed on or above the ground to support the underground Facilities, and located in, upon, along, under, through, and across a portion of the Property within an easement area described as follows: A strip of land fifteen

feet (15') in uniform width, lying equidistant on both sides of a centerline, which centerline shall be established by the center of the Facilities as installed, along with an area ten feet (10') wide on all sides of the foundation of any Grantee enclosure/transformer, vault and/or manhole, and as generally shown on Exhibit "A", attached hereto and becoming a part hereof (hereinafter referred to as the "Easement Area").

The rights granted herein include, but are not limited to, the following:

1. Grantee shall have the right of ingress and egress over the Easement Area, Property, and any adjoining lands now owned or hereinafter acquired by Grantor (using lanes, driveways, and adjoining public roads where practical as determined by Grantee).
2. Grantee shall have the right to trim, cut down, and remove from the Easement Area, at any time or times and using safe and generally accepted arboricultural practices, trees, limbs, undergrowth, other vegetation, and obstructions.
3. Grantee shall have the right to trim, cut down, and remove from the Property, at any time or times and using safe and generally accepted arboricultural practices, dead, diseased, weak, dying, or leaning trees or limbs, which, in the opinion of Grantee, might fall upon the Easement Area or interfere with the safe and reliable operation of the Facilities.
4. Grantee shall have the right to install necessary guy wires and anchors extending beyond the boundaries of the Easement Area.
5. Grantee shall have the right to relocate the Facilities and Easement Area on the Property to conform to any future highway or street relocation, widening, or alterations.
6. Grantor shall not place, or permit the placement of, any structures, improvements, facilities, or obstructions, within or adjacent to the Easement Area, which may interfere with the exercise of the rights granted herein to Grantee. Grantee shall have the right to remove any such structure, improvement, facility, or obstruction at the expense of Grantor.
7. Excluding the removal of vegetation, structures, improvements, facilities, and obstructions as provided herein, Grantee shall promptly repair or cause to be repaired any physical damage to the surface area of the Easement Area and Property resulting from the exercise of the rights granted herein to Grantee. Such repair shall be to a condition which is reasonably close to the condition prior to the damage, and shall only be to the extent such damage was caused by Grantee or its contractors or employees.
8. Intentionally omitted.
9. All other rights and privileges reasonably necessary, in Grantee's sole discretion, for the safe, reliable, and efficient installation, operation, and maintenance of the Facilities.

The terms Grantor and Grantee shall include the respective heirs, successors, and assigns of Grantor and Grantee. The failure of Grantee to exercise or continue to exercise or enforce any of the rights herein granted shall not be construed as a waiver or abandonment of the right thereafter at any time, or from time to time, to exercise any and all such rights.

TO HAVE AND TO HOLD said rights, privilege, and easement unto Grantee, its successors, licensees, and assigns, forever. Grantor warrants and covenants that Grantor has the full right and authority to convey to Grantee this perpetual Easement, and that Grantee shall have quiet and peaceful possession, use and enjoyment of the same.

IN WITNESS WHEREOF, Grantor has signed this Easement under seal effective this 27th day of July, 20 21.

ROSE-HULMAN INSTITUTE OF TECHNOLOGY, INC.
an Indiana non-profit corporation

Matthew Davis
Signed Name

Matthew Davis
Printed Name

Vice President for Finance
Title

STATE OF Indiana)
) ss:
COUNTY OF Vigo)

This certificate relates to an acknowledgment in connection with which, no oath or affirmation was administered to the document signer.

The foregoing instrument was acknowledged before me, a notary public in the county and state written above this 27 day of July, 20 21 by Matthew Davis, as Vice President for Finance of ROSE-HULMAN INSTITUTE OF TECHNOLOGY, INC., a non-profit corporation, organized under the laws of Indiana, on behalf of such non-profit corporation.

WITNESS my hand and official seal dated July 27, 20 21.

SEAL:

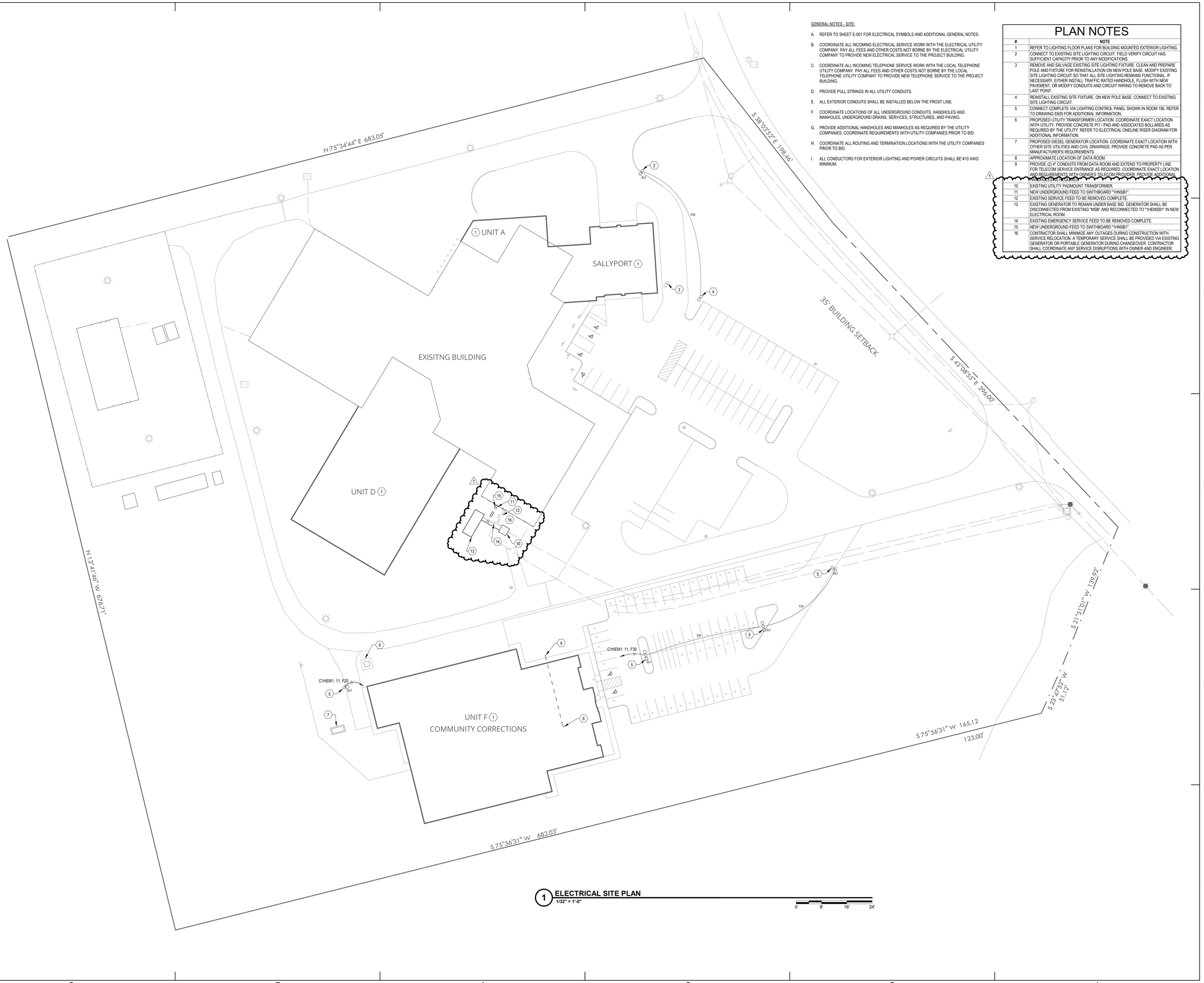
AMY L SIMONSON
Notary Public - Seal
Clay County - State of Indiana
Commission Number NP0732665
My Commission Expires Mar 29, 2029

Signed: Amy L Simonson
Printed or Typed Name: Amy L. Simonson
Commission Expires: 3/29/2029
My County of Residence: Clay
My Commission Number: NP0732665

This instrument prepared by John Scheidler, Attorney-at-Law, 1000 E. Main St, Plainfield, IN 46168.

I affirm, under the penalties of perjury, that I have taken reasonable care to redact each Social Security number in this document, unless required by law. Jamie Stevens

For Grantee's Internal Use:
Work Order #: 40279221



GENERAL NOTES - SITE:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. COORDINATE ALL INCOMING ELECTRICAL SERVICE WORK WITH THE ELECTRICAL UTILITY COMPANY. PAY ALL FEES AND OTHER COSTS NOT BORNE BY THE ELECTRICAL UTILITY COMPANY TO PROVIDE NEW ELECTRICAL SERVICE TO THE PROJECT BUILDING.

C. COORDINATE ALL INCOMING TELEPHONE SERVICE WORK WITH THE LOCAL TELEPHONE UTILITY COMPANY. PAY ALL FEES AND OTHER COSTS NOT BORNE BY THE LOCAL TELEPHONE UTILITY COMPANY TO PROVIDE NEW TELEPHONE SERVICE TO THE PROJECT BUILDING.

D. PROVIDE PULL STRINGS IN ALL UTILITY CONDUITS.

E. ALL EXTERIOR CONDUITS SHALL BE INSTALLED BELOW THE FROST LINE.

F. COORDINATE LOCATIONS OF ALL UNDERGROUND CONDUITS, HANDHOLES AND MANHOLES, UNDERGROUND DRAINS, SERVICES, STRUCTURES, AND PAVING.

G. PROVIDE ADDITIONAL HANDHOLES AND MANHOLES AS REQUIRED BY THE UTILITY COMPANIES. COORDINATE REQUIREMENTS WITH UTILITY COMPANIES PRIOR TO BID.

H. COORDINATE ALL ROUTING AND TERMINATION LOCATIONS WITH THE UTILITY COMPANIES PRIOR TO BID.

I. ALL CONDUCTORS FOR EXTERIOR LIGHTING AND POWER CIRCUITS SHALL BE #10 AWG MINIMUM.

PLAN NOTES

#	NOTE
1	REFER TO LIGHTING FLOOR PLANS FOR BUILDING MOUNTED EXTERIOR LIGHTING.
2	CONNECT TO EXISTING SITE LIGHTING CIRCUIT. FIELD VERIFY CIRCUIT HAS SUFFICIENT CAPACITY PRIOR TO ANY MODIFICATIONS.
3	REMOVE AND SALVAGE EXISTING SITE LIGHTING FIXTURE. CLEAN AND PREPARE POLE AND FIXTURE FOR REINSTALLATION ON NEW POLE BASE. MODIFY EXISTING SITE LIGHTING CIRCUIT SO THAT ALL SITE LIGHTING REMAINS FUNCTIONAL. IF NECESSARY, EITHER INSTALL TRAFFIC RATED HANDHOLE, FLUSH WITH NEW PAVEMENT, OR MODIFY CONDUITS AND CIRCUIT WIRING TO REMOVE BACK TO LAST POINT.
4	REINSTALL EXISTING SITE FIXTURE, ON NEW POLE BASE. CONNECT TO EXISTING SITE LIGHTING CIRCUIT.
5	CONNECT COMPLETE VIA LIGHTING CONTROL PANEL SHOWN IN ROOM 156. REFER TO DRAWING E600 FOR ADDITIONAL INFORMATION.
6	PROPOSED UTILITY TRANSFORMER LOCATION. COORDINATE EXACT LOCATION WITH UTILITY. PROVIDE CONCRETE PIT / PAD AND ASSOCIATED BOLLARDS AS REQUIRED BY THE UTILITY. REFER TO ELECTRICAL ONELINE RISER DIAGRAM FOR ADDITIONAL INFORMATION.
7	PROPOSED DIESEL GENERATOR LOCATION. COORDINATE EXACT LOCATION WITH OTHER SITE UTILITIES AND CIVIL DRAWINGS. PROVIDE CONCRETE PAD AS PER MANUFACTURER'S REQUIREMENTS.
8	APPROXIMATE LOCATION OF DATA ROOM.
9	PROVIDE (2) 4" CONDUITS FROM DATA ROOM AND EXTEND TO PROPERTY LINE FOR TELECOM SERVICE ENTRANCE AS REQUIRED. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH OWNER'S TELECOM PROVIDER. PROVIDE ADDITIONAL HANDHOLES AS REQUIRED.
10	EXISTING UTILITY PADMOUNT TRANSFORMER.
11	NEW UNDERGROUND FEED TO SWITHBOARD "1HNSB1".
12	EXISTING SERVICE FEED TO BE REMOVED COMPLETE.
13	EXISTING GENERATOR TO REMAIN UNDER BASE BID. GENERATOR SHALL BE DISCONNECTED FROM EXISTING "MSB" AND RECONNECTED TO "1HEMSB1" IN NEW ELECTRICAL ROOM.
14	EXISTING EMERGENCY SERVICE FEED TO BE REMOVED COMPLETE.
15	NEW UNDERGROUND FEED TO SWITHBOARD "1HNSB1".
16	CONTRACTOR SHALL MINIMIZE ANY OUTAGES DURING CONSTRUCTION WITH SERVICE RELOCATION. A TEMPORARY SERVICE SHALL BE PROVIDED VIA EXISTING GENERATOR OR PORTABLE GENERATOR DURING CHANGEOVER. CONTRACTOR SHALL COORDINATE ANY SERVICE DISRUPTIONS WITH OWNER AND ENGINEER.

1 **ELECTRICAL SITE PLAN**
1/32" = 1'-0"

0 8' 16' 24'

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

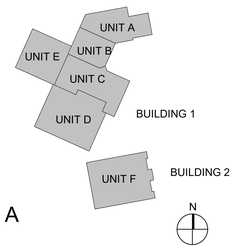
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	ADD-02	02/21/2022

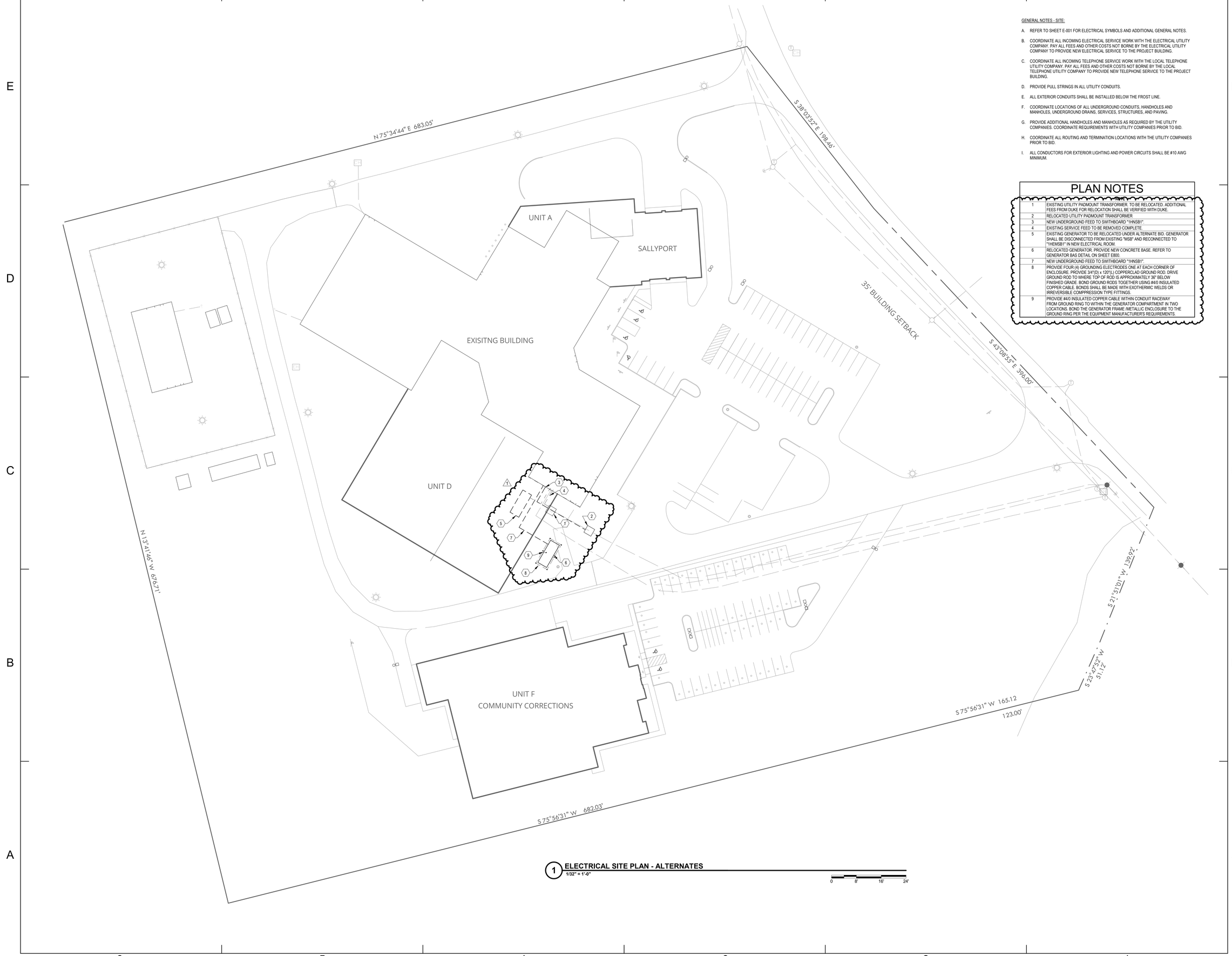
Project #: 20-700-151-2
Designed By: EAE
Drawn By: EAE
Checked By: DLJ
Date: 02.04.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT



ELECTRICAL SITE PLAN

E010



1 **ELECTRICAL SITE PLAN - ALTERNATES**
1/32" = 1'-0"

0 8' 16' 24'

GENERAL NOTES - SITE:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. COORDINATE ALL INCOMING ELECTRICAL SERVICE WORK WITH THE ELECTRICAL UTILITY COMPANY. PAY ALL FEES AND OTHER COSTS NOT BORNE BY THE ELECTRICAL UTILITY COMPANY TO PROVIDE NEW ELECTRICAL SERVICE TO THE PROJECT BUILDING.

C. COORDINATE ALL INCOMING TELEPHONE SERVICE WORK WITH THE LOCAL TELEPHONE UTILITY COMPANY. PAY ALL FEES AND OTHER COSTS NOT BORNE BY THE LOCAL TELEPHONE UTILITY COMPANY TO PROVIDE NEW TELEPHONE SERVICE TO THE PROJECT BUILDING.

D. PROVIDE PULL STRINGS IN ALL UTILITY CONDUITS.

E. ALL EXTERIOR CONDUITS SHALL BE INSTALLED BELOW THE FROST LINE.

F. COORDINATE LOCATIONS OF ALL UNDERGROUND CONDUITS, HANDHOLES AND MANHOLES, UNDERGROUND DRAINS, SERVICES, STRUCTURES, AND PAVING.

G. PROVIDE ADDITIONAL HANDHOLES AND MANHOLES AS REQUIRED BY THE UTILITY COMPANIES. COORDINATE REQUIREMENTS WITH UTILITY COMPANIES PRIOR TO BID.

H. COORDINATE ALL ROUTING AND TERMINATION LOCATIONS WITH THE UTILITY COMPANIES PRIOR TO BID.

I. ALL CONDUCTORS FOR EXTERIOR LIGHTING AND POWER CIRCUITS SHALL BE #10 AWG MINIMUM.

PLAN NOTES

NOTE	
1	EXISTING UTILITY PADMOUNT TRANSFORMER. TO BE RELOCATED. ADDITIONAL FEES FROM DUKE FOR RELOCATION SHALL BE VERIFIED WITH DUKE.
2	RELOCATED UTILITY PADMOUNT TRANSFORMER
3	NEW UNDERGROUND FEED TO SWITHBOARD "1HNSB1".
4	EXISTING SERVICE FEED TO BE REMOVED COMPLETE.
5	EXISTING GENERATOR TO BE RELOCATED UNDER ALTERNATE BID. GENERATOR SHALL BE DISCONNECTED FROM EXISTING "NSB" AND RECONNECTED TO "1HEMSB1" IN NEW ELECTRICAL ROOM.
6	RELOCATED GENERATOR. PROVIDE NEW CONCRETE BASE. REFER TO GENERATOR BAS DETAIL ON SHEET E800.
7	NEW UNDERGROUND FEED TO SWITHBOARD "1HNSB1".
8	PROVIDE FOUR (4) GROUNDING ELECTRODES ONE AT EACH CORNER OF ENCLOSURE. PROVIDE 3/4"(D) x 120"(L) COPPERCLAD GROUND ROD. DRIVE GROUND ROD TO WHERE TOP OF ROD IS APPROXIMATELY 36" BELOW FINISHED GRADE. BOND GROUND RODS TOGETHER USING #4/0 INSULATED COPPER CABLE. BONDS SHALL BE MADE WITH EXOTHERMIC WELDS OR IRREVERSIBLE COMPPRESSION TYPE FITTINGS.
9	PROVIDE #4/0 INSULATED COPPER CABLE WITHIN CONDUIT RACEWAY FROM GROUND RING TO WITHIN THE GENERATOR COMPARTMENT IN TWO LOCATIONS. BOND THE GENERATOR FRAME /METALLIC ENCLOSURE TO THE GROUND RING PER THE EQUIPMENT MANUFACTURER'S REQUIREMENTS.

RQAW
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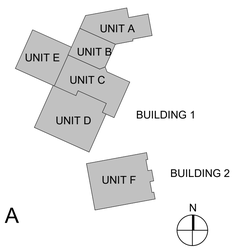

ELECTRICAL SITE PLAN - ALTERNATES

E011

PLAN NOTES

#	NOTE
1	DISCONNECT AND REMOVE ALL EQUIPMENT AND DEVICES INCLUDING BUT NOT LIMITED TO LIGHTING, RECEPTACLES, FIRE ALARM DEVICES, EXIT SIGNS, TELECOM, ELECTRICAL EQUIPMENT AND ASSOCIATED WIRING / CONDUIT, ETC., WITHIN DASHED LINE, UNLESS NOTED OTHERWISE. REMOVE BACK TO SOURCE. REMOVAL OF DEVICES SHALL BE COMPLETE. REFER TO GENERAL NOTES FOR ADDITIONAL INFORMATION.
2	DISCONNECT AND REMOVE ALL LIGHTING FIXTURES WITHIN THIS AREA UNLESS OTHERWISE NOTED. EXISTING CONDUIT AND WIRING FEEDING DEVICES SHALL REMAIN FOR CONNECTION TO NEW FIXTURES.
3	DISCONNECT AND REMOVE ALL ELECTRICAL DEVICES LOCATED WITHIN DEMOLISHED WALLS. REMOVE CONDUIT AND WIRING OF ASSOCIATED DEVICES BACK TO SOURCE COMPLETE. PROVIDE LABOR AND MATERIALS FOR REROUTING ANY CONDUIT AND WIRING LOCATED WITHIN WALLS AS REQUIRED.

FREEZER 1311
DRY STORAGE 1312
COOLER 1310
KITCHEN 1309
RR 1313
SALLY PORT 1314
OFFICE 1315
CHEM. STR. 1318
CHEM. STR. 1318
PROPERTY STORAGE 1125
DRESS 1129
SECURED CORRIDOR 1130
EXAM 1128B
STOR 1127
DRESS 1123
STAFF RR 1124
SECURED CORRIDOR 1130
VID COURT 2 1118
PADDED 1122
NURSE OFFICE 1120
RR 1121
RR 1117
WAITING 1110
RR 1113
PADDED 1114
PADDED 1115
ISO 1132
ISO 1133
ISO 1134
ISO 1135
ISO 1136
ISO 1137
ISO 1138
PADDED 1139A
RR 1139B

1 FIRST FLOOR ELECTRICAL DEMOLITION PLAN - UNITS B AND C
1/8" = 1'-0"
0 4' 8' 16'

RQAW ARCHITECTURE

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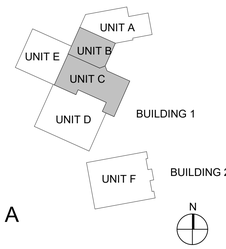
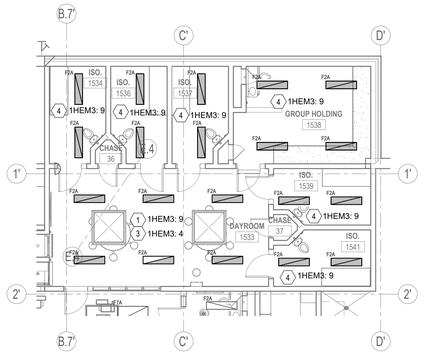


FIRST FLOOR ELECTRICAL DEMOLITION PLAN - UNITS B AND C

E110



1 **FIRST FLOOR LIGHTING PLAN - ALTERNATE A**
1/8" = 1'-0"

0 4' 8' 16'

GENERAL NOTES - LIGHTING:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO SPECIFICATION SECTION 260519 FOR MINIMUM CONDUCTOR SIZE REQUIRED BASED ON TOTAL CIRCUIT DISTANCE.

C. CONNECT ALL EXIT AND EGRESS LIGHTING WITH A MINIMUM OF #10AWG UNLESS NOTED OTHERWISE.

D. PROVIDE ALL OCCUPANCY/VACANCY SENSOR, POWER PACKS, AND ADDITIONAL RELAYS, ETC. AS REQUIRED FOR FULL COVERAGE OF ROOMS/AREAS INDICATED TO HAVE SUCH CONTROL.

E. WALL MOUNTED EXIT LIGHTS SHALL BE MOUNTED AT LEAST 1'-0" ABOVE EXIT OPENING UNLESS NOTED OTHERWISE. CONTRACTOR TO VERIFY HEIGHT OF EXIT OPENING PRIOR TO ROUGH-IN.

F. ALL OCCUPANCY SENSOR SHALL BE DUAL TECHNOLOGY (PASSIVE INFRARED AND ULTRASONIC) UNLESS NOTED OTHERWISE.

G. SCHEDULE A MEETING WITH THE OWNER PRIOR TO PROGRAMMING OF LIGHTING CONTROL DEVICES TO DETERMINE DESIRED CONTROL, TIME DELAY SETTINGS, OCCUPANCY, ETC.

H. ALL RECESSED LIGHTING FIXTURES IN LAY-IN CEILINGS SHALL BE INSTALLED WITH A FLEXIBLE METAL CONDUIT WITH MAXIMUM LENGTH OF 6 FEET.

I. LIGHT FIXTURES THAT ARE INSTALLED WITHIN A FIRE-RATED CEILING SHALL BE PROVIDED WITH FIRE RATED COVERS IN ORDER TO MAINTAIN THE CEILING FIRE RATINGS. FIRE RATED COVERS SHALL BE COVERS SUCH AS TENMAT FIRE PROTECTION SOLUTIONS OR SIMILAR. REFER TO ARCHITECTURAL DRAWINGS FOR ALL FIRE RATED CEILING LOCATIONS AND PROVIDE COVERS ACCORDINGLY.

J. OCCUPANCY SENSORS LOCATED IN SECURE AREAS MUST BE SUPPORTED BY UNISTRUT BRACKET.

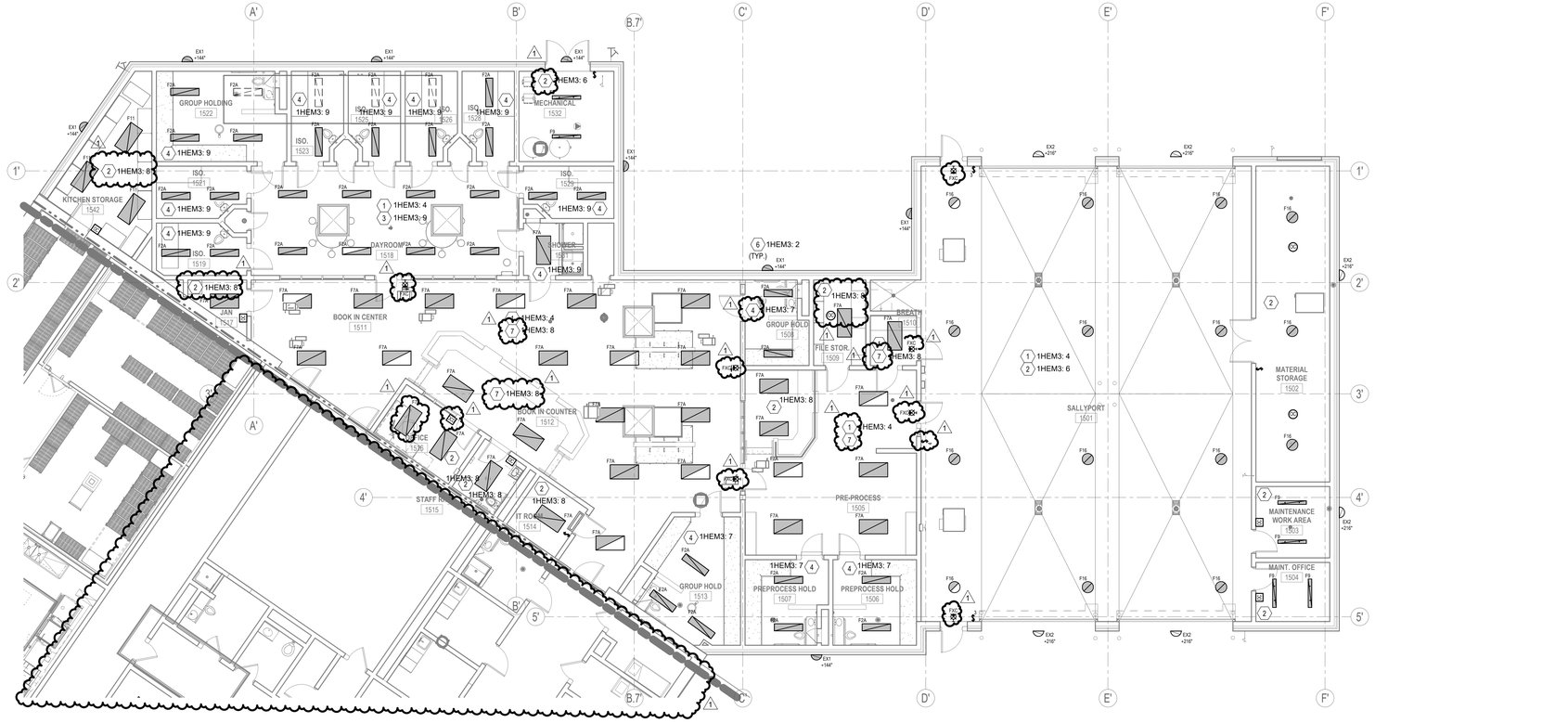
PLAN NOTES

#	NOTE
1	CONNECT COMPLETE EXIT AND UNSWITCHED EGRESS LIGHTS IN AREA A VIA CIRCUIT INDICATED.
2	CONNECT COMPLETE LIGHT FIXTURES WITHIN THIS ROOM / AREA VIA LIGHTING CONTROL DEVICE(S) SHOWN UTILIZING CIRCUIT INDICATED.
3	CONNECT COMPLETE LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. SWITCHED DAYROOM LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED.
4	CONNECT COMPLETE LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. SWITCHED CELL LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED.
6	ALL NEW WALL PACKS SHALL MATCH EXISTING HEIGHTS AT APPROX. THE HEIGHT SHOWN. EXTEND EXISTING SITE LIGHTING CONTROLS TO INCLUDE NEW CIRCUITS AS SHOWN. CONNECT COMPLETE ALL EXTERIOR WALL PACKS IN AREA A VIA CIRCUIT INDICATED.
7	CONNECT COMPLETE LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED.

LIGHTING CONTROL INTENT SCHEDULE

SPACE TYPE	DESCRIPTION
OFFICES CONFERENCE ROOMS TRAINING	LIGHTING IN THIS SPACE SHALL OPERATE AS MANUAL ON; MANUAL OR AUTO OFF. USER SHALL HAVE ON, OFF, RAISE, AND LOWER MANUAL OVERRIDE BUTTONS AT WALL CONTROLS.
ARMORY ELECTRICAL ROOMS TELECOM ROOMS SECURITY ROOMS	MANUAL LINE VOLTAGE SWITCH(ES). NO LIGHTING CONTROL SYSTEM INTEGRATION.
NON-CORRECTIONAL CORRIDORS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. NO MANUAL CONTROL.
BREAKROOMS LOCKER ROOMS RESTROOMS STORAGE JANITORS CLOSETS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. CONTROL VIA MANUAL ON/OFF SWITCH AT WALL OR AUTO ON/OFF VIA OCCUPANCY SENSOR.
VESTIBULES STAIRWELLS	LIGHTING SHALL DIM DOWN TO 50% OUTPUT, UNSWITCHED, IN UNOCCUPIED STATE. LIGHT OUTPUT TO INCREASE TO 100% WHEN OCCUPANY SENSOR DETECTS THE SPACE IS OCCUPIED.
MECHANICAL CHASES	THIS AREA IS CONTROLLED VIA DIGITAL PROGRAMMABLE TIMER SWITCH FOR TIME ON / TIME OFF OR MANUAL OFF OPERATION. TIME DURATION SHALL BE SELECTABLE AT EACH SWITCH. PROVIDE BLINK WARNING OF LIGHTS IN SPACE TWO MINUTES PRIOR TO TIME OFF.
DETENTION AREA INMATE ACCESSIBLE AREAS DRIVE IN SALLY PORT	SWITCHED CORRECTIONAL & DETENTION AREA LIGHTING CIRCUITS SHALL BE CONTROLLED VIA SECURITY RELAY PANEL.

NOTE: ROOM/SPACE CONTROL OPERATION SHALL NOT DEPEND ON "LAST STATE" USER INPUTS FOR HOW IT WILL OPERATE DAY TO DAY. REGARDLESS IF THE ROOM/SPACE HAS BEEN SHUT-OFF AUTOMATICALLY OR MANUALLY, AFTER ROOM SENSORS HAVE DETECTED NO OCCUPANTS FOR A PRESET TIME DELAY THEN THE ROOM CONTROLS SHALL REVERT BACK AND OPERATE AS DESCRIBED ABOVE.



2 **FIRST FLOOR LIGHTING PLAN - UNIT A**
1/8" = 1'-0"

0 4' 8' 16'

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	ADD-02	02/21/2022

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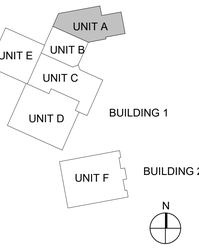
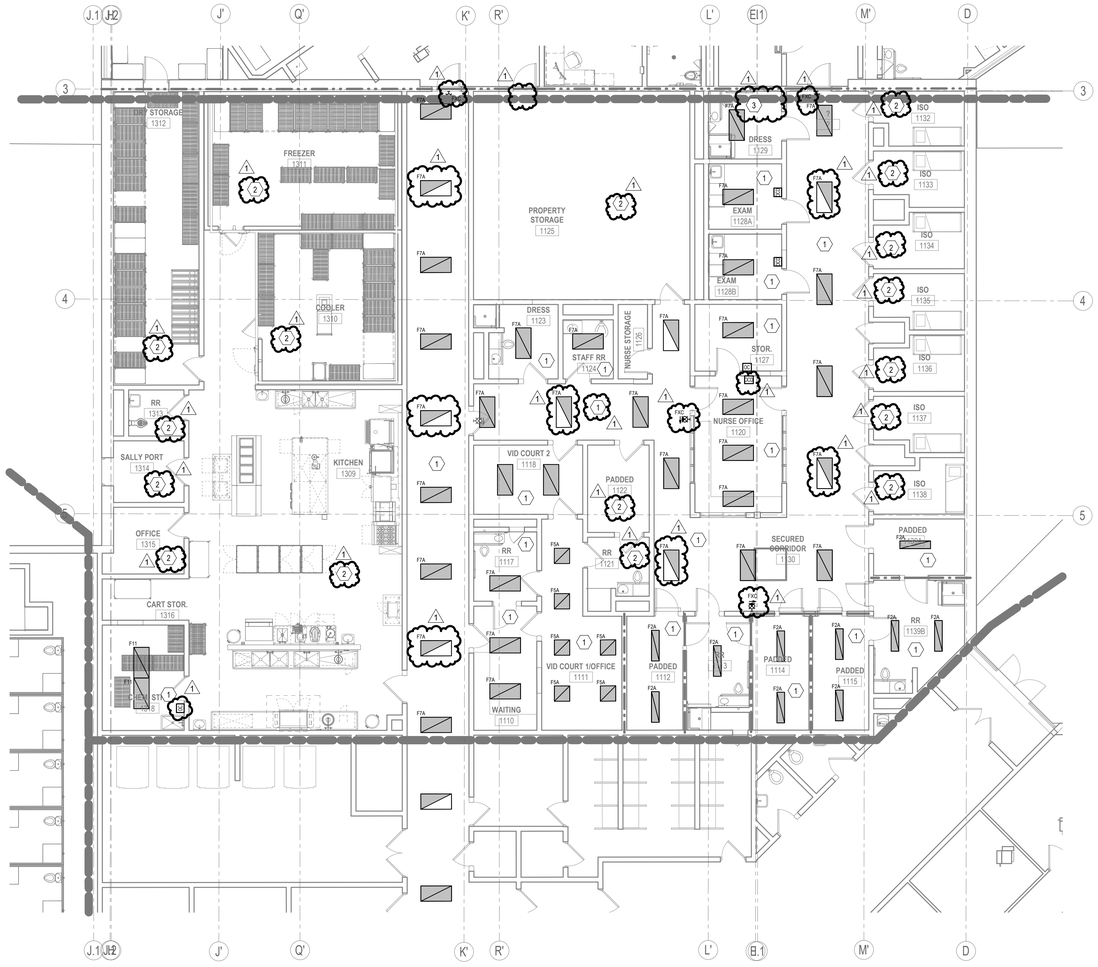


FIRST FLOOR LIGHTING PLAN - UNIT A

E210A



1 **FIRST FLOOR LIGHTING PLAN - UNIT B**
1/8" = 1'-0"
0 4' 8' 16'

GENERAL NOTES - LIGHTING:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO SPECIFICATION SECTION 260519 FOR MINIMUM CONDUCTOR SIZE REQUIRED BASED ON TOTAL CIRCUIT DISTANCE.

C. CONNECT ALL EXIT AND EGRESS LIGHTING WITH A MINIMUM OF #10AWG UNLESS NOTED OTHERWISE.

D. PROVIDE ALL OCCUPANCY/VACANCY SENSOR, POWER PACKS, AND ADDITIONAL RELAYS, ETC. AS REQUIRED FOR FULL COVERAGE OF ROOMS/AREAS INDICATED TO HAVE SUCH CONTROL.

E. WALL MOUNTED EXIT LIGHTS SHALL BE MOUNTED AT LEAST 1'-0" ABOVE EXIT OPENING UNLESS NOTED OTHERWISE. CONTRACTOR TO VERIFY HEIGHT OF EXIT OPENING PRIOR TO ROUGH-IN.

F. ALL OCCUPANCY SENSOR SHALL BE DUAL TECHNOLOGY (PASSIVE INFRARED AND ULTRASONIC) UNLESS NOTED OTHERWISE.

G. SCHEDULE A MEETING WITH THE OWNER PRIOR TO PROGRAMMING OF LIGHTING CONTROL DEVICES TO DETERMINE DESIRED CONTROL, TIME DELAY SETTINGS, OCCUPANCY, ETC.

H. ALL RECESSED LIGHTING FIXTURES IN LAY-IN CEILINGS SHALL BE INSTALLED WITH A FLEXIBLE METAL CONDUIT WITH MAXIMUM LENGTH OF 6 FEET.

I. LIGHT FIXTURES THAT ARE INSTALLED WITHIN A FIRE-RATED CEILING SHALL BE PROVIDED WITH FIRE RATED COVERS IN ORDER TO MAINTAIN THE CEILING FIRE RATINGS. FIRE RATED COVERS SHALL BE COVERS SUCH AS TENMAT FIRE PROTECTION SOLUTIONS OR SIMILAR. REFER TO ARCHITECTURAL DRAWINGS FOR ALL FIRE RATED CEILING LOCATIONS AND PROVIDE COVERS ACCORDINGLY.

J. OCCUPANCY SENSORS LOCATED IN SECURE AREAS MUST BE SUPPORTED BY UNISTRUT BRACKET.

PLAN NOTES

#	NOTE
1	CONNECT NEW FIXTURES IN THIS AREA TO EXISTING EMERGENCY CIRCUIT THAT FED REMOVED FIXTURES IN SAME AREA. REWORK CONTROLS, WIRING, AND CONDUITS AS REQUIRED.
3	CONNECT COMPLETE LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED.

LIGHTING CONTROL INTENT SCHEDULE

SPACE TYPE	DESCRIPTION
OFFICES CONFERENCE ROOMS TRAINING	LIGHTING IN THIS SPACE SHALL OPERATE AS MANUAL ON; MANUAL OR AUTO OFF. USER SHALL HAVE ON, OFF, RAISE, AND LOWER MANUAL OVERRIDE BUTTONS AT WALL CONTROLS.
ARMORY ELECTRICAL ROOMS TELECOM ROOMS SECURITY ROOMS	MANUAL LINE VOLTAGE SWITCH(ES). NO LIGHTING CONTROL SYSTEM INTEGRATION.
NON-CORRECTIONAL CORRIDORS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. NO MANUAL CONTROL.
BREAKROOMS LOCKER ROOMS RESTROOMS STORAGE JANITORS CLOSETS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. CONTROL VIA MANUAL ON/OFF SWITCH AT WALL OR AUTO ON/OFF VIA OCCUPANCY SENSOR.
VESTIBULES STAIRWELLS	LIGHTING SHALL DIM DOWN TO 50% OUTPUT, UNSWITCHED, IN UNOCCUPIED STATE. LIGHT OUTPUT TO INCREASE TO 100% WHEN OCCUPANY SENSOR DETECTS THE SPACE IS OCCUPIED.
MECHANICAL CHASES	THIS AREA IS CONTROLLED VIA DIGITAL PROGRAMMABLE TIMER SWITCH FOR TIME ON / TIME OFF OR MANUAL OFF OPERATION. TIME DURATION SHALL BE SELECTABLE AT EACH SWITCH. PROVIDE BLINK WARNING OF LIGHTS IN SPACE TWO MINUTES PRIOR TO TIME OFF.
DETENTION AREA, INMATE ACCESSIBLE AREAS DRIVE IN SALLY PORT	SWITCHED CORRECTIONAL & DETENTION AREA LIGHTING CIRCUITS SHALL BE CONTROLLED VIA SECURITY RELAY PANEL.

NOTE: ROOM/SPACE CONTROL OPERATION SHALL NOT DEPEND ON "LAST STATE" USER INPUTS FOR HOW IT WILL OPERATE DAY TO DAY. REGARDLESS IF THE ROOM/SPACE HAS BEEN SHUT-OFF AUTOMATICALLY OR MANUALLY, AFTER ROOM SENSORS HAVE DETECTED NO OCCUPANTS FOR A PRESET TIME DELAY THEN THE ROOM CONTROLS SHALL REVERT BACK AND OPERATE AS DESCRIBED ABOVE.

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

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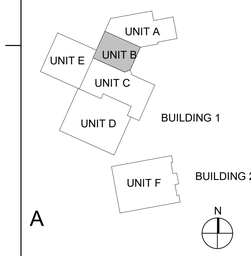
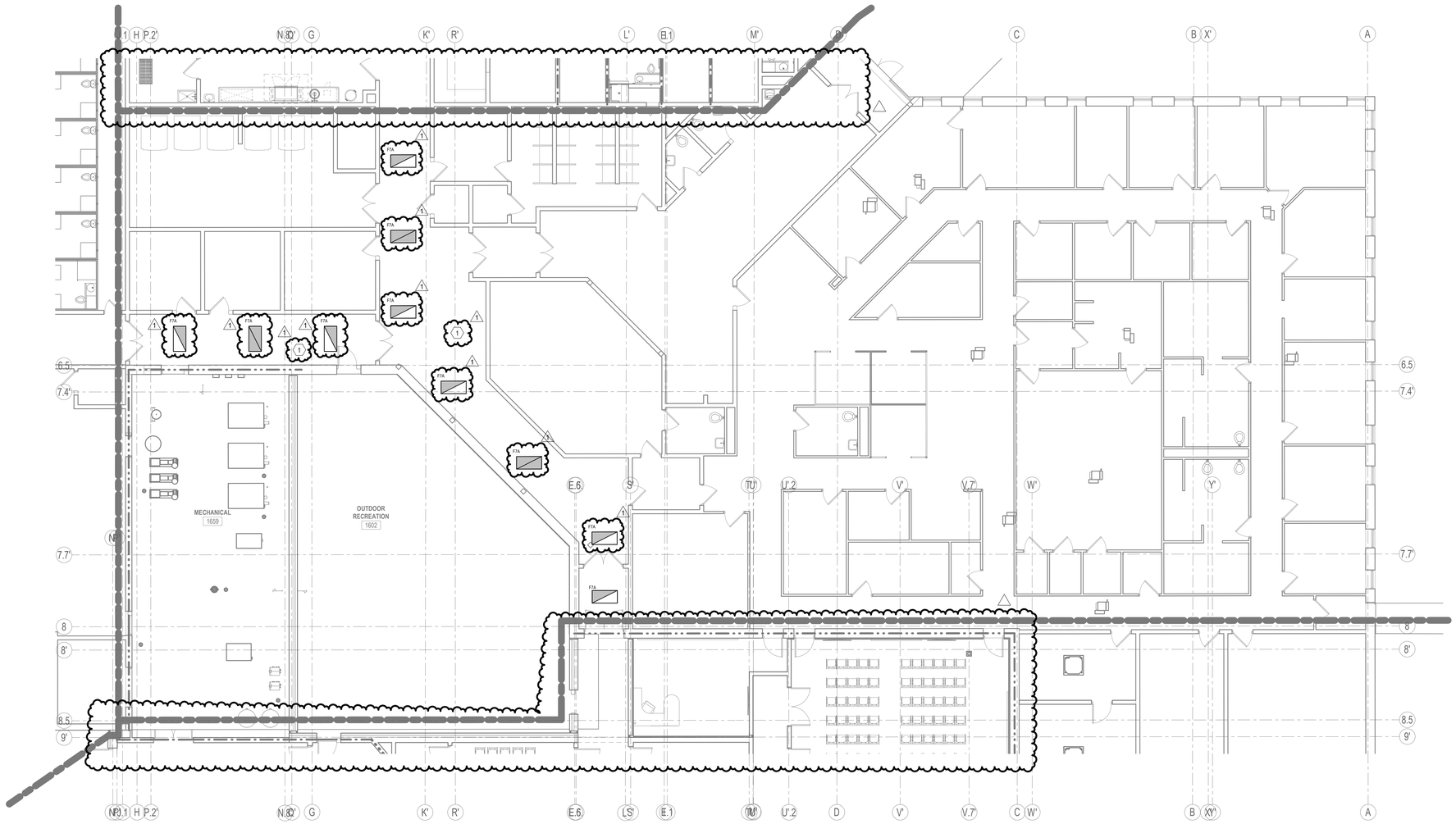


FIRST FLOOR LIGHTING PLAN - UNIT B

E210B



1 FIRST FLOOR LIGHTING PLAN - UNIT C
1/8" = 1'-0"
0 4' 8' 16'

GENERAL NOTES - LIGHTING:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO SPECIFICATION SECTION 260519 FOR MINIMUM CONDUCTOR SIZE REQUIRED BASED ON TOTAL CIRCUIT DISTANCE.

C. CONNECT ALL EXIT AND EGRESS LIGHTING WITH A MINIMUM OF #10AWG UNLESS NOTED OTHERWISE.

D. PROVIDE ALL OCCUPANCY/VACANCY SENSOR, POWER PACKS, AND ADDITIONAL RELAYS, ETC. AS REQUIRED FOR FULL COVERAGE OF ROOMS/AREAS INDICATED TO HAVE SUCH CONTROL.

E. WALL MOUNTED EXIT LIGHTS SHALL BE MOUNTED AT LEAST 1'-0" ABOVE EXIT OPENING UNLESS NOTED OTHERWISE. CONTRACTOR TO VERIFY HEIGHT OF EXIT OPENING PRIOR TO ROUGH-IN.

F. ALL OCCUPANCY SENSOR SHALL BE DUAL TECHNOLOGY (PASSIVE INFRARED AND ULTRASONIC) UNLESS NOTED OTHERWISE.

G. SCHEDULE A MEETING WITH THE OWNER PRIOR TO PROGRAMMING OF LIGHTING CONTROL DEVICES TO DETERMINE DESIRED CONTROL, TIME DELAY SETTINGS, OCCUPANCY, ETC.

H. ALL RECESSED LIGHTING FIXTURES IN LAY-IN CEILINGS SHALL BE INSTALLED WITH A FLEXIBLE METAL CONDUIT WITH MAXIMUM LENGTH OF 6 FEET.

I. LIGHT FIXTURES THAT ARE INSTALLED WITHIN A FIRE-RATED CEILING SHALL BE PROVIDED WITH FIRE RATED COVERS IN ORDER TO MAINTAIN THE CEILING FIRE RATINGS. FIRE RATED COVERS SHALL BE COVERS SUCH AS TENMAT FIRE PROTECTION SOLUTIONS OR SIMILAR. REFER TO ARCHITECTURAL DRAWINGS FOR ALL FIRE RATED CEILING LOCATIONS AND PROVIDE COVERS ACCORDINGLY.

J. OCCUPANCY SENSORS LOCATED IN SECURE AREAS MUST BE SUPPORTED BY UNISTRUT BRACKET.

PLAN NOTES

#	NOTE
1	CONNECT NEW FIXTURES IN THIS AREA TO EXISTING EMERGENCY CIRCUIT THAT FED REMOVED FIXTURES IN SAME AREA. REWORK CONTROLS, WIRING, AND CONDUITS AS REQUIRED.

LIGHTING CONTROL INTENT SCHEDULE

SPACE TYPE	DESCRIPTION
OFFICES CONFERENCE ROOMS TRAINING	LIGHTING IN THIS SPACE SHALL OPERATE AS MANUAL ON; MANUAL OR AUTO OFF. USER SHALL HAVE ON, OFF, RAISE, AND LOWER MANUAL OVERRIDE BUTTONS AT WALL CONTROLS.
ARMORY ELECTRICAL ROOMS TELECOM ROOMS SECURITY ROOMS	MANUAL LINE VOLTAGE SWITCH(ES). NO LIGHTING CONTROL SYSTEM INTEGRATION.
NON-CORRECTIONAL CORRIDORS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. NO MANUAL CONTROL.
BREAKROOMS LOCKER ROOMS RESTROOMS STORAGE JANITORS CLOSETS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. CONTROL VIA MANUAL ON/OFF SWITCH AT WALL OR AUTO ON/OFF VIA OCCUPANCY SENSOR.
VESTIBULES STAIRWELLS	LIGHTING SHALL DIM DOWN TO 50% OUTPUT, UNSWITCHED, IN UNOCCUPIED STATE. LIGHT OUTPUT TO INCREASE TO 100% WHEN OCCUPANY SENSOR DETECTS THE SPACE IS OCCUPIED.
MECHANICAL CHASES	THIS AREA IS CONTROLLED VIA DIGITAL PROGRAMMABLE TIMER SWITCH FOR TIME ON / TIME OFF OR MANUAL OFF OPERATION. TIME DURATION SHALL BE SELECTABLE AT EACH SWITCH. PROVIDE BLINK WARNING OF LIGHTS IN SPACE TWO MINUTES PRIOR TO TIME OFF.
DETENTION AREA, INMATE ACCESSIBLE AREAS DRIVE IN SALLY PORT	SWITCHED CORRECTIONAL & DETENTION AREA LIGHTING CIRCUITS SHALL BE CONTROLLED VIA SECURITY RELAY PANEL.

NOTE: ROOM/SPACE CONTROL OPERATION SHALL NOT DEPEND ON "LAST STATE" USER INPUTS FOR HOW IT WILL OPERATE DAY TO DAY. REGARDLESS IF THE ROOM/SPACE HAS BEEN SHUT-OFF AUTOMATICALLY OR MANUALLY, AFTER ROOM SENSORS HAVE DETECTED NO OCCUPANTS FOR A PRESET TIME DELAY THEN THE ROOM CONTROLS SHALL REVERT BACK AND OPERATE AS DESCRIBED ABOVE.

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

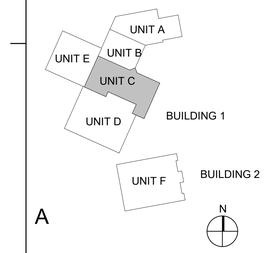
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	ADD-02	02/21/2022

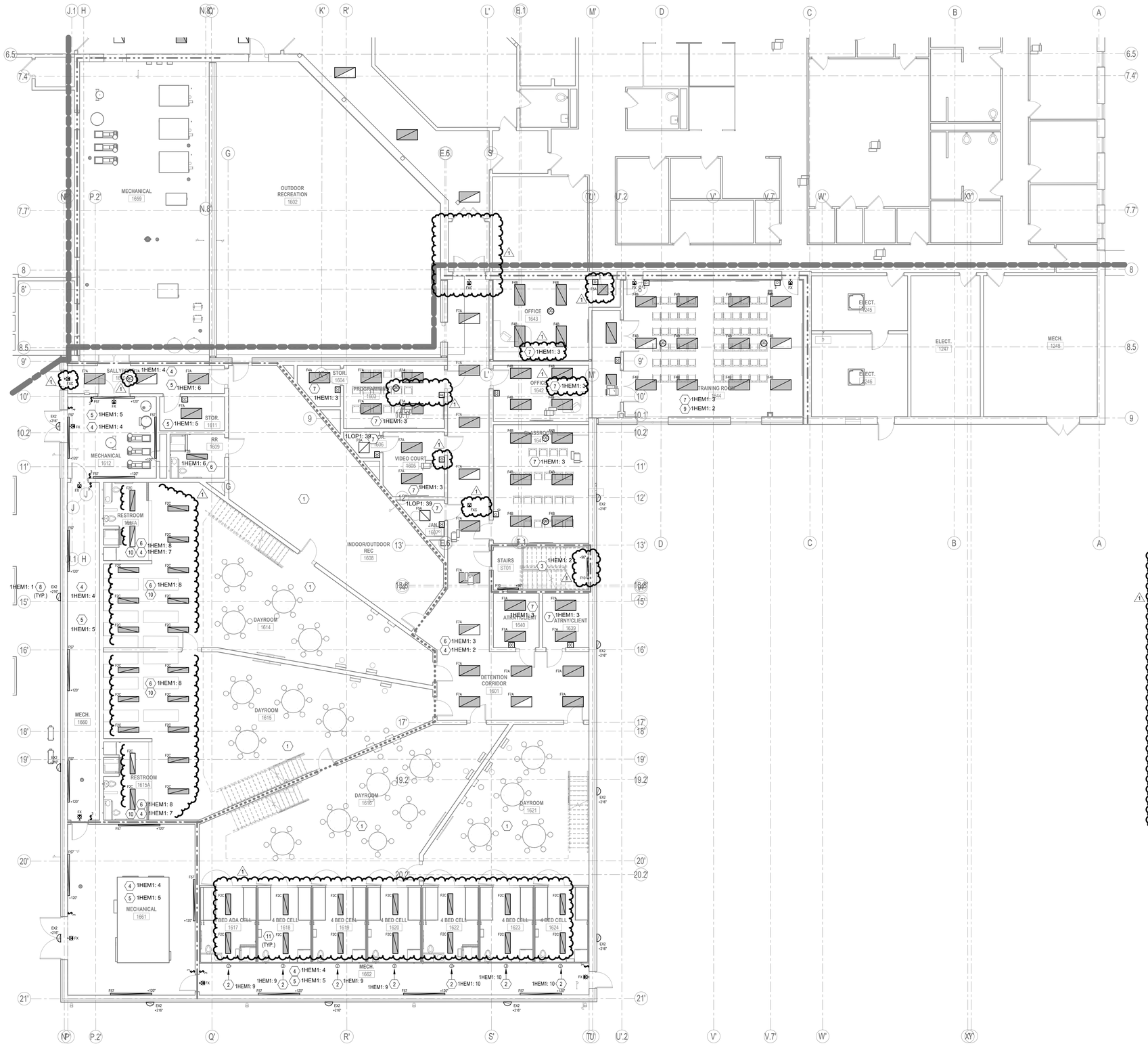
Project #: 20-700-151-2
Designed By: EAE
Drawn By: EAE
Checked By: DLJ
Date: 02.04.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT



FIRST FLOOR LIGHTING PLAN - UNIT C

E210C



1 **FIRST FLOOR LIGHTING PLAN - UNIT D**
1/8" = 1'-0"
0 4' 8' 16'

GENERAL NOTES - LIGHTING:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO SPECIFICATION SECTION 260519 FOR MINIMUM CONDUCTOR SIZE REQUIRED BASED ON TOTAL CIRCUIT DISTANCE.

C. CONNECT ALL EXIT AND EGRESS LIGHTING WITH A MINIMUM OF #10AWG UNLESS NOTED OTHERWISE.

D. PROVIDE ALL OCCUPANCY/VACANCY SENSOR, POWER PACKS, AND ADDITIONAL RELAYS, ETC. AS REQUIRED FOR FULL COVERAGE OF ROOMS/AREAS INDICATED TO HAVE SUCH CONTROL.

E. WALL MOUNTED EXIT LIGHTS SHALL BE MOUNTED AT LEAST 1'-0" ABOVE EXIT OPENING UNLESS NOTED OTHERWISE. CONTRACTOR TO VERIFY HEIGHT OF EXIT OPENING PRIOR TO ROUGH-IN.

F. ALL OCCUPANCY SENSOR SHALL BE DUAL TECHNOLOGY (PASSIVE INFRARED AND ULTRASONIC) UNLESS NOTED OTHERWISE.

G. SCHEDULE A MEETING WITH THE OWNER PRIOR TO PROGRAMMING OF LIGHTING CONTROL DEVICES TO DETERMINE DESIRED CONTROL, TIME DELAY SETTINGS, OCCUPANCY, ETC.

H. ALL RECESSED LIGHTING FIXTURES IN LAY-IN CEILINGS SHALL BE INSTALLED WITH A FLEXIBLE METAL CONDUIT WITH MAXIMUM LENGTH OF 6 FEET.

I. LIGHT FIXTURES THAT ARE INSTALLED WITHIN A FIRE-RATED CEILING SHALL BE PROVIDED WITH FIRE RATED COVERS IN ORDER TO MAINTAIN THE CEILING FIRE RATINGS. FIRE RATED COVERS SHALL BE COVERS SUCH AS TENMAT FIRE PROTECTION SOLUTIONS OR SIMILAR. REFER TO ARCHITECTURAL DRAWINGS FOR ALL FIRE RATED CEILING LOCATIONS AND PROVIDE COVERS ACCORDINGLY.

J. OCCUPANCY SENSORS LOCATED IN SECURE AREAS MUST BE SUPPORTED BY UNISTRUT BRACKET.

PLAN NOTES

#	NOTE
1	REFER TO LEVEL ABOVE FOR ADDITIONAL LIGHTING IN THIS AREA.
2	CELL LIGHTING PROVIDED INTEGRAL WITH CELL BY CELL MANUFACTURER. CELL LIGHTING IS PRE-WIRED TO JUNCTION BOX ON BACK OF CELL. EACH JUNCTION BOX CONTAINS LIGHT FIXTURE PIGTAILS WITH SWITCHED AND NIGHT LIGHT CIRCUITS. CONNECT COMPLETE SWITCHED CIRCUIT LEG VIA SECURITY CONTROLS RELAY CONTROL DEVICE SUCH THAT CELL LIGHTING IN EACH BLOCK IS CONTROLLED TOGETHER, WITH THE EXCEPTION OF THE ADA CELL. IT SHALL BE CONTROLLED VIA A DEDICATED REALY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL CONTROL INFORMATION AND PROVIDE CONNECTIONS ACCORDINGLY. CONNECT VIA CIRCUIT INDICATED. REFER TO SECOND FLOOR LIGHTING PLAN FOR ADDITIONAL INFORMATION.
3	STAIRWELL LIGHT FIXTURES SHALL BE PROVIDED WITH INTEGRAL OCCUPANCY SENSORS. STAIRWELL LIGHTING SHALL OPERATE AT 50% LIGHT OUTPUT UNSWITCHED, IN UNOCCUPIED STATE. LIGHT OUTPUT SHALL INCREASE TO 100% WHEN SPACE IS OCCUPIED. CONNECT COMPLETE VIA CIRCUIT INDICATED.
4	CONNECT COMPLETE UNSWITCHED EXIT AND EGRESS LIGHTING VIA CIRCUIT INDICATED.
5	CONNECT COMPLETE SWITCHED LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED.
6	CONNECT COMPLETE LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED.
7	CONNECT COMPLETE LIGHT FIXTURES WITHIN THIS ROOM / AREA VIA LIGHTING CONTROL DEVICE(S) SHOWN UTILIZING CIRCUIT INDICATED.
8	ALL NEW WALL PACKS SHALL MATCH EXISTING HEIGHTS AT APPROX. THE HEIGHT SHOWN. EXTEND EXISTING SITE LIGHTING CONTROLS TO INCLUDE NEW CIRCUITS AS SHOWN. CONNECT COMPLETE ALL EXTERIOR WALL PACKS IN AREA D VIA CIRCUIT INDICATED.
9	CONNECT COMPLETE EMERGENCY LIGHT FIXTURES WITHIN THIS ROOM / AREA VIA LIGHTING CONTROL DEVICE(S) SHOWN UTILIZING CIRCUIT INDICATED. EMERGENCY LIGHTING IN THIS AREA SHALL SWITCH ON/OFF WITH GENERAL ROOM LIGHTING, WILL CONTINUE POWERED FROM EMERGENCY CIRCUIT.
10	PROVIDE EACH SUAM AREA FIXTURE WITH INTEGRAL DIMMABLE NIGHT LIGHT SWITCH LEG AND DRIVER.
11	PREMANUFACTURED CELL FIXTURES SHALL BE THE SAME TYPE AND DESIGN AS TYPE F2C, AND PROVIDED BY CELL MANUFACTURER.

LIGHTING CONTROL INTENT SCHEDULE

SPACE TYPE	DESCRIPTION
OFFICES CONFERENCE ROOMS TRAINING	LIGHTING IN THIS SPACE SHALL OPERATE AS MANUAL ON; MANUAL OR AUTO OFF. USER SHALL HAVE ON, OFF, RAISE, AND LOWER MANUAL OVERRIDE BUTTONS AT WALL CONTROLS.
ARMORY ELECTRICAL ROOMS TELECOM ROOMS SECURITY ROOMS	MANUAL LINE VOLTAGE SWITCH(ES). NO LIGHTING CONTROL SYSTEM INTEGRATION.
NON-CORRECTIONAL CORRIDORS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. NO MANUAL CONTROL.
BREAKROOMS LOCKER ROOMS RESTROOMS STORAGE JANITORS CLOSETS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. CONTROL VIA MANUAL ON/OFF SWITCH AT WALL OR AUTO ON/OFF VIA OCCUPANCY SENSOR.
VESTIBULES STAIRWELLS	LIGHTING SHALL DIM DOWN TO 50% OUTPUT, UNSWITCHED, IN UNOCCUPIED STATE. LIGHT OUTPUT TO INCREASE TO 100% WHEN OCCUPANY SENSOR DETECTS THE SPACE IS OCCUPIED.
MECHANICAL CHASES	THIS AREA IS CONTROLLED VIA DIGITAL PROGRAMMABLE TIMER SWITCH FOR TIME ON / TIME OFF OR MANUAL OFF OPERATION. TIME DURATION SHALL BE SELECTABLE AT EACH SWITCH. PROVIDE BLINK WARNING OF LIGHTS IN SPACE TWO MINUTES PRIOR TO TIME OFF.
DETENTION AREA INMATE ACCESSIBLE AREAS DRIVE-IN SALLY PORT	SWITCHED CORRECTIONAL & DETENTION AREA LIGHTING CIRCUITS SHALL BE CONTROLLED VIA SECURITY RELAY PANEL.

NOTE: ROOM/SPACE CONTROL OPERATION SHALL NOT DEPEND ON "LAST STATE" USER INPUTS FOR HOW IT WILL OPERATE DAY TO DAY. REGARDLESS IF THE ROOM/SPACE HAS BEEN SHUT-OFF AUTOMATICALLY OR MANUALLY, AFTER ROOM SENSORS HAVE DETECTED NO OCCUPANTS FOR A PRESET TIME DELAY THEN THE ROOM CONTROLS SHALL REVERT BACK AND OPERATE AS DESCRIBED ABOVE.

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

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1	ADD-02	02/21/2022

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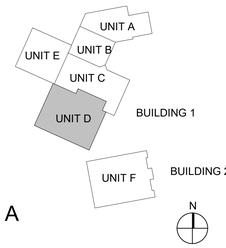


FIRST FLOOR LIGHTING PLAN - UNIT D

E210D

GENERAL NOTES - LIGHTING:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO SPECIFICATION SECTION 260519 FOR MINIMUM CONDUCTOR SIZE REQUIRED BASED ON TOTAL CIRCUIT DISTANCE.

C. CONNECT ALL EXIT AND EGRESS LIGHTING WITH A MINIMUM OF #10AWG UNLESS NOTED OTHERWISE.

D. PROVIDE ALL OCCUPANCY/VACANCY SENSOR, POWER PACKS, AND ADDITIONAL RELAYS, ETC. AS REQUIRED FOR FULL COVERAGE OF ROOMS/AREAS INDICATED TO HAVE SUCH CONTROL.

E. WALL MOUNTED EXIT LIGHTS SHALL BE MOUNTED AT LEAST 1'-0" ABOVE EXIT OPENING UNLESS NOTED OTHERWISE. CONTRACTOR TO VERIFY HEIGHT OF EXIT OPENING PRIOR TO ROUGH-IN.

F. ALL OCCUPANCY SENSOR SHALL BE DUAL TECHNOLOGY (PASSIVE INFRARED AND ULTRASONIC) UNLESS NOTED OTHERWISE.

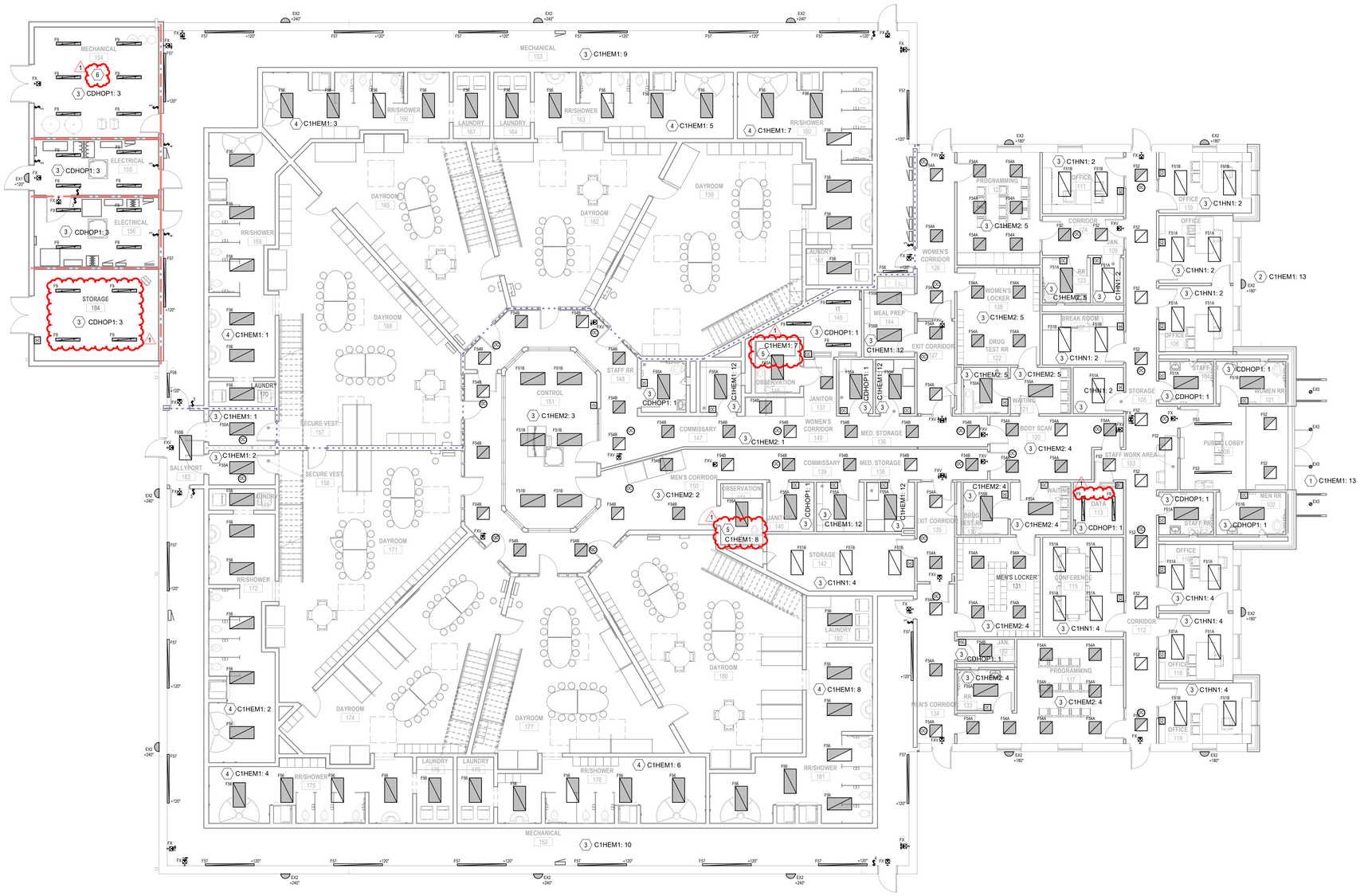
G. SCHEDULE A MEETING WITH THE OWNER PRIOR TO PROGRAMMING OF LIGHTING CONTROL DEVICES TO DETERMINE DESIRED CONTROL, TIME DELAY SETTINGS, OCCUPANCY, ETC.

H. ALL RECESSED LIGHTING FIXTURES IN LAY-IN CEILINGS SHALL BE INSTALLED WITH A FLEXIBLE METAL CONDUIT WITH MAXIMUM LENGTH OF 6 FEET.

I. LIGHT FIXTURES THAT ARE INSTALLED WITHIN A FIRE-RATED CEILING SHALL BE PROVIDED WITH FIRE RATED COVERS IN ORDER TO MAINTAIN THE CEILING FIRE RATINGS. FIRE RATED COVERS SHALL BE COVERS SUCH AS TENMAT FIRE PROTECTION SOLUTIONS OR SIMILAR. REFER TO ARCHITECTURAL DRAWINGS FOR ALL FIRE RATED CEILING LOCATIONS AND PROVIDE COVERS ACCORDINGLY.

PLAN NOTES

#	NOTE
1	INSTALL SURFACE MOUNT DOWNLIGHTS UNDERNEATH CANOPY. DO NOT DIRECTLY PENETRATE THROUGH BOX AND CANOPY STRUCTURE TO PREVENT WATER DAMAGE. CONNECT COMPLETE VIA LIGHTING CONTROL PANEL. REFER TO DRAWING E600 FOR ADDITIONAL INFORMATION.
2	CONNECT ALL EXTERIOR WALL PACKS IN AREA F TO CIRCUIT INDICATED, VIA LIGHTING CONTROL PANEL. REFER TO DRAWING E600 FOR ADDITIONAL INFORMATION.
3	CONNECT COMPLETE LIGHT FIXTURES WITHIN THIS ROOM VIA LIGHTING CONTROL DEVICE(S) SHOWN UTILIZING CIRCUIT INDICATED.
4	CONNECT COMPLETE LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. SWITCHED DAYROOM AND ASSOCIATE RESTROOM / LAUNDRY AREA LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED. REFER TO SECOND FLOOR DRAWINGS FOR ADDITIONAL DAYROOM LIGHTING.
5	CONNECT COMPLETE LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED.
6	COORDINATE EXACT LOCATIONS OF LIGHT FIXTURES WITHIN THIS SPACE WITH ALL DISCIPLINES. MODIFY LOCATIONS AND MOUNTING HEIGHTS AS REQUIRED TO ACCOMODATE DUCTWORK, PIPING, STRUCTURE, ETC.



1 FIRST FLOOR LIGHTING PLAN - UNIT F
1/8" = 1'-0"
0 4' 8' 16'

RQAW ARCHITECTURE

BID SET

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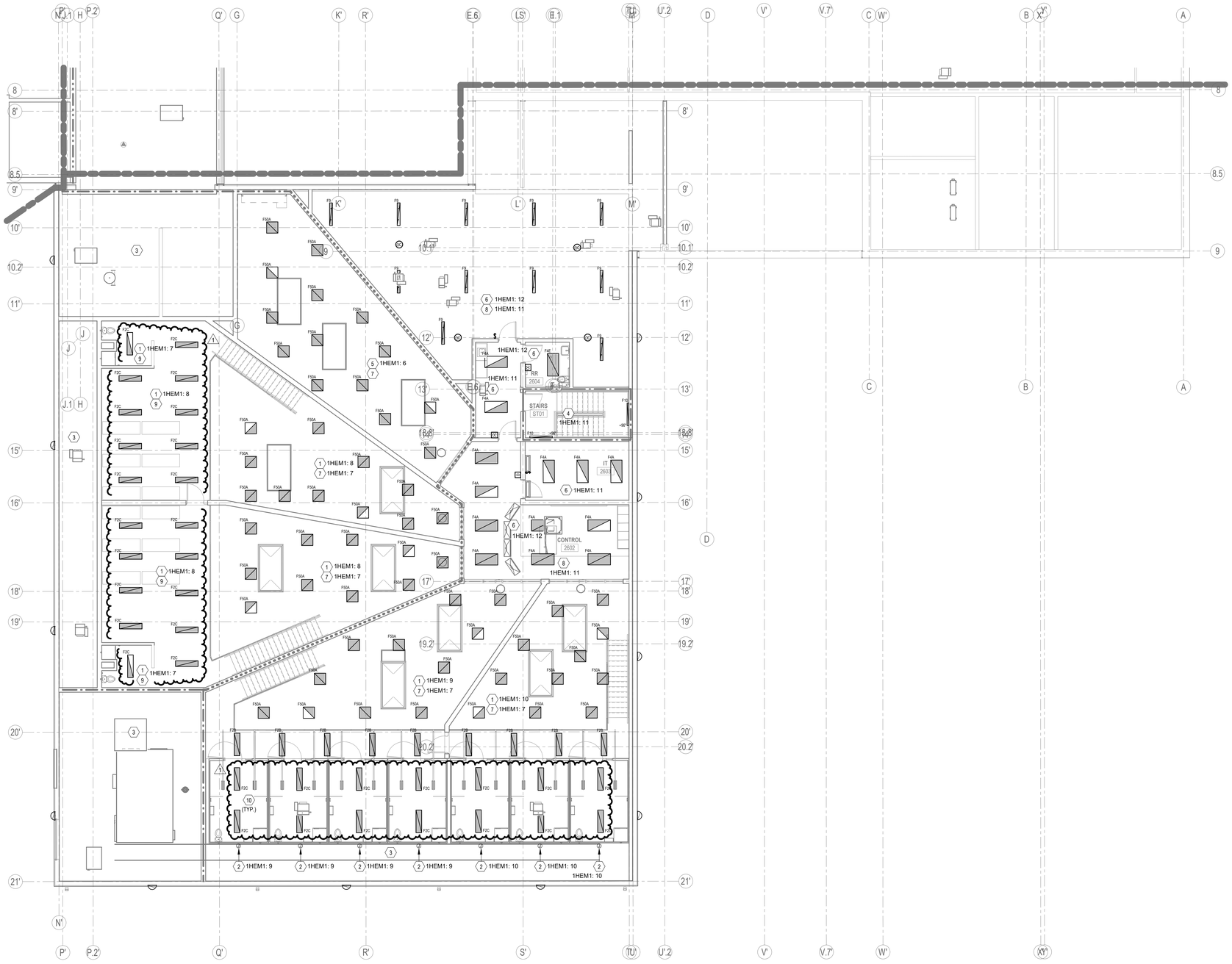
ERIC S. WERLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT

UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
BUILDING 1
UNIT F
BUILDING 2
N

FIRST FLOOR LIGHTING PLAN - UNIT F

E210F



1 **CONTROL ROOM / MEZZANINE LIGHTING PLAN - UNIT D**
1/8" = 1'-0"

0 4' 8' 16'

GENERAL NOTES - LIGHTING:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO SPECIFICATION SECTION 260519 FOR MINIMUM CONDUCTOR SIZE REQUIRED BASED ON TOTAL CIRCUIT DISTANCE.

C. CONNECT ALL EXIT AND EGRESS LIGHTING WITH A MINIMUM OF #10AWG UNLESS NOTED OTHERWISE.

D. PROVIDE ALL OCCUPANCY/VACANCY SENSOR, POWER PACKS, AND ADDITIONAL RELAYS, ETC. AS REQUIRED FOR FULL COVERAGE OF ROOMS/AREAS INDICATED TO HAVE SUCH CONTROL.

E. WALL MOUNTED EXIT LIGHTS SHALL BE MOUNTED AT LEAST 1'-0" ABOVE EXIT OPENING UNLESS NOTED OTHERWISE. CONTRACTOR TO VERIFY HEIGHT OF EXIT OPENING PRIOR TO ROUGH-IN.

F. ALL OCCUPANCY SENSOR SHALL BE DUAL TECHNOLOGY (PASSIVE INFRARED AND ULTRASONIC) UNLESS NOTED OTHERWISE.

G. SCHEDULE A MEETING WITH THE OWNER PRIOR TO PROGRAMMING OF LIGHTING CONTROL DEVICES TO DETERMINE DESIRED CONTROL, TIME DELAY SETTINGS, OCCUPANCY, ETC.

H. ALL RECESSED LIGHTING FIXTURES IN LAY-IN CEILINGS SHALL BE INSTALLED WITH A FLEXIBLE METAL CONDUIT WITH MAXIMUM LENGTH OF 6 FEET.

I. LIGHT FIXTURES THAT ARE INSTALLED WITHIN A FIRE-RATED CEILING SHALL BE PROVIDED WITH FIRE RATED COVERS IN ORDER TO MAINTAIN THE CEILING FIRE RATINGS. FIRE RATED COVERS SHALL BE COVERS SUCH AS TENMAT FIRE PROTECTION SOLUTIONS OR SIMILAR. REFER TO ARCHITECTURAL DRAWINGS FOR ALL FIRE RATED CEILING LOCATIONS AND PROVIDE COVERS ACCORDINGLY.

J. OCCUPANCY SENSORS LOCATED IN SECURE AREAS MUST BE SUPPORTED BY UNISTRUT BRACKET.

PLAN NOTES

#	NOTE
1	CONNECT COMPLETE LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. SWITCHED DAYROOM LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED.
2	CELL LIGHTING PROVIDED INTEGRAL WITH CELL BY CELL MANUFACTURER. CELL LIGHTING IS PRE-WIRED TO JUNTION BOX ON BACK OF CELL. EACH JUNCTION BOX CONTAINS LIGHT FIXTURE PIGTAILS WITH SWITCHED AND NIGHT LIGHT CIRCUITS. CONNECT COMPLETE SWITCHED CIRCUIT LEG VIA SECURITY CONTROLS RELAY CONTROL DEVICE SUCH THAT CELL LIGHTING IN EACH BLOCK IS CONTROLLED TOGETHER, WITH THE EXCEPTION OF THE ADA CELL, IT SHALL BE CONTROLLED VIA A DEDICATED RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL CONTROL INFORMATION AND PROVIDE CONNECTIONS ACCORDINGLY. CONNECT VIA CIRCUIT INDICATED.
3	REFER TO LEVEL BELOW FOR ADDITIONAL INFORMATION IN THIS AREA.
4	STAIRWELL LIGHT FIXTURES SHALL BE PROVIDED WITH INTEGRAL OCCUPANCY SENSORS. STAIRWELL LIGHTING SHALL OPERATE AT 50% LIGHT OUTPUT UNSWITCHED, IN UNOCCUPIED STATE. LIGHT OUTPUT SHALL INCREASE TO 100% WHEN SPACE IS OCCUPIED. CONNECT COMPLETE VIA CIRCUIT INDICATED.
5	CONNECT COMPLETE LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED.
6	CONNECT COMPLETE LIGHT FIXTURES WITHIN THIS ROOM / AREA VIA LIGHTING CONTROL DEVICE(S) SHOWN UTILIZING CIRCUIT INDICATED.
7	CONNECT COMPLETE EMERGENCY LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED.
8	CONNECT COMPLETE EMERGENCY LIGHT FIXTURES WITHIN THIS ROOM / AREA VIA LIGHTING CONTROL DEVICE(S) SHOWN UTILIZING CIRCUIT INDICATED.
9	PROVIDE EACH BUNK AREA FIXTURE WITH INTEGRAL DIMMABLE NIGHT LIGHT SWITCH LEG AND DRIVER.
10	PREMANUFACTURED CELL FIXTURES SHALL BE THE SAME TYPE AND DESIGN AS TYPE F2C, AND PROVIDED BY CELL MANUFACTURER.

LIGHTING CONTROL INTENT SCHEDULE

SPACE TYPE	DESCRIPTION
OFFICES CONFERENCE ROOMS TRAINING	LIGHTING IN THIS SPACE SHALL OPERATE AS MANUAL ON; MANUAL OR AUTO OFF. USER SHALL HAVE ON, OFF, RAISE, AND LOWER MANUAL OVERRIDE BUTTONS AT WALL CONTROLS.
ARMORY ELECTRICAL ROOMS TELECOM ROOMS SECURITY ROOMS	MANUAL LINE VOLTAGE SWITCH(ES). NO LIGHTING CONTROL SYSTEM INTEGRATION.
NON-CORRECTIONAL CORRIDORS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. NO MANUAL CONTROL.
BREAKROOMS LOCKER ROOMS RESTROOMS STORAGE JANITORS CLOSETS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. CONTROL VIA MANUAL ON/OFF SWITCH AT WALL OR AUTO ON/OFF VIA OCCUPANCY SENSOR.
VESTIBULES STAIRWELLS	LIGHTING SHALL DIM DOWN TO 50% OUTPUT, UNSWITCHED, IN UNOCCUPIED STATE. LIGHT OUTPUT TO INCREASE TO 100% WHEN OCCUPANY SENSOR DETECTS THE SPACE IS OCCUPIED.
MECHANICAL CHASES	THIS AREA IS CONTROLLED VIA DIGITAL PROGRAMMABLE TIMER SWITCH FOR TIME ON / TIME OFF OR MANUAL OFF OPERATION. TIME DURATION SHALL BE SELECTABLE AT EACH SWITCH. PROVIDE BLINK WARNING OF LIGHTS IN SPACE TWO MINUTES PRIOR TO TIME OFF.
DETENTION AREA INMATE ACCESSIBLE AREAS DRIVE IN SALLY PORT	SWITCHED CORRECTIONAL & DETENTION AREA LIGHTING CIRCUITS SHALL BE CONTROLLED VIA SECURITY RELAY PANEL.

NOTE: ROOM/SPACE CONTROL OPERATION SHALL NOT DEPEND ON "LAST STATE" USER INPUTS FOR HOW IT WILL OPERATE DAY TO DAY. REGARDLESS IF THE ROOM/SPACE HAS BEEN SHUT-OFF AUTOMATICALLY OR MANUALLY, AFTER ROOM SENSORS HAVE DETECTED NO OCCUPANTS FOR A PRESET TIME DELAY THEN THE ROOM CONTROLS SHALL REVERT BACK AND OPERATE AS DESCRIBED ABOVE.

RQAW ARCHITECTURE

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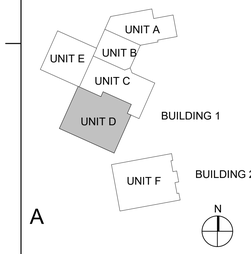
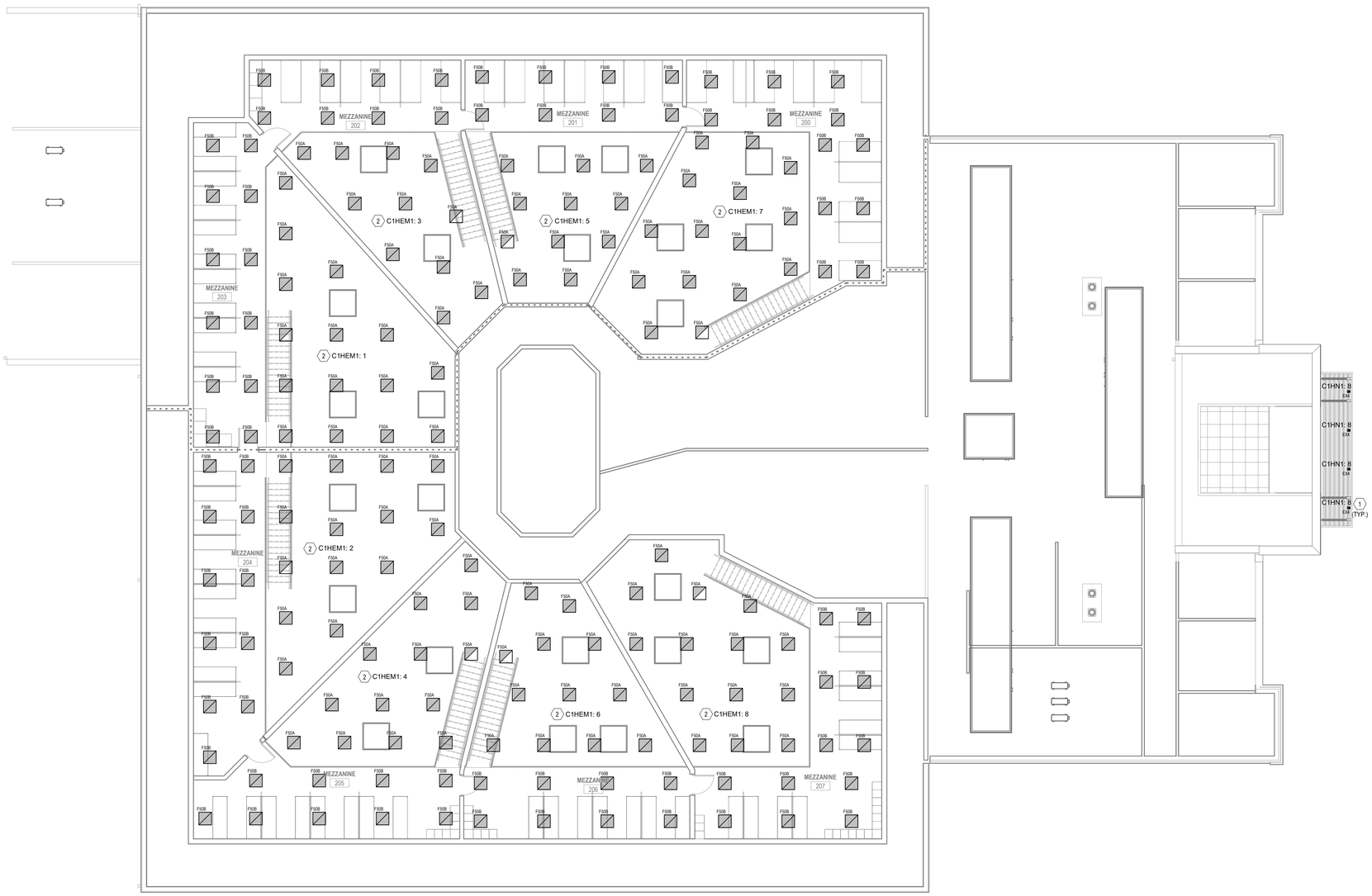


SECOND FLOOR
LIGHTING PLAN - UNIT D

E220D



1 **CONTROL ROOM / MEZZANINE LIGHTING PLAN - UNIT F**
1/8" = 1'-0"
0 4' 8' 16'

GENERAL NOTES - LIGHTING:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

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E. WALL MOUNTED EXIT LIGHTS SHALL BE MOUNTED AT LEAST 1'-0" ABOVE EXIT OPENING UNLESS NOTED OTHERWISE. CONTRACTOR TO VERIFY HEIGHT OF EXIT OPENING PRIOR TO ROUGH-IN.

F. ALL OCCUPANCY SENSOR SHALL BE DUAL TECHNOLOGY (PASSIVE INFRARED AND ULTRASONIC) UNLESS NOTED OTHERWISE.

G. SCHEDULE A MEETING WITH THE OWNER PRIOR TO PROGRAMMING OF LIGHTING CONTROL DEVICES TO DETERMINE DESIRED CONTROL, TIME DELAY SETTINGS, OCCUPANCY, ETC.

H. ALL RECESSED LIGHTING FIXTURES IN LAY-IN CEILINGS SHALL BE INSTALLED WITH A FLEXIBLE METAL CONDUIT WITH MAXIMUM LENGTH OF 6 FEET.

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PLAN NOTES

#	NOTE
1	INSTALL TYPE EX4 FLOODLIGHTS ABOVE CANOPY STRUCTURE. COORDINATE FASTENERS TO PREVENT WATER LEAKING THROUGH. ADJUST FLOODLIGHTS AT NIGHT. PROVIDE DIMMING SWITCH CONTROL, IN CONJUNCTION WITH LIGHTING CONTROL RELAY PANEL. REFER TO DRAWING E600 FOR ADDITIONAL INFORMATION.
2	CONNECT COMPLETE LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. SWITCHED DAYROOM LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED.

1

LIGHTING CONTROL INTENT SCHEDULE

SPACE TYPE	DESCRIPTION
OFFICES CONFERENCE ROOMS TRAINING	LIGHTING IN THIS SPACE SHALL OPERATE AS MANUAL ON; MANUAL OR AUTO OFF. USER SHALL HAVE ON, OFF, RAISE, AND LOWER MANUAL OVERRIDE BUTTONS AT WALL CONTROLS.
ARMORY ELECTRICAL ROOMS TELECOM ROOMS SECURITY ROOMS	MANUAL LINE VOLTAGE SWITCH(ES). NO LIGHTING CONTROL SYSTEM INTEGRATION.
NON-CORRECTIONAL CORRIDORS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. NO MANUAL CONTROL.
BREAKROOMS LOCKER ROOMS RESTROOMS STORAGE JANITORS CLOSETS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. CONTROL VIA MANUAL ON/OFF SWITCH AT WALL OR AUTO ON/OFF VIA OCCUPANCY SENSOR.
VESTIBULES STAIRWELLS	LIGHTING SHALL DIM DOWN TO 50% OUTPUT, UNSWITCHED, IN UNOCCUPIED STATE. LIGHT OUTPUT TO INCREASE TO 100% WHEN OCCUPANY SENSOR DETECTS THE SPACE IS OCCUPIED.
MECHANICAL CHASES	THIS AREA IS CONTROLLED VIA DIGITAL PROGRAMMABLE TIMER SWITCH FOR TIME ON / TIME OFF OR MANUAL OFF OPERATION. TIME DURATION SHALL BE SELECTABLE AT EACH SWITCH. PROVIDE BLINK WARNING OF LIGHTS IN SPACE TWO MINUTES PRIOR TO TIME OFF.
DETENTION AREA INMATE ACCESSIBLE AREAS DRIVE IN SALLY PORT	SWITCHED CORRECTIONAL & DETENTION AREA LIGHTING CIRCUITS SHALL BE CONTROLLED VIA SECURITY RELAY PANEL.

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UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
UNIT F
BUILDING 1
BUILDING 2
N

SECOND FLOOR
LIGHTING PLAN - UNIT F

E220F

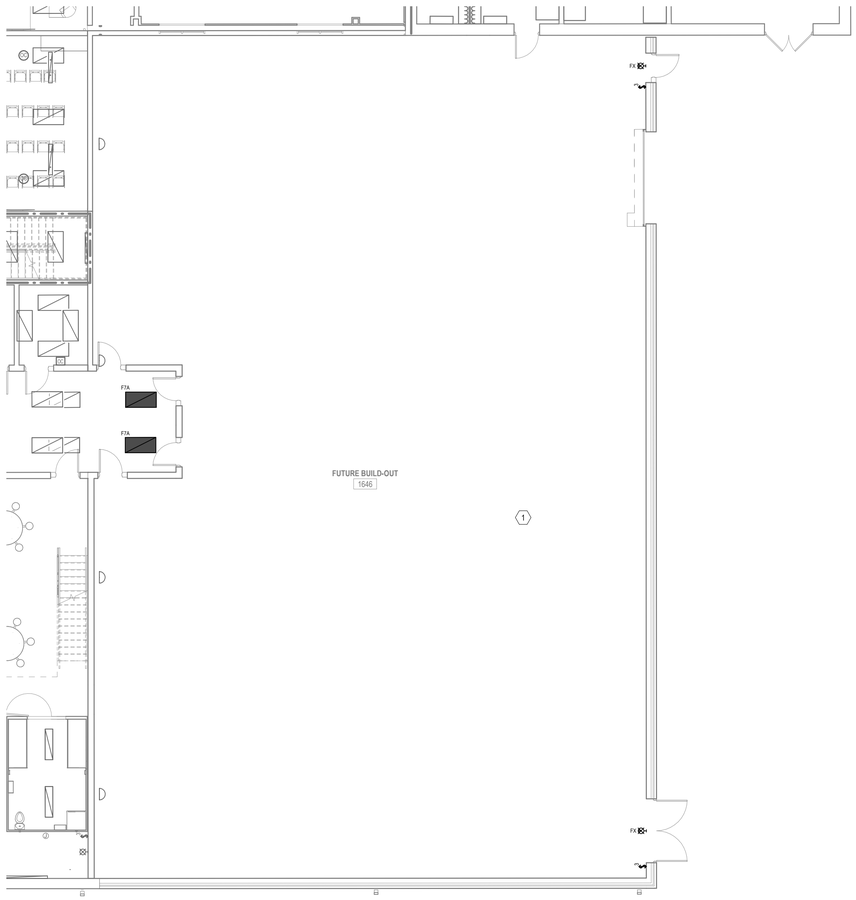
LIGHTING CONTROL INTENT SCHEDULE

SPACE TYPE	DESCRIPTION
OFFICES CONFERENCE ROOMS TRAINING	LIGHTING IN THIS SPACE SHALL OPERATE AS MANUAL ON; MANUAL OR AUTO OFF. USER SHALL HAVE ON, OFF, RAISE, AND LOWER MANUAL OVERRIDE BUTTONS AT WALL CONTROLS.
ARMORY ELECTRICAL ROOMS TELECOM ROOMS SECURITY ROOMS	MANUAL LINE VOLTAGE SWITCH(ES). NO LIGHTING CONTROL SYSTEM INTEGRATION.
NON-CORRECTIONAL CORRIDORS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. NO MANUAL CONTROL.
BREAKROOMS LOCKER ROOMS RESTROOMS STORAGE JANITORS CLOSETS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. CONTROL VIA MANUAL ON/OFF SWITCH AT WALL OR AUTO ON/OFF VIA OCCUPANCY SENSOR.
VESTIBULES STAIRWELLS	LIGHTING SHALL DIM DOWN TO 50% OUTPUT, UNSWITCHED, IN UNOCCUPIED STATE. LIGHT OUTPUT TO INCREASE TO 100% WHEN OCCUPANY SENSOR DETECTS THE SPACE IS OCCUPIED.
MECHANICAL CHASES	THIS AREA IS CONTROLLED VIA DIGITAL PROGRAMMABLE TIMER SWITCH FOR TIME ON / TIME OFF OR MANUAL OFF OPERATION. TIME DURATION SHALL BE SELECTABLE AT EACH SWITCH. PROVIDE BLINK WARNING OF LIGHTS IN SPACE TWO MINUTES PRIOR TO TIME OFF.
DETENTION AREA, INMATE ACCESSIBLE AREAS DRIVE IN SALLY PORT	SWITCHED CORRECTIONAL & DETENTION AREA LIGHTING CIRCUITS SHALL BE CONTROLLED VIA SECURITY RELAY PANEL.

NOTE: ROOM/SPACE CONTROL OPERATION SHALL NOT DEPEND ON "LAST STATE" USER INPUTS FOR HOW IT WILL OPERATE DAY TO DAY. REGARDLESS IF THE ROOM/SPACE HAS BEEN SHUT-OFF AUTOMATICALLY OR MANUALLY, AFTER ROOM SENSORS HAVE DETECTED NO OCCUPANTS FOR A PRESET TIME DELAY THEN THE ROOM CONTROLS SHALL REVERT BACK AND OPERATE AS DESCRIBED ABOVE.

PLAN NOTES

#	NOTE
1	REFER TO LEVEL ABOVE FOR ADDITIONAL LIGHTING IN THIS AREA.
2	CONNECT COMPLETE LIGHT FIXTURES WITHIN THIS ROOM / AREA VIA LIGHTING CONTROL DEVICE(S) SHOWN UTILIZING CIRCUIT INDICATED.
3	CONNECT COMPLETE LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED.
4	CONNECT COMPLETE UNSWITCHED EXIT AND EGRESS LIGHTING VIA CIRCUIT INDICATED.
5	CONNECT COMPLETE SWITCHED LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED.
6	CELL LIGHTING PROVIDED INTEGRAL WITH CELL BY CELL MANUFACTURER. CELL LIGHTING IS PRE-WIRED TO JUNTION BOX ON BACK OF CELL. EACH JUNCTION BOX CONTAINS LIGHT FIXTURE PIGTAILS WITH SWITCHED AND NIGHT LIGHT CIRCUITS. CONNECT COMPLETE SWITCHED CIRCUIT LEG VIA SECURITY CONTROLS RELAY CONTROL DEVICE SUCH THAT CELL LIGHTING IN EACH BLOCK IS CONTROLLED TOGETHER, WITH THE EXCEPTION OF THE ADA CELL. IT SHALL BE CONTROLLED VIA A DEDICATED REALY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL CONTROL INFORMATION AND PROVIDE CONNECTIONS ACCORDINGLY. CONNECT VIA CIRCUIT INDICATED. REFER TO SECOND FLOOR LIGHTING PLAN FOR ADDITIONAL INFORMATION.



1 FIRST FLOOR LIGHTING PLAN - UNIT D_ALTERNATE D
1/8" = 1'-0"
0 4' 8' 16'

2 FIRST FLOOR LIGHTING PLAN - UNIT D_ALTERNATES D1-D3
1/8" = 1'-0"
0 4' 8' 16'

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

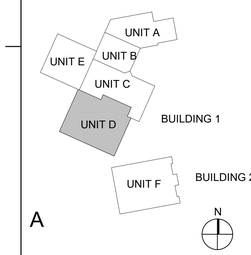
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	ADD-02	02/21/2022

Project #: 20-700-151-2
Designed By: EAE
Drawn By: EAE
Checked By: DLJ
Date: 02.04.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT



ELECTRICAL LIGHTING PLANS - UNIT D - ALTERNATE BIDS

E290D

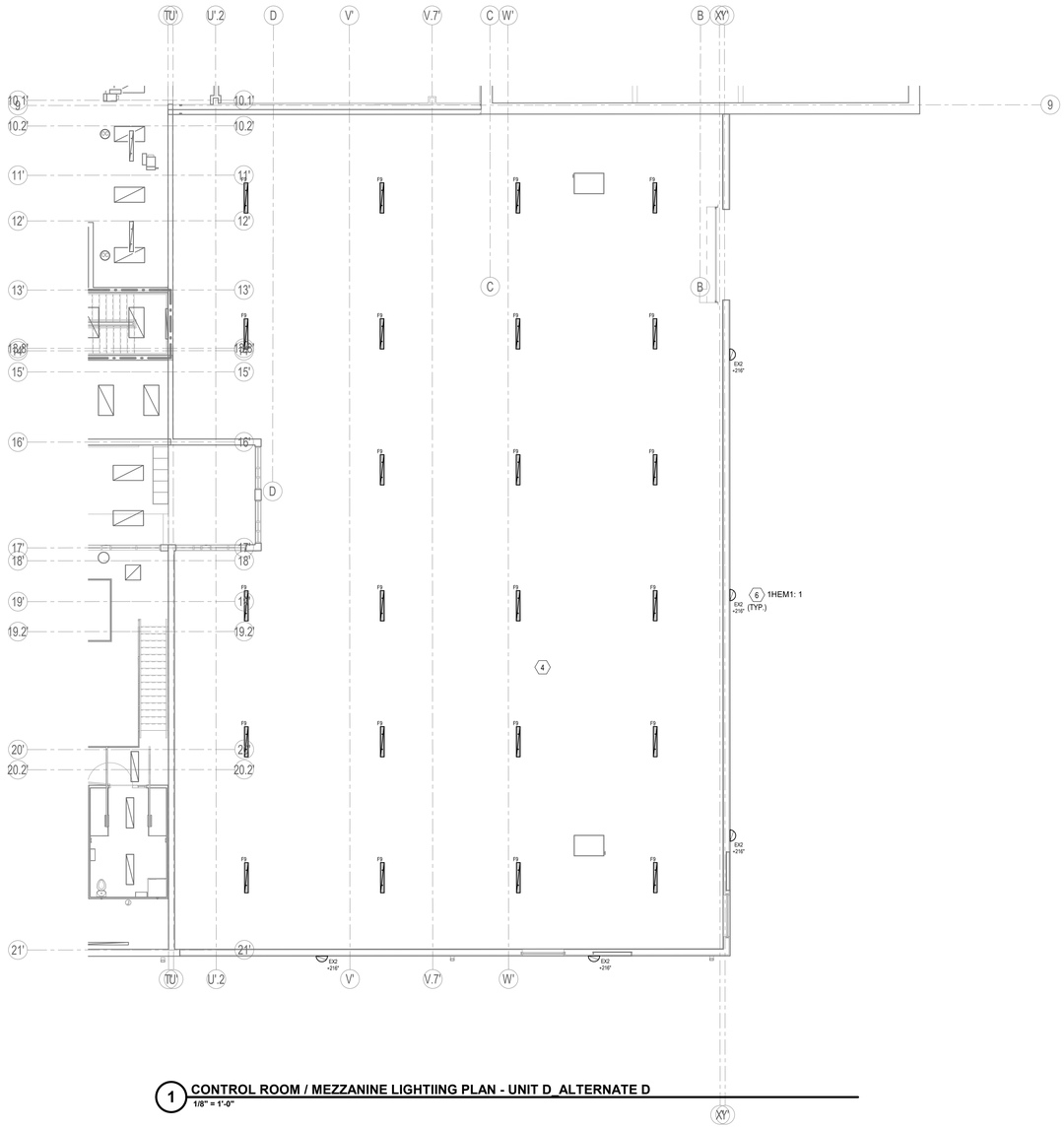
LIGHTING CONTROL INTENT SCHEDULE

SPACE TYPE	DESCRIPTION
OFFICES CONFERENCE ROOMS TRAINING	LIGHTING IN THIS SPACE SHALL OPERATE AS MANUAL ON; MANUAL OR AUTO OFF. USER SHALL HAVE ON, OFF, RAISE, AND LOWER MANUAL OVERRIDE BUTTONS AT WALL CONTROLS.
ARMORY ELECTRICAL ROOMS TELECOM ROOMS SECURITY ROOMS	MANUAL LINE VOLTAGE SWITCH(ES). NO LIGHTING CONTROL SYSTEM INTEGRATION.
NON-CORRECTIONAL CORRIDORS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. NO MANUAL CONTROL.
BREAKROOMS LOCKER ROOMS RESTROOMS STORAGE JANITORS CLOSETS	LIGHTING IN THIS ROOM SHALL OPERATE AS AUTO ON/ AUTO OFF. CONTROL VIA MANUAL ON/OFF SWITCH AT WALL OR AUTO ON/OFF VIA OCCUPANCY SENSOR.
VESTIBULES STAIRWELLS	LIGHTING SHALL DIM DOWN TO 50% OUTPUT, UNSWITCHED, IN UNOCCUPIED STATE. LIGHT OUTPUT TO INCREASE TO 100% WHEN OCCUPANY SENSOR DETECTS THE SPACE IS OCCUPIED.
MECHANICAL CHASES	THIS AREA IS CONTROLLED VIA DIGITAL PROGRAMMABLE TIMER SWITCH FOR TIME ON / TIME OFF OR MANUAL OFF OPERATION. TIME DURATION SHALL BE SELECTABLE AT EACH SWITCH. PROVIDE BLINK WARNING OF LIGHTS IN SPACE TWO MINUTES PRIOR TO TIME OFF.
DETENTION AREA, INMATE ACCESSIBLE AREAS DRIVE IN SALLY PORT	SWITCHED CORRECTIONAL & DETENTION AREA LIGHTING CIRCUITS SHALL BE CONTROLLED VIA SECURITY RELAY PANEL.

NOTE: ROOM/SPACE CONTROL OPERATION SHALL NOT DEPEND ON "LAST STATE" USER INPUTS FOR HOW IT WILL OPERATE DAY TO DAY. REGARDLESS IF THE ROOM/SPACE HAS BEEN SHUT-OFF AUTOMATICALLY OR MANUALLY, AFTER ROOM SENSORS HAVE DETECTED NO OCCUPANTS FOR A PRESET TIME DELAY THEN THE ROOM CONTROLS SHALL REVERT BACK AND OPERATE AS DESCRIBED ABOVE.

PLAN NOTES

#	NOTE
1	CONNECT COMPLETE LIGHTING IN THIS ROOM / AREA VIA CIRCUIT INDICATED. SWITCHED DAYROOM LIGHTS SHALL BE CONTROLLED VIA SECURITY CONTROLS RELAY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS AS REQUIRED.
2	CELL LIGHTING PROVIDED INTEGRAL WITH CELL BY CELL MANUFACTURER. CELL LIGHTING IS PRE-WIRED TO JUNTION BOX ON BACK OF CELL. EACH JUNCTION BOX CONTAINS LIGHT FIXTURE PIGTAILS WITH SWITCHED AND NIGHT LIGHT CIRCUITS. CONNECT COMPLETE SWITCHED CIRCUIT LEG VIA SECURITY CONTROLS RELAY CONTROL DEVICE SUCH THAT CELL LIGHTING IN EACH BLOCK IS CONTROLLED TOGETHER, WITH THE EXCEPTION OF THE ADA CELL, IT SHALL BE CONTROLLED VIA A DEDICATED REALY. REFER TO SECURITY DRAWINGS FOR ADDITIONAL CONTROL INFORMATION AND PROVIDE CONNECTIONS ACCORDINGLY. CONNECT VIA CIRCUIT INDICATED.
3	REFER TO LEVEL BELOW FOR ADDITIONAL INFORMATION IN THIS AREA.
4	CONNECT COMPLETE LIGHT FIXTURES WITHIN THIS ROOM / AREA VIA LIGHTING CONTROL DEVICE(S) SHOWN UTILIZING CIRCUIT INDICATED.
5	CONNECT COMPLETE LIGHT FIXTURES WITHIN THIS ROOM / AREA VIA LIGHTING CONTROL DEVICE(S) SHOWN UTILIZING CIRCUIT INDICATED.
6	ALL NEW WALL PACKS SHALL MATCH EXISTING HEIGHTS AT APPROX. THE HEIGHT SHOWN. EXTEND EXISTING SITE LIGHTING CONTROLS TO INCLUDE NEW CIRCUITS AS SHOWN. CONNECT COMPLETE ALL EXTERIOR WALL PACKS IN AREA D VIA CIRCUIT INDICATED.



1 **CONTROL ROOM / MEZZANINE LIGHTIING PLAN - UNIT D_ALTERNATE D**
1/8" = 1'-0"

2 **CONTROL ROOM / MEZZANINE LIGHTIING PLAN - UNIT D_ALTERNATES D1-D3**
1/8" = 1'-0"

RQAW ARCHITECTURE

BID SET

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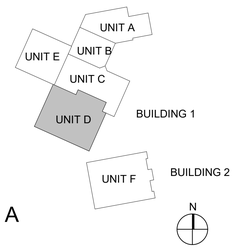


ELECTRICAL LIGHTING PLANS - UNIT D - ALTERNATE BIDS

E291D

GENERAL NOTES - POWER:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO MECHANICAL AND PLUMBING SERIES DRAWINGS FOR ADDITIONAL SCOPE OF WORK.

C. REFER TO SPECIFICATION SECTION 260519 FOR MINIMUM CONDUCTOR SIZE REQUIRED BASED ON THE TOTAL CIRCUIT DISTANCE.

D. ALL RECEPTACLES LOCATED WITHIN 6 FEET OF A SINK SHALL BE GFCI TYPE. ALL RECEPTACLES MAY NOT BE IDENTIFIED AS GFCI ON PLAN, BUT SHALL BE PROVIDED ACCORDING TO REQUIREMENT.

E. ALL SPECIAL TYPE RECEPTACLES SHALL BE NEMA 6-20R UNLESS NOTED OTHERWISE AND SHALL BE CIRCUITED WITH (2)#10 + (1)#10 NEUTRAL + (1)#10 GROUND. COORDINATE REQUIREMENTS WITH OWNER SUPPLIED EQUIPMENT PRIOR TO INSTALLATION.

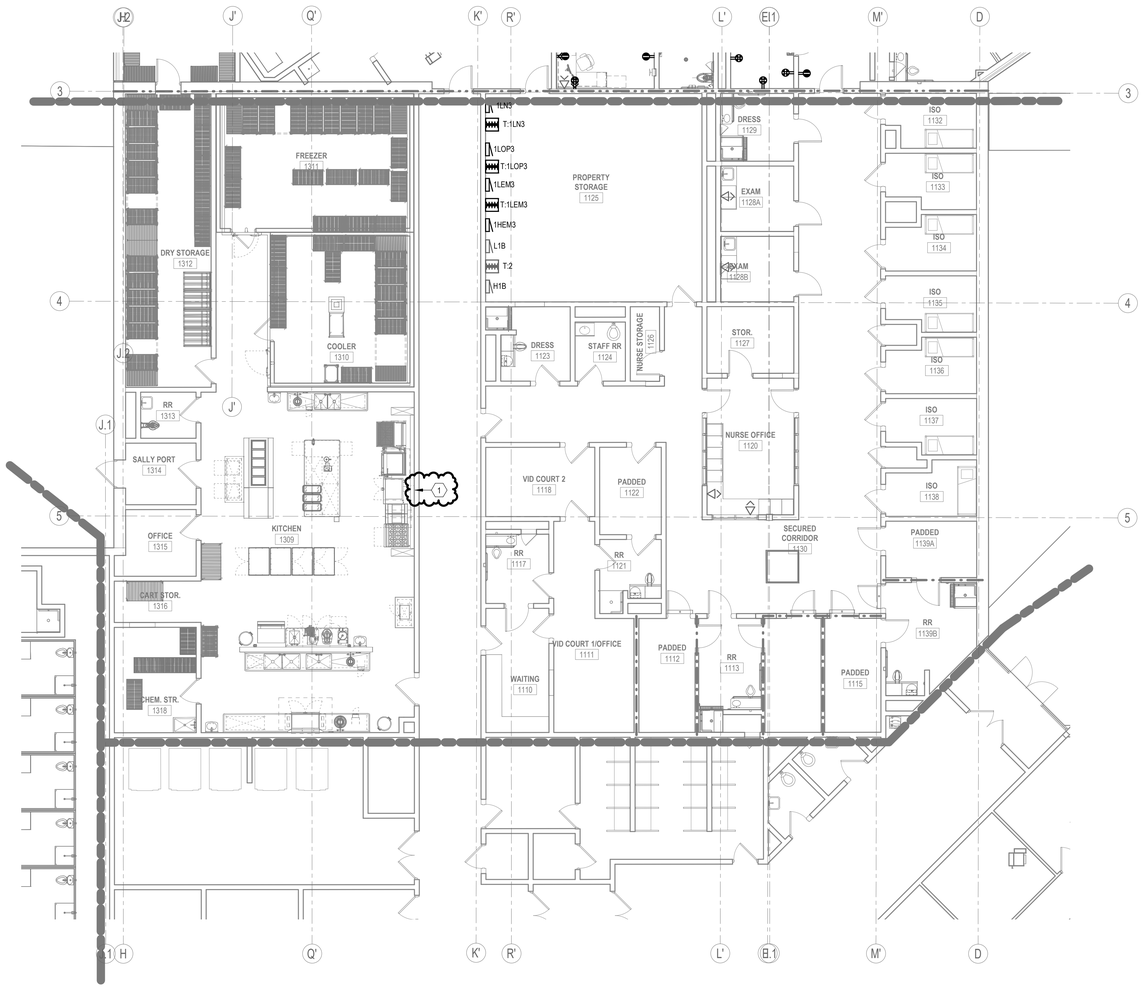
F. REFER TO ARCHITECTURAL SCHEDULES, DETAILS, AND ELEVATIONS FOR ADDITIONAL INFORMATION ON DEVICE LOCATIONS PRIOR TO ROUGH-IN.

G. UNLESS NOTED OTHERWISE, ALL NEW DEVICES SHALL BE INSTALLED FLUSH IN WALL.

H. CIRCUIT NUMBERS AT DEVICES CORRESPOND TO PANELBOARD BREAKERS. REFER TO PANELBOARD SCHEDULES FOR ADDITIONAL INFORMATION.

PLAN NOTES

#	NOTE
1	EXISTING DISTRIBUTION RACEWAY SYSTEM TO BE MODIFIED TO ACCOMIDATE RELOCATED EQUIPMENT. REFER TO FOOD SERVICE DRAWINGS FOR ADDITIONAL REQUIREMENTS.



1 FIRST FLOOR POWER PLAN - UNIT B
1/8" = 1'-0"
0 4' 8' 16'

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

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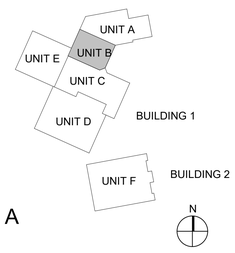


FIRST FLOOR POWER PLAN - UNIT B

E310B

GENERAL NOTES - POWER:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO MECHANICAL AND PLUMBING SERIES DRAWINGS FOR ADDITIONAL SCOPE OF WORK.

C. REFER TO SPECIFICATION SECTION 260519 FOR MINIMUM CONDUCTOR SIZE REQUIRED BASED ON THE TOTAL CIRCUIT DISTANCE.

D. ALL RECEPTACLES LOCATED WITHIN 6 FEET OF A SINK SHALL BE GFCI TYPE. ALL RECEPTACLES MAY NOT BE IDENTIFIED AS GFCI ON PLAN, BUT SHALL BE PROVIDED ACCORDING TO REQUIREMENT.

E. ALL SPECIAL TYPE RECEPTACLES SHALL BE NEMA 6-20R UNLESS NOTED OTHERWISE AND SHALL BE CIRCUITED WITH (2)#10 + (1)#10 NEUTRAL + (1)#10 GROUND. COORDINATE REQUIREMENTS WITH OWNER SUPPLIED EQUIPMENT PRIOR TO INSTALLATION.

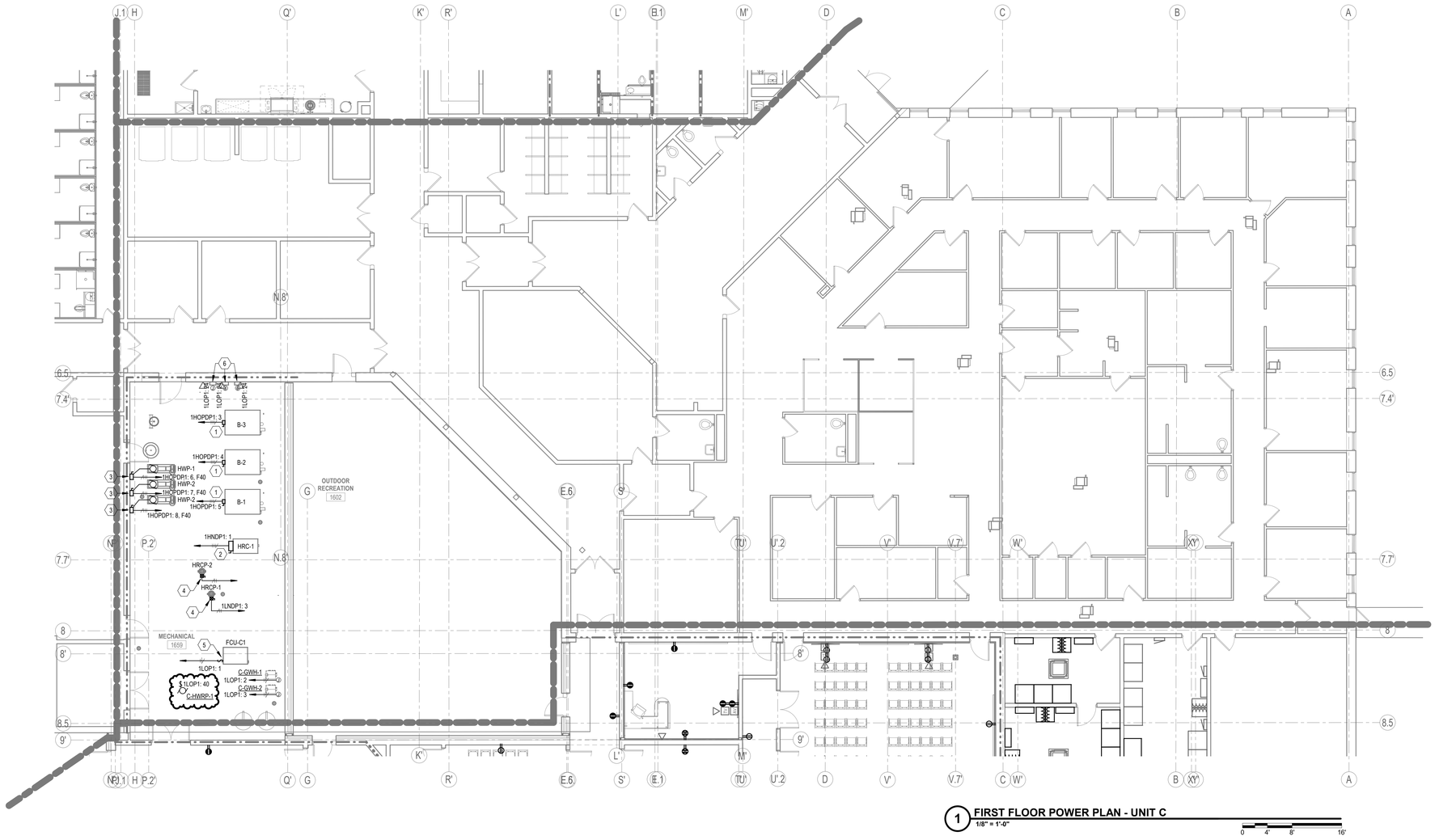
F. REFER TO ARCHITECTURAL SCHEDULES, DETAILS, AND ELEVATIONS FOR ADDITIONAL INFORMATION ON DEVICE LOCATIONS PRIOR TO ROUGH-IN.

G. UNLESS NOTED OTHERWISE, ALL NEW DEVICES SHALL BE INSTALLED FLUSH IN WALL.

H. CIRCUIT NUMBERS AT DEVICES CORRESPOND TO PANELBOARD BREAKERS. REFER TO PANELBOARD SCHEDULES FOR ADDITIONAL INFORMATION.

PLAN NOTES

#	NOTE
1	DISCONNECT PROVIDED BY EQUIPMENT MANUFACTURER. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH EQUIPMENT MANUFACTURER PRIOR TO INSTALLATION.
2	CONNECT COMPLETE VIA CIRCUIT INDICATED. CONNECTION POINT / DISCONNECT PROVIDED BY EQUIPMENT MANUFACTURER. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH EQUIPMENT MANUFACTURER PRIOR TO INSTALLATION. PROVIDE ALL INTERNAL INTERCONNECTIONS AS REQUIRED.
3	PROVIDE 480V, 3PH, 60A DISCONNECT AND CONNECT COMPLETE VIA VARIABLE FREQUENCY CONTROLLER. VFC PROVIDED BY ECC. COORDINATE EXACT LOCATION PRIOR TO INSTALLATION.
4	PROVIDE COMBINATION STARTER / DISCONNECT, NEMA SIZE 00. FUSED AS PER MANUFACTURER'S RECOMMENDATIONS. CONNECT COMPLETE VIA CIRCUIT INDICATED. COORDINATE EXACT LOCATION PRIOR TO INSTALLATION.
5	DISCONNECT PROVIDED BY EQUIPMENT MANUFACTURER. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH EQUIPMENT MANUFACTURER PRIOR TO INSTALLATION.
6	DDC PANELS FOR MECHANICAL EQUIPMENT CONTROLS. EXACT LOCATIONS SHALL BE VERIFIED AND COORDINATED WITH TEMPERATURE CONTROLS CONTRACTOR PRIOR TO INSTALLATION.



1 FIRST FLOOR POWER PLAN - UNIT C
1/8" = 1'-0"
0 4' 8' 16'

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

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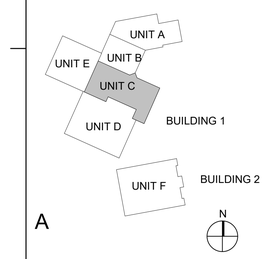

FIRST FLOOR POWER PLAN - UNIT C

E310C

GENERAL NOTES - POWER:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO MECHANICAL AND PLUMBING SERIES DRAWINGS FOR ADDITIONAL SCOPE OF WORK.

C. REFER TO SPECIFICATION SECTION 260519 FOR MINIMUM CONDUCTOR SIZE REQUIRED BASED ON THE TOTAL CIRCUIT DISTANCE.

D. ALL RECEPTACLES LOCATED WITHIN 6 FEET OF A SINK SHALL BE GFCI TYPE. ALL RECEPTACLES MAY NOT BE IDENTIFIED AS GFCI ON PLAN, BUT SHALL BE PROVIDED ACCORDING TO REQUIREMENT.

E. ALL SPECIAL TYPE RECEPTACLES SHALL BE NEMA 6-20R UNLESS NOTED OTHERWISE AND SHALL BE CIRCUITED WITH (2)#10 + (1)#10 NEUTRAL + (1)#10 GROUND. COORDINATE REQUIREMENTS WITH OWNER SUPPLIED EQUIPMENT PRIOR TO INSTALLATION.

F. REFER TO ARCHITECTURAL SCHEDULES, DETAILS, AND ELEVATIONS FOR ADDITIONAL INFORMATION ON DEVICE LOCATIONS PRIOR TO ROUGH-IN.

G. UNLESS NOTED OTHERWISE, ALL NEW DEVICES SHALL BE INSTALLED FLUSH IN WALL.

H. CIRCUIT NUMBERS AT DEVICES CORRESPOND TO PANELBOARD BREAKERS. REFER TO PANELBOARD SCHEDULES FOR ADDITIONAL INFORMATION.

PLAN NOTES

#	NOTE
1	CONNECT COMPLETE TO JUNCTION BOX ON BACK OF CELL FOR RECEPTACLE PROVIDED INTEGRAL TO ADA CELL. RECEPTACLE CIRCUIT SHALL BE CONTROLLED VIA SECURITY CONTROLS. REFER TO SECURITY DRAWINGS FOR ADDITIONAL INFORMATION AND PROVIDE CONNECTIONS ACCORDINGLY.
2	PROVIDE NEMA 3R 208V, 2P-60A FUSIBLE DISCONNECT. FUSE AS PER MANUFACTURERS RECOMMENDATIONS. PROVIDE ADDITIONAL SUPPORT STRUCTURE AS REQUIRED.
3	TV RECEPTACLE SHALL BE CONTROLLED VIA SECURITY SYSTEM RELAY. REFER TO SECURITY SYSTEMS DRAWINGS FOR ADDITIONAL INFORMATION AND CONNECT ACCORDINGLY VIA CONTROLLED RELAY. REFER TO DETAIL ON E800-SERIES DRAWINGS FOR ADDITIONAL INFORMATION. COORDINATE EXACT MOUNTING PRIOR TO INSTALLATION.
4	CONNECT COMPLETE VIA CIRCUIT INDICATED. CONNECTION POINT / DISCONNECT PROVIDED BY EQUIPMENT MANUFACTURER. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH EQUIPMENT MANUFACTURER PRIOR TO INSTALLATION. PROVIDE ALL INTERNAL INTERCONNECTIONS AS REQUIRED.
5	EC SHALL PROVIDE DISCONNECT AND ALL ELECTRICAL INTERCONNECTIONS BETWEEN INDOOR UNIT AND ASSOCIATED OUTDOOR UNIT AS REQUIRED.
6	PROVIDE NEMA 3R, 600V, 600A, 3 POLE FUSED HEAVY-DUTY DISCONNECT SWITCH. PROVIDE FUSES NOT EXCEEDING NAMEPLATE MAX. FUSE / OVERCURRENT RATING.
7	COORDINATE FINAL LOCATION AND QUANTITY OF VAV CONTROL POWER TRANSFORMERS WITH MECHANICAL CONTRACTOR. PROVIDE LINE DISCONNECT SWITCH.

1 FIRST FLOOR POWER PLAN - UNIT D
1/8" = 1'-0"
0 4' 8' 16'

RQAW ARCHITECTURE

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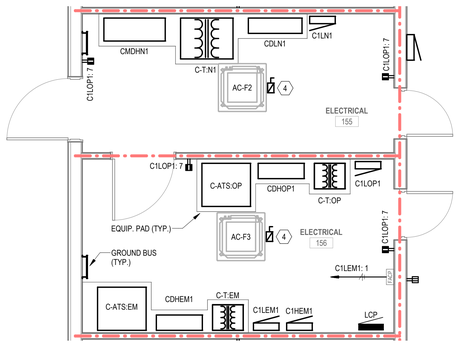
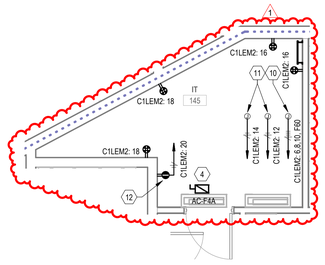
UNIT A, UNIT B, UNIT C, UNIT D, UNIT E — BUILDING 1
UNIT F — BUILDING 2
N

FIRST FLOOR POWER PLAN - UNIT D

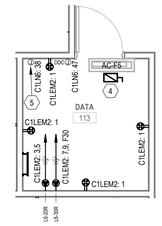
E310D



4 E310F ENLARGED POWER PLAN - UNIT F - ELECTRICAL 155 & 156
1/4" = 1'-0"



3 E310F ENLARGED POWER PLAN - UNIT F - IT 145
1/4" = 1'-0"



2 E310F ENLARGED POWER PLAN - UNIT F - DATA 113
1/4" = 1'-0"

GENERAL NOTES - POWER:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO MECHANICAL AND PLUMBING SERIES DRAWINGS FOR ADDITIONAL SCOPE OF WORK.

C. REFER TO SPECIFICATION SECTION 260519 FOR MINIMUM CONDUCTOR SIZE REQUIRED BASED ON THE TOTAL CIRCUIT DISTANCE.

D. ALL RECEPTACLES LOCATED WITHIN 6 FEET OF A SINK SHALL BE GFCI TYPE. ALL RECEPTACLES MAY NOT BE IDENTIFIED AS GFCI ON PLAN, BUT SHALL BE PROVIDED ACCORDING TO REQUIREMENT.

E. ALL SPECIAL TYPE RECEPTACLES SHALL BE NEMA 6-20R UNLESS NOTED OTHERWISE AND SHALL BE CIRCUITED WITH (2)#10 + (1)#10 NEUTRAL + (1)#10 GROUND. COORDINATE REQUIREMENTS WITH OWNER SUPPLIED EQUIPMENT PRIOR TO INSTALLATION.

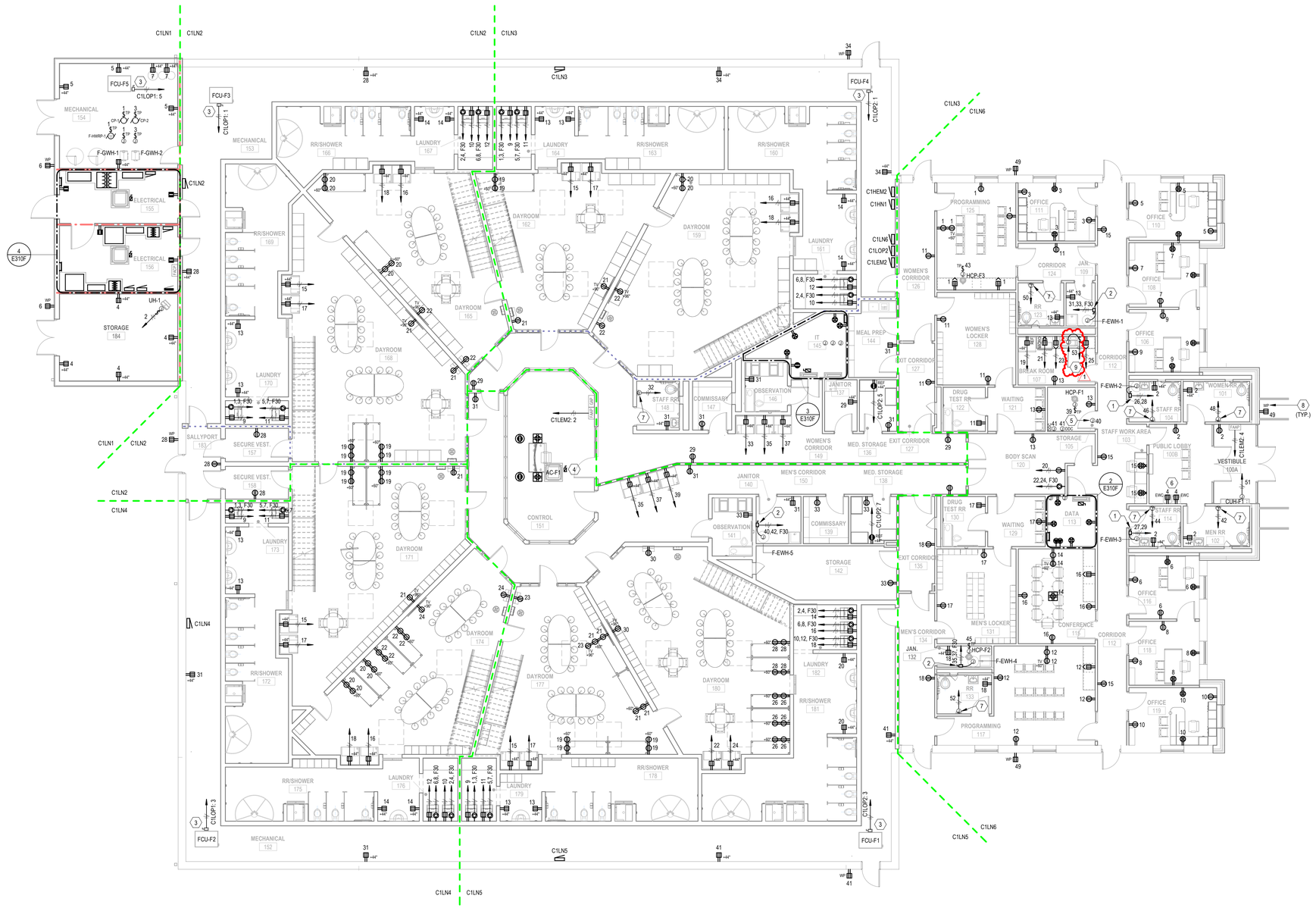
F. REFER TO ARCHITECTURAL SCHEDULES, DETAILS, AND ELEVATIONS FOR ADDITIONAL INFORMATION ON DEVICE LOCATIONS PRIOR TO ROUGH-IN.

G. UNLESS NOTED OTHERWISE, ALL NEW DEVICES SHALL BE INSTALLED FLUSH IN WALL.

H. CIRCUIT NUMBERS AT DEVICES CORRESPOND TO PANELBOARD BREAKERS. REFER TO PANELBOARD SCHEDULES FOR ADDITIONAL INFORMATION.

PLAN NOTES

#	NOTE
1	ELECTRIC WATER HEATER MOUNTED ABOVE ACCESSIBLE CEILING. PROVIDE 208V, 1PH, 30A DISCONNECT AS REQUIRED ADJACENT TO WATER HEATER AND CONNECT COMPLETE VIA THE CIRCUIT INDICATED.
2	ELECTRIC WATER HEATER. PROVIDE 208V, 1PH, 30A DISCONNECT AS REQUIRED ADJACENT TO WATER HEATER AND CONNECT COMPLETE VIA THE CIRCUIT INDICATED.
3	CONNECT COMPLETE VIA CIRCUIT INDICATED. DISCONNECT PROVIDED BY EQUIPMENT MANUFACTURER. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH EQUIPMENT MANUFACTURER PRIOR TO INSTALLATION. PROVIDE ALL INTERNAL CONNECTIONS AS REQUIRED.
4	EC SHALL PROVIDE DISCONNECT AND ALL ELECTRICAL INTERCONNECTIONS BETWEEN INDOOR UNIT AND ASSOCIATED OUTDOOR UNIT AS REQUIRED.
5	VAV BOX TRANSFORMER(S) PER MECHANICAL DISCIPLINE TO BE LOCATED IN THIS AREA. PROVIDE POWER FROM CIRCUIT INDICATED TO PRIMARY OF TRANSFORMERS. PROVIDE A DISCONNECTING MEANS AT PRIMARY OF TRANSFORMERS. COORDINATE EXACT LOCATION AND QUANTITY OF TRANSFORMERS WITH MECHANICAL DISCIPLINE.
6	WATER COOLER. COORDINATE ROUGH-IN REQUIREMENTS AND MOUNTING HEIGHTS BASED ON TYPE WITH EQUIPMENT PROVIDER PRIOR TO INSTALLATION.
7	HAND DRYER. CONNECT COMPLETE VIA CIRCUIT INDICATED. COORDINATE BACK-BOX REQUIREMENTS AND MOUNTING HEIGHT WITH EQUIPMENT PROVIDER.
8	PROVIDE METAL WEATHERPROOF COVER. COVER SHALL REMAIN WEATHERPROOF WHILE IN USE.
9	RECEPTACLE / CIRCUIT CONNECTION INSIDE BASE CABINET BELOW SINK FOR GARBAGE DISPOSAL. VERIFY EXACT LOCATION PRIOR TO INSTALLATION. COORDINATE SWITCH MOUNTING LOCATION WITH CASEWORK PRIOR TO INSTALLATION.
10	CONNECT COMPLETE SECURITY ELECTRONICS UPS CABINET. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH SECURITY ELECTRONICS DRAWINGS PRIOR TO INSTALLATION.
11	PROVIDE CIRCUITS INDICATED FOR SECURITY ELECTRONICS EQUIPMENT AND CONNECT COMPLETE. REFER TO SECURITY ELECTRONICS DRAWINGS FOR EXACT LOCATIONS AND REQUIREMENTS AND PROVIDE ACCORDINGLY.
12	PROVIDE CONNECTION AS REQUIRED FOR FIRE PROTECTION CLEAN AGENT CONTROL PANEL. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH FIRE PROTECTION EQUIPMENT.



1 FIRST FLOOR POWER PLAN - UNIT F
1/8" = 1'-0"
0 4' 8' 16'

RQAW ARCHITECTURE

BID SET

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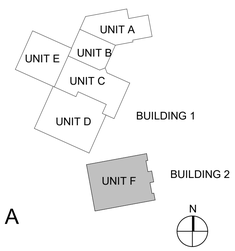


FIRST FLOOR POWER PLAN - UNIT F

E310F

GENERAL NOTES - POWER:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO MECHANICAL AND PLUMBING SERIES DRAWINGS FOR ADDITIONAL SCOPE OF WORK.

C. REFER TO SPECIFICATION SECTION 260519 FOR MINIMUM CONDUCTOR SIZE REQUIRED BASED ON THE TOTAL CIRCUIT DISTANCE.

D. ALL RECEPTACLES LOCATED WITHIN 6 FEET OF A SINK SHALL BE GFCI TYPE. ALL RECEPTACLES MAY NOT BE IDENTIFIED AS GFCI ON PLAN, BUT SHALL BE PROVIDED ACCORDING TO REQUIREMENT.

E. ALL SPECIAL TYPE RECEPTACLES SHALL BE NEMA 6-20R UNLESS NOTED OTHERWISE AND SHALL BE CIRCUITED WITH (2)#10 + (1)#10 NEUTRAL + (1)#10 GROUND. COORDINATE REQUIREMENTS WITH OWNER SUPPLIED EQUIPMENT PRIOR TO INSTALLATION.

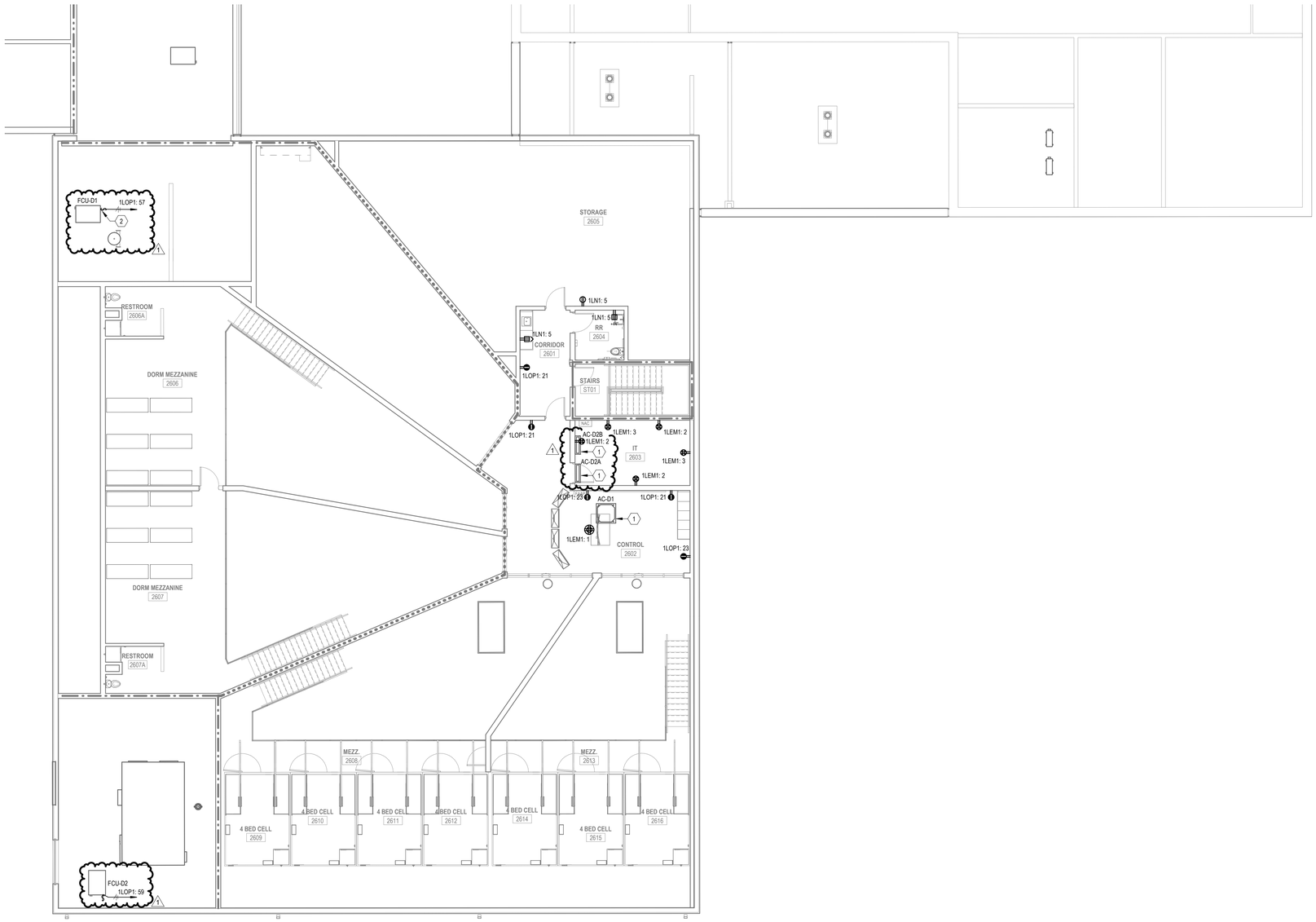
F. REFER TO ARCHITECTURAL SCHEDULES, DETAILS, AND ELEVATIONS FOR ADDITIONAL INFORMATION ON DEVICE LOCATIONS PRIOR TO ROUGH-IN.

G. UNLESS NOTED OTHERWISE, ALL NEW DEVICES SHALL BE INSTALLED FLUSH IN WALL.

H. CIRCUIT NUMBERS AT DEVICES CORRESPOND TO PANELBOARD BREAKERS. REFER TO PANELBOARD SCHEDULES FOR ADDITIONAL INFORMATION.

PLAN NOTES

#	NOTE
1	EC SHALL PROVIDE DISCONNECT AND ALL ELECTRICAL INTERCONNECTIONS BETWEEN INDOOR UNIT AND ASSOCIATED OUTDOOR UNIT AS REQUIRED.
2	DISCONNECT PROVIDED BY EQUIPMENT MANUFACTURER. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH EQUIPMENT MANUFACTURER PRIOR TO INSTALLATION.



1 CONTROL ROOM / MEZZANINE POWER PLAN - UNIT D
1/8" = 1'-0"

0 4' 8' 16'

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	ADD-02	02/21/2022

Project #: 20-700-151-2

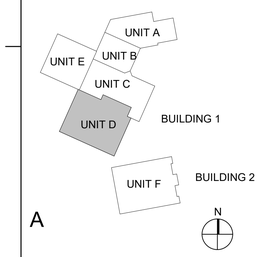
Designed By: EAE

Drawn By: DLJ

Checked By: EAE

Date: 02.04.2022

ERIC S. WEFLEN REGISTERED No. AR11500138 STATE OF INDIANA ARCHITECT



SECOND FLOOR POWER PLAN - UNIT D

E320D

PLAN NOTES

#	NOTE
1	DISCONNECT PROVIDED BY EQUIPMENT MANUFACTURER. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH EQUIPMENT MANUFACTURER PRIOR TO INSTALLATION.
2	CONNECT COMPLETE VIA CIRCUIT INDICATED. CONNECTION POINT / DISCONNECT PROVIDED BY EQUIPMENT MANUFACTURER. COORDINATE EXACT LOCATION AND REQUIREMENTS WITH EQUIPMENT MANUFACTURER PRIOR TO INSTALLATION. PROVIDE ALL INTERNAL INTERCONNECTIONS AS REQUIRED.
3	PROVIDE NEMA 3R 208V, 2P-60A FUSIBLE DISCONNECT. FUSE AS PER MANUFACTURER'S RECOMMENDATIONS. PROVIDE ADDITIONAL SUPPORT STRUCTURE AS REQUIRED.
4	UNIT LIGHTS AND RECEPTACLES TO BE PROVIDED WITHIN THE UNIT BY MANUFACTURER. COORDINATE EXACT CONNECTION POINT IN FIELD AND CONNECT VIA CIRCUIT INDICATED. PROVIDE ALL INTERNAL WIRING AND CONNECTIONS AS REQUIRED.

GENERAL NOTES - POWER:

A. REFER TO SHEET E-001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO MECHANICAL AND PLUMBING SERIES DRAWINGS FOR ADDITIONAL SCOPE OF WORK.

C. REFER TO SPECIFICATION SECTION 260519 FOR MINIMUM CONDUCTOR SIZE REQUIRED BASED ON THE TOTAL CIRCUIT DISTANCE.

D. ALL RECEPTACLES LOCATED WITHIN 6 FEET OF A SINK SHALL BE GFCI TYPE. ALL RECEPTACLES MAY NOT BE IDENTIFIED AS GFCI ON PLAN, BUT SHALL BE PROVIDED ACCORDING TO REQUIREMENT.

E. ALL SPECIAL TYPE RECEPTACLES SHALL BE NEMA 6-20R UNLESS NOTED OTHERWISE AND SHALL BE CIRCUITED WITH (2)#10 + (1)#10 NEUTRAL + (1)#10 GROUND. COORDINATE REQUIREMENTS WITH OWNER SUPPLIED EQUIPMENT PRIOR TO INSTALLATION.

F. REFER TO ARCHITECTURAL SCHEDULES, DETAILS, AND ELEVATIONS FOR ADDITIONAL INFORMATION ON DEVICE LOCATIONS PRIOR TO ROUGH-IN.

G. UNLESS NOTED OTHERWISE, ALL NEW DEVICES SHALL BE INSTALLED FLUSH IN WALL.

H. CIRCUIT NUMBERS AT DEVICES CORRESPOND TO PANELBOARD BREAKERS. REFER TO PANELBOARD SCHEDULES FOR ADDITIONAL INFORMATION.

1 **OVERALL ROOF ELECTRICAL PLAN**
1/16" = 1'-0"

0 4' 8' 16'

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	ADD-02	02/21/2022

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Drawn By: EAE
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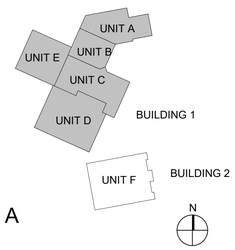
Date: 02.04.2022

ERIC S. WEFLEN REGISTERED No. AR11500138 STATE OF INDIANA ARCHITECT



ROOF ELECTRICAL PLAN

E330

GENERAL NOTES - SYSTEMS:

A. REFER TO SHEET E001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. MAXIMUM NUMBER OF 4 INFORMATION OUTLET LOCATIONS PER CONDUIT HOME RUN TO MDF OR IDF IS PERMITTED. CONDUIT SHALL BE SIZED AS FOLLOWS:
   1. (1) INFORMATION OUTLET LOCATION: 1"C
   2. (2) INFORMATION OUTLET LOCATIONS: 1-1/4"C
   3. (3) INFORMATION OUTLET LOCATIONS: 1-1/2"C

C. ALL COMMUNICATIONS CABLES SHALL BE INSTALLED IN CONDUIT, CABLE TRAY, OR SUPPORTED BY CABLE HOOKS. PROVIDE BUSHINGS AT THE ENDS OF ALL CONDUIT WHERE STUBBED ABOVE ACCESSIBLE CEILINGS OR WHERE DROPPED INTO CABLE TRAY. PROVIDE CABLE HOOKS ABOVE ACCESSIBLE CEILINGS FOR CABLE INSTALLATION WHERE NOT INSTALLED IN CONDUIT OR CABLE TRAY.

D. WHERE CONDUIT IS STUBBED ABOVE ACCESSIBLE CEILING, CABLES SHALL BE INSTALLED WITH SERVICE LOOPS. SERVICE LOOPS SHALL BE APPROXIMATELY TWO WRAPS, OR ABOUT 16" EXTRA INCHES FOR LOOP.

E. ALL CABLEING SHALL BE CATEGORY 6.

GENERAL NOTES - FIRE ALARM:

A. REFER TO SHEET E001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. THE FIRE ALARM PLANS ARE INTENDED TO DEPICT THE GENERAL PERFORMANCE OF THE SYSTEM. THE FIRE ALARM VENDOR SHALL BE RESPONSIBLE FOR PROVIDING A COMPLETE DESIGN PER EQUIPMENT LIMITATIONS. PROVIDE ALL NECESSARY EQUIPMENT, DEVICES, WIRING, ETC AS REQUIRED FOR A COMPLETE AND CODE COMPLIANT FIRE ALARM SYSTEM.

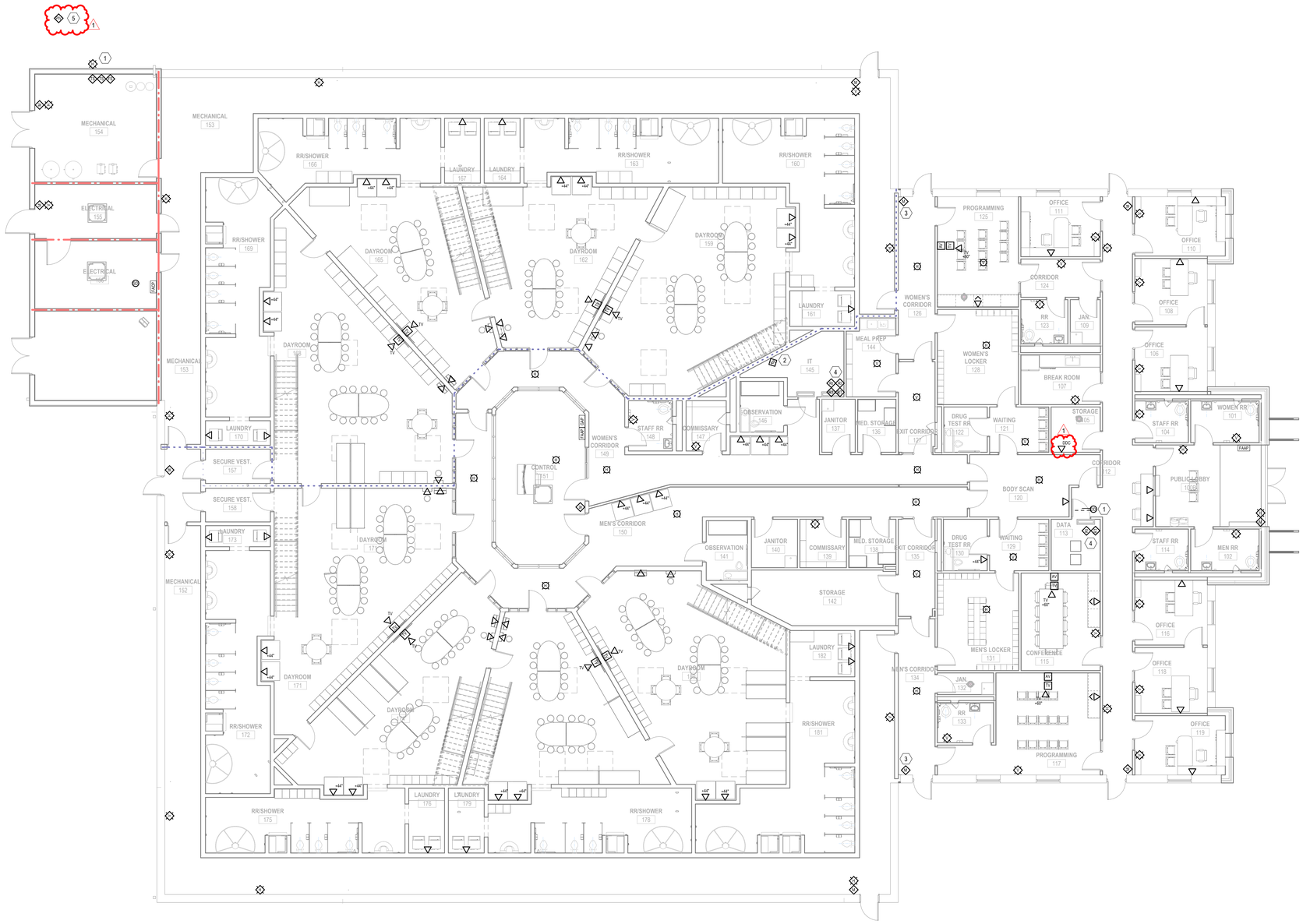
C. DO NOT LOCATE ANY DETECTION DEVICE WITHIN 3-FEET OF AN AIR DIFFUSER.

D. ADDRESSABLE RELAYS AND MONITOR MODULES SHALL BE INSTALLED WITHIN 3-FEET OF CONTROLLED OR MONITORED DEVICE.

E. A VISUAL INDICATOR SHALL BE PROVIDED FOR ALL INITIATING DEVICES LOCATED OUTSIDE OF NORMAL VIEWING.

PLAN NOTES

#	NOTE
1	PROVIDE WEATHERPROOF HORN/STROBE ACTIVATED ON WATER FLOW. COORDINATE EXACT LOCATION WITH FIRE PROTECTION CONTRACTOR.
2	PROVIDE INPUT MODULE TO MONITOR CLEAN AGENT SYSTEM.
3	PROVIDE KEY OPERATED SINGLE ACTION MANUAL STATION WITH INSTITUTIONAL COVER IN ALL DETAINEE AREAS.
4	PROVIDE REMOTE TEST / INDICATOR STATIONS FOR DUCT SMOKE DETECTORS.
5	POST INDICATING VALVE. COORDINATE EXACT LOCATION WITH FIRE PROTECTION CONTRACTOR.



1 FIRST FLOOR SYSTEMS PLAN - UNIT F
1/8" = 1'-0"
0 4' 8' 16'

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	ADD-02	02/21/2022

Project #: 20-700-151-2
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ERIC S. WEFLEN REGISTERED No. AR11500138 STATE OF INDIANA ARCHITECT

UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
BUILDING 1
UNIT F
BUILDING 2
N

FIRST FLOOR SYSTEMS PLAN - UNIT F

E410F

Distribution Panel: CMDHN1

Location: ELECTRICAL 155 | **Voltage:** 480Y/277 | **Branch:** NORMAL
Supplied From: | **Phase:** 3 | **A.I.C. Rating:** TBD
Mounting: PAD / SURFACE | **Wire:** 4 | **Main Type:** MAIN CIRCUIT BREAKER
Enclosure Type: TYPE 1 | **Ground:** EQUIPMENT GROUND BUS | **Main Rating:** 600A

General Panel Comments:
1) SHALL BE UL LISTED AND RATED AS SERVICE ENTRANCE EQUIPMENT.
2) MAIN BREAKER SHALL BE 100% RATED, INDIVIDUALLY MOUNTED, SOLID-STATE, ELECTRONIC-TRIP WITH FIELD ADJUSTABLE LSI SETTINGS.
3) SHALL BE PROTECTED VIA REMOTE SURGE PROTECTION DEVICE (SPD) PER DIVISION 26 SECTION "SURGE PROTECTION DEVICES".

Circuit Number	Circuit Description	Breaker Information: Thermal Mag Fixed	Thermal Mag Adj. Inst	Electronic Trip L	Electronic Trip S	Electronic Trip I	Electronic Trip G	100% Rated	Poles	Frame Size	Trip Rating	Load (kVA)	Remarks:
1	C-T:N1								3	400 A	350 A	264.4	
2	C1HN1								3	200 A	200 A	80.4	
3	C-ATS:OP								3	400 A	20 A	41.3	
4	C-ATS:EM								3	400 A	20 A	46.8	
5													
6													
7													
8													
9													
10													
11													
12													

Total Connected Load (kVA): 432.8
Total Connected Load (Amps): 520.6

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Lighting	20784 VA	100.00%	20784 VA		
Motor	34374 VA	100.00%	34374 VA	**Total Conn. Load:**	432830 VA
Receptacle	276974 VA	51.81%	143487 VA	**Total Est. Demand:**	299343 VA
Mechanical	100705 VA	100.00%	100705 VA	**Total Conn. Current:**	520.6 A
				Total Est. Demand Current:	360.1 A

Remarks:

Distribution Panel: CDLN1

Location: ELECTRICAL 155 | **Voltage:** 208Y/120 | **Branch:** NORMAL
Supplied From: C-T:N1 | **Phase:** 3 | **A.I.C. Rating:** TBD
Mounting: PAD / SURFACE | **Wire:** 4 | **Main Type:** MAIN CIRCUIT BREAKER
Enclosure Type: TYPE 1 | **Ground:** EQUIPMENT GROUND BUS | **Main Rating:** 800A

General Panel Comments:
1) MAIN BREAKER SHALL BE 100% RATED, INDIVIDUALLY-MOUNTED, SOLID-STATE, ELECTRONIC TRIP, WITH FIELD ADJUSTABLE LSI SETTINGS.
2) SHALL BE PROTECTED VIA REMOTE SURGE PROTECTION DEVICE (SPD) PER DIVISION 26 SECTION "SURGE PROTECTION DEVICES."

Circuit Number	Circuit Description	Breaker Information: Thermal Mag Fixed	Thermal Mag Adj. Inst	Electronic Trip L	Electronic Trip S	Electronic Trip I	Electronic Trip G	100% Rated	Poles	Frame Size	Trip Rating	Load (kVA)	Remarks:
1	C1LN1		X						3	200 A	100 A	17.3	
2	C1LN2		X						3	200 A	200 A	39.5	
3	C1LN3		X						3	200 A	200 A	46.3	
4	C1LN4		X						3	200 A	200 A	39.2	
5	C1LN5		X						3	200 A	200 A	56.2	
6	C1LN6		X						3	200 A	200 A	65.7	
7													
8													
9													
10													
11													
12													

Total Connected Load (kVA): 264.4
Total Connected Load (Amps): 733.8

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Motor	1584 VA	100.00%	1584 VA		
Receptacle	241234 VA	52.07%	125617 VA	**Total Conn. Load:**	264374 VA
Mechanical	21556 VA	100.00%	21556 VA	**Total Est. Demand:**	148757 VA
				Total Conn. Current:	733.8 A
				Total Est. Demand Current:	412.9 A

Remarks:

Distribution Panel: CDHEM1

Location: ELECTRICAL 156 | **Voltage:** 480Y/277 | **Branch:** EMERGENCY
Supplied From: C-ATS:EM | **Phase:** 3 | **A.I.C. Rating:** TBD
Mounting: | **Wire:** 4 | **Main Type:** MAIN CIRCUIT BREAKER
Enclosure Type: | **Ground:** EQUIPMENT GROUND BUS | **Main Rating:** 300A

General Panel Comments:
1) MAIN BREAKER SHALL BE 100% RATED, INDIVIDUALLY-MOUNTED, SOLID-STATE, ELECTRONIC TRIP, WITH FIELD ADJUSTABLE LSI SETTINGS.
2) SHALL BE PROTECTED VIA REMOTE SURGE PROTECTION DEVICE (SPD) PER DIVISION 26 SECTION "SURGE PROTECTION DEVICES."

Circuit Number	Circuit Description	Breaker Information: Thermal Mag Fixed	Thermal Mag Adj. Inst	Electronic Trip L	Electronic Trip S	Electronic Trip I	Electronic Trip G	100% Rated	Poles	Frame Size	Trip Rating	Load (kVA)	Remarks:
1	C-T:EM			X	X	X			3	100 A	80 A	28.5	
2	C1HEM1			X	X	X			3	100 A	100 A	13.4	
3	C1HEM2			X	X	X			3	100 A	100 A	4.9	
4													
5													
6													
7													
8													
9													
10													
11													
12													

Total Connected Load (kVA): 46.8
Total Connected Load (Amps): 56.2

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Lighting	18230 VA	100.00%	18230 VA		
Receptacle	28540 VA	67.52%	19270 VA	**Total Conn. Load:**	46764 VA
				Total Est. Demand:	37495 VA
				Total Conn. Current:	56.2 A
				Total Est. Demand Current:	45.1 A

Remarks:

Distribution Panel: CDHOP1

Location: ELECTRICAL 156 | **Voltage:** 480Y/277 | **Branch:** OPTIONAL STANDBY
Supplied From: C-ATS:OP | **Phase:** 3 | **A.I.C. Rating:** TBD
Mounting: SURFACE | **Wire:** 4 | **Main Type:** MAIN CIRCUIT BREAKER
Enclosure Type: TYPE 1 | **Ground:** EQUIPMENT GROUND BUS | **Main Rating:** 300A

General Panel Comments:
1) MAIN BREAKER SHALL BE 100% RATED, INDIVIDUALLY-MOUNTED, SOLID-STATE, ELECTRONIC TRIP, WITH FIELD ADJUSTABLE LSI SETTINGS.
2) SHALL BE PROTECTED VIA REMOTE SURGE PROTECTION DEVICE (SPD) PER DIVISION 26 SECTION "SURGE PROTECTION DEVICES."

Circuit Number	Circuit Description	Breaker Information: Thermal Mag Fixed	Thermal Mag Adj. Inst	Electronic Trip L	Electronic Trip S	Electronic Trip I	Electronic Trip G	100% Rated	Poles	Frame Size	Trip Rating	Load (kVA)	Remarks:
1	LTG_ 101,102,104,113,114,132,137,140,145,148								1	100 A	20 A	0.5	
2	C-T:OP								3	200 A	150 A	40.0	
3	LTG_ Mech 154, Elec 155, Elec 156								1	100 A	20 A	0.7	
4													
5													
6													
7													
8													
9													
10													
11													
12													

Total Connected Load (kVA): 41.3
Total Connected Load (Amps): 49.6

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Lighting	1276 VA	100.00%	1276 VA		
Motor	32790 VA	100.00%	32790 VA	**Total Conn. Load:**	41266 VA
Receptacle	7200 VA	100.00%	7200 VA	**Total Est. Demand:**	41266 VA
				Total Conn. Current:	49.6 A
				Total Est. Demand Current:	49.6 A

Remarks:

Branch Panel: C1HN1

Location: MECHANICAL 166 | **Voltage:** 480Y/277 | **Branch:** NORMAL
Supplied From: CMDHN1 | **Phase:** 3 | **A.I.C. Rating:** TBD
Mounting: Surface | **Wire:** 4 | **Main Type:** MAIN CIRCUIT BREAKER
Enclosure Type: Type 1 | **Ground:** EQUIPMENT GROUND BUS | **Main Rating:** 200A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1				6.5	0.5					1	20 A	LTG_ North Admin	2
3	ROOF_ AHU-F1	30 A	3			6.5	0.6			1	20 A	LTG_ South Admin	4
5								6.5	0.2	1	20 A	LTG_ Admin Corridor	6
7				6.5	0					1	20 A	LTG_ Exterior Building Signage	8
9	ROOF_ AHU-F2	30 A	3			6.5	0			1	20 A	SPARE	10
11								6.5	0	1	20 A	SPARE	12
13				6.5	0					1	20 A	SPARE	14
15	ROOF_ AHU-F3	30 A	3			6.5	0			1	20 A	SPARE	16
17								6.5	0	1	20 A	SPARE	18
19				6.8	0					1	20 A	SPARE	20
21	ROOF_ ERV-F4	35 A	3			6.8	0			1	20 A	SPARE	22
23								6.8	0	1	20 A	SPARE	24
25				0	0					1	20 A	SPARE	26
27	SPARE	20 A	3			0	0			1	20 A	SPARE	28
29								0	0	1	20 A	SPARE	30
31				0	0								32
33	SPARE	30 A	3			0	0			3	35 A	SPARE	34
35								0	0				36
37	SPACE	--	--	0	0					--	--	SPACE	38
39	SPACE	--	--			0	0			--	--	SPACE	40
41	SPACE	--	--					0	0	--	--	SPACE	42
		Total Load:		26.9 kVA		26.9 kVA		26.6 kVA					

Load Sumamry:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Lighting	1279 VA	100.00%	1279 VA		
Mechanical	79149 VA	100.00%	79149 VA		
				Total Conn. Load:	80428 VA
				Total Est. Demand:	80428 VA
				Total Conn. Current:	96.7 A
				Total Est. Demand Current:	96.7 A

Remarks:

PLAN NOTES

#	NOTE
1	ALL ELECTRICAL EQUIPMENT SHALL BE RATED TO WITHSTAND THE AVAILABLE FAULT CURRENT FROM THE UTILITY. SERIES RATED DEVICES ARE NOT ACCEPTABLE. AVAILABLE FAULT CURRENT SHALL BE CONFIRMED WITH UTILITY AND FAULT ANALYSIS COMPLETE AS PER SPECIFICATIONS SECTION 26 05 73 PRIOR TO FINAL EQUIPMENT APPROVAL.

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	ADD-02	02/21/2022

Project #: 20-700-151-2
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Drawn By: JAF
Checked By: DLJ
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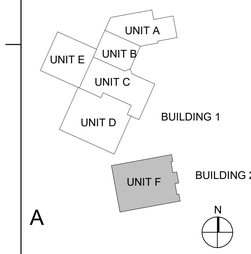
ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT



ELECTRICAL SCHEDULES - UNIT F

E610

Branch Panel: C1LOP1

Location: ELECTRICAL 156 | **Supplied From:** C-T:OP | **Mounting:** Surface | **Enclosure Type:** Type 1
Voltage: 208Y/120 | **Phase:** 3 | **Wire:** 4 | **Ground:** EQUIPMENT GROUND BUS
Branch: OPTIONAL STANDBY | **A.I.C. Rating:** TBD | **Main Type:** MAIN CIRCUIT BREAKER | **Main Rating:** 250A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1	153_ FCU-F3	20 A	1	1.6	2.1					2	30 A	ROOF_ ACCU-F2	2
3	152_ FCU-F2	20 A	1			1.6	2.1						4
5	154_ FCU-F5	20 A	1					1.6	2.1	2	30 A	ROOF_ ACCU-F3	6
7	155_156_ Recpcs	20 A	1	4.8	2.1								8
9	SPARE	20 A	1			0	0			1	20 A	SPARE	10
11	SPARE	20 A	1					0	0	1	20 A	SPARE	12
13	SPARE	20 A	1	0	0					1	20 A	SPARE	14
15	SPARE	20 A	1			0	0			1	20 A	SPARE	16
17	SPARE	20 A	1					0	0	1	20 A	SPARE	18
19	SPARE	20 A	1	0	0					1	20 A	SPARE	20
21	SPARE	20 A	1			0	0			1	20 A	SPARE	22
23	SPARE	20 A	1					0	0	1	20 A	SPARE	24
25	SPARE	20 A	1	0	0					1	20 A	SPARE	26
27	SPARE	20 A	1			0	0			1	20 A	SPARE	28
29	SPARE	20 A	1					0	0	1	20 A	SPARE	30
31	SPARE	20 A	1	0	0					1	20 A	SPARE	32
33	SPARE	20 A	1			0	0			1	20 A	SPARE	34
35	SPARE	20 A	1					0	0	1	20 A	SPARE	36
37	SPARE	20 A	1	0	0					1	20 A	SPARE	38
39	SPARE	20 A	1			0	0			1	20 A	SPARE	40
41	SPARE	20 A	1					0	0	1	20 A	SPARE	42
				8									
	(FEED THRU LUGS TO PANEL C1LOP2)					6.8							
								7.4					
	Total Load:			18.5 kVA		10.4 kVA		11.1 kVA					

Load Sumamry:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Motor	32790 VA	100.00%	32790 VA		
Receptacle	7200 VA	100.00%	7200 VA	**Total Conn. Load:**	39990 VA
				Total Est. Demand:	39990 VA
				Total Conn. Current:	111.0 A
				Total Est. Demand Current:	111.0 A

Remarks:

Branch Panel: C1LOP2

Location: MECHANICAL 166 | **Supplied From:** C1LOP1 | **Mounting:** Surface | **Enclosure Type:** Type 1
Voltage: 208Y/120 | **Phase:** 3 | **Wire:** 4 | **Ground:** EQUIPMENT GROUND BUS
Branch: OPTIONAL STANDBY | **A.I.C. Rating:** TBD | **Main Type:** MLO | **Main Rating:** 250A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1	Mech. 153_ FCU-F4	20 A	1	1.6	2.1					2	30 A	ROOF_ ACCU-F1	2
3	Mech. 152_ FCU-F1	20 A	1			1.6	2.1						4
5	136_ Ref	20 A	1					1.2	3.1	2	50 A	ROOF_ ACCU-F4	6
7	139_ Ref	20 A	1	1.2	3.1								8
9	SPARE	20 A	1			0	3.1			2	50 A	ROOF_ ACCU-F5	10
11	SPARE	20 A	1					0	3.1				12
13	SPARE	20 A	1	0	0					1	20 A	SPARE	14
15	SPARE	20 A	1			0	0			1	20 A	SPARE	16
17	SPARE	20 A	1					0	0	1	20 A	SPARE	18
19	SPARE	20 A	1	0	0					1	20 A	SPARE	20
21	SPARE	20 A	1			0	0			1	20 A	SPARE	22
23	SPARE	20 A	1					0	0	1	20 A	SPARE	24
25	SPARE	20 A	1	0	0					1	20 A	SPARE	26
27	SPARE	20 A	1			0	0			1	20 A	SPARE	28
29	SPARE	20 A	1					0	0	1	20 A	SPARE	30
31	SPARE	20 A	1	0	0					1	20 A	SPARE	32
33	SPARE	20 A	1			0	0			1	20 A	SPARE	34
35	SPARE	20 A	1					0	0	1	20 A	SPARE	36
37	SPARE	20 A	1	0	0					1	20 A	SPARE	38
39	SPARE	20 A	1			0	0			1	20 A	SPARE	40
41	SPARE	20 A	1					0	0	1	20 A	SPARE	42
	Total Load:			8.0 kVA		6.8 kVA		7.4 kVA					

Load Sumamry:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Motor	19772 VA	100.00%	19772 VA		
Receptacle	2400 VA	100.00%	2400 VA	**Total Conn. Load:**	22172 VA
				Total Est. Demand:	22172 VA
				Total Conn. Current:	61.5 A
				Total Est. Demand Current:	61.5 A

Remarks:

Branch Panel: C1HEM1

Location: ELECTRICAL 156 | **Supplied From:** CDHEM1 | **Mounting:** Surface | **Enclosure Type:** Type 1
Voltage: 480Y/277 | **Phase:** 3 | **Wire:** 4 | **Ground:** EQUIPMENT GROUND BUS
Branch: EMERGENCY | **A.I.C. Rating:** TBD | **Main Type:** MLO | **Main Rating:** 100A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1	LTG_ Dayroom 168, RR 169, Laundry 170, Mezz. 203	20 A	1	1.3	1.2					1	20 A	LTG_ Dayroom 171, RR 172, Laundry 173, Mezz. 204	2
3	LTG_ Dayroom 165, RR 166, Laundry 167, Mezz. 202	20 A	1			0.9	1.1			1	20 A	LTG_ Dayroom 174, RR 175, Laundry 176, Mezz. 205	4
5	LTG_ Dayroom 162, RR 163, Laundry 164, Mezz. 201	20 A	1					0.9	1	1	20 A	LTG_ Dayroom 177, RR 178, Laundry 179, Mezz. 206	6
7	LTG_ Dayroom 159, RR 160, Laundry 161, Mezz. 200	20 A	1	1.3	1.3					1	20 A	LTG_ Dayroom 180, RR 181, Laundry 182, Mezz. 207	8
9	LTG_ Mech. 153	20 A	1			0.8	0.8			1	20 A	LTG_ Mech 152	10
11	Exterior Lighting_CC Site Poles	20 A	1					0.6	0.3	1	20 A	LTG_ Commissary, Med Storage, Meal Prep	12
13	Exterior Lighting_Exterior Wall Packs_ Canopy	20 A	1	0.8	0.4					1	20 A	LTG_ Exit & Egress - North Mech Chase, Mech Rm, Ele...	14
15	SPARE	20 A	1			0	0.6			1	20 A	LTG_ Exit & Egress - South Mech Chase	16
17	SPARE	20 A	1					0	0	1	20 A	SPARE	18
19	SPARE	20 A	1	0	0					1	20 A	SPARE	20
21	SPARE	20 A	1			0	0			1	20 A	SPARE	22
23	SPARE	20 A	1					0	0	1	20 A	SPARE	24
25	SPARE	20 A	1	0	0					1	20 A	SPARE	26
27	SPARE	20 A	1			0	0			1	20 A	SPARE	28
29	SPARE	20 A	1					0	0	1	20 A	SPARE	30
31	SPACE	--	--	0	0					--	--	SPACE	32
33	SPACE	--	--			0	0			--	--	SPACE	34
35	SPACE	--	--					0	0	--	--	SPACE	36
37	SPACE	--	--	0	0					--	--	SPACE	38
39	SPACE	--	--			0	0			--	--	SPACE	40
41	SPACE	--	--					0	0	--	--	SPACE	42
	Total Load:			6.3 kVA		4.3 kVA		2.8 kVA					

Load Sumamry:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Lighting	13367 VA	100.00%	13367 VA		
				Total Conn. Load:	13367 VA
				Total Est. Demand:	13367 VA
				Total Conn. Current:	16.1 A
				Total Est. Demand Current:	16.1 A

Remarks:

Branch Panel: C1LEM1

Location: ELECTRICAL 156 | **Supplied From:** C-T:EM | **Mounting:** Surface | **Enclosure Type:** Type 1
Voltage: 208Y/120 | **Phase:** 3 | **Wire:** 4 | **Ground:** EQUIPMENT GROUND BUS
Branch: EMERGENCY | **A.I.C. Rating:** TBD | **Main Type:** MAIN CIRCUIT BREAKER | **Main Rating:** 175A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1	156_ Fire Alarm Control Panel	20 A	1	0.5	0					1	20 A	SPARE	2
3	SPARE	20 A	1			0	0			1	20 A	SPARE	4
5	SPARE	20 A	1					0	0	1	20 A	SPARE	6
7	SPARE	20 A	1	0	0					1	20 A	SPARE	8
9	SPARE	20 A	1			0	0			1	20 A	SPARE	10
11	SPARE	20 A	1					0	0	1	20 A	SPARE	12
13	SPARE	20 A	1	0	0					1	20 A	SPARE	14
15	SPARE	20 A	1			0	0			1	20 A	SPARE	16
17	SPARE	20 A	1					0	0	1	20 A	SPARE	18
19	SPARE	20 A	1	0	0					1	20 A	SPARE	20
21	SPARE	20 A	1			0	0			1	20 A	SPARE	22
23	SPARE	20 A	1					0	0	1	20 A	SPARE	24
25	SPARE	20 A	1	0	0					1	20 A	SPARE	26
27	SPARE	20 A	1			0	0			1	20 A	SPARE	28
29	SPARE	20 A	1					0	0	1	20 A	SPARE	30
31	SPARE	20 A	1	0	0					1	20 A	SPARE	32
33	SPARE	20 A	1			0	0			1	20 A	SPARE	34
35	SPARE	20 A	1					0	0	1	20 A	SPARE	36
37	SPACE	--	--	0	0					--	--	SPACE	38
39	SPACE	--	--			0	0			--	--	SPACE	40
41	SPACE	--	--					0	0	--	--	SPACE	42
				10.6									
	(FEED THRU LUGS TO PANEL C1LEM2)				9.5								
								8					
	Total Load:			11.1 kVA		9.5 kVA		8.0 kVA					

Load Sumamry:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Receptacle	28540 VA	67.52%	19270 VA		
				Total Conn. Load:	28540 VA
				Total Est. Demand:	19270 VA
				Total Conn. Current:	79.2 A
				Total Est. Demand Current:	53.5 A

Remarks:

Branch Panel: C1LEM2

Location: MECHANICAL 166 | **Supplied From:** C1LEM1 | **Mounting:** Surface | **Enclosure Type:** Type 1
Voltage: 208Y/120 | **Phase:** 3 | **Wire:** 4 | **Ground:** EQUIPMENT GROUND BUS
Branch: EMERGENCY | **A.I.C. Rating:** TBD | **Main Type:** MLO | **Main Rating:** 175A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1	113_ Recpcs	20 A	1	1.6	0.5					1	20 A	151_ FAAP	2
3	113_ Recep	20 A	2			1.3	0.5			1	20 A	100A_ FAAP	4
5								1.3	5				6
7	113_ Recep	30 A	2	2	5					3	60 A	145_ Security Electronics UPS Equip.	8
9						2	5						10
11	SPARE	20 A	1					0	1	1	20 A	145_ Security Electronics Equip.	12
13	SPARE	20 A	1	0	1					1	20 A	145_ Security Electronics Equip.	14
15	SPARE	20 A	1			0	0.7			1	20 A	145_ Recpcs	16
17	SPARE	20 A	1					0	0.7	1	20 A	145_ Recpcs	18
19	SPARE	20 A	1	0	0.5					1	20 A	145_ FP Clean Agent Control Panel	20
21	SPARE	20 A	1			0	0			1	20 A	SPARE	22
23	SPARE	20 A	1					0	0	1	20 A	SPARE	24
25	SPARE	20 A	1	0	0					1	20 A	SPARE	26
27	SPARE	20 A	1			0	0			1	20 A	SPARE	28
29	SPARE	20 A	1					0	0	1	20 A	SPARE	30
31	SPARE	20 A	1	0	0					1	20 A	SPARE	32
33	SPARE	20 A	1			0	0			1	20 A	SPARE	34
35	SPARE	20 A	1					0	0	1	20 A	SPARE	36
37	SPACE	--	--							--	--	SPACE	38
39	SPACE	--	--			0	0			--	--	SPACE	40
41	SPACE	--	--					0	0	--	--	SPACE	42
	Total Load:			10.6 kVA		9.5 kVA		8.0 kVA					

Load Sumamry:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Receptacle	28040 VA	67.83%	19020 VA		
				Total Conn. Load:	28040 VA
				Total Est. Demand:	19020 VA
				Total Conn. Current:	77.8 A
				Total Est. Demand Current:	52.8 A

Remarks:

Branch Panel: C1HEM2

Location: MECHANICAL 166 | **Supplied From:** CDHEM1 | **Mounting:** Surface | **Enclosure Type:** Type 1
Voltage: 480Y/277 | **Phase:** 3 | **Wire:** 4 | **Ground:** EQUIPMENT GROUND BUS
Branch: EMERGENCY | **A.I.C. Rating:** TBD | **Main Type:** MLO | **Main Rating:** 100A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1	LTG_ 126, 127, 149 Women'sCorridors	20 A	1	0.4	0.4					1	20 A	LTG_ 134, 135, 150 Men'sCorridors	2
3	LTG_ Control Room 151	20 A	1			0.3	0.6			1	20 A	LTG_ 117, 120, 129, 130, 131, 133	4
5	LTG_ 121, 122, 125, 128	20 A	1					0.5	0.7	1	20 A	LTG_ Exit & Egress - Secure Corridor Areas	6
7	SPARE	20 A	1	0	2					1	20 A	LTG_ Exit & Egress - Admin	8
9	SPARE	20 A	1			0	0			1	20 A	SPARE	10
11	SPARE	20 A	1					0	0	1	20 A	SPARE	12
13	SPARE	20 A	1	0	0					1	20 A	SPARE	14
15	SPARE	20 A	1			0	0			1	20 A	SPARE	16
17	SPARE	20 A	1					0	0	1	20 A	SPARE	18
19	SPARE	20 A	1	0	0					1	20 A	SPARE	20
21	SPARE	20 A	1			0	0			1	20 A	SPARE	22
23	SPARE	20 A	1					0	0	1	20 A	SPARE	24
25	SPARE	20 A	1	0	0					1	20 A	SPARE	26
27	SPARE	20 A	1			0	0			1	20 A	SPARE	28
29	SPARE	20 A	1					0	0	1	20 A	SPARE	30
31	SPARE	20 A	1	0	0					1	20 A	SPARE	32
33	SPARE	20 A	1			0	0			1	20 A	SPARE	34
35	SPARE	20 A	1					0	0	1	20 A	SPARE	36
37	SPACE	--	--	0	0					--	--	SPACE	38
39	SPACE	--	--			0	0			--	--	SPACE	40
41	SPACE	--	--					0	0	--	--	SPACE	42
	Total Load:			2.8 kVA		0.9 kVA		1.2 kVA					

Load Sumamry:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Lighting	4886 VA	100.00%	4886 VA		
				Total Conn. Load:	4886 VA
				Total Est. Demand:	4886 VA
				Total Conn. Current:	5.9 A
				Total Est. Demand Current:	5.9 A

Remarks:

PLAN NOTES

#	NOTE
1	ALL ELECTRICAL EQUIPMENT SHALL BE RATED TO WITHSTAND THE AVAILABLE FAULT CURRENT FROM THE UTILITY. SERIES RATED DEVICES ARE NOT ACCEPTABLE. AVAILABLE FAULT CURRENT SHALL BE CONFIRMED WITH UTILITY AND FAULT ANALYSIS COMPLETE AS PER SPECIFICATIONS SECTION 26 05 73 PRIOR TO FINAL EQUIPMENT APPROVAL.

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

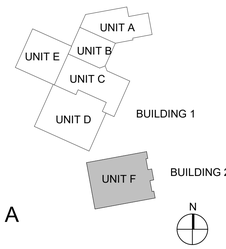
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	ADD-02	02/21/2022

Project #: 20-700-151-2
Designed By: JAF
Drawn By: JAF
Checked By: DLJ
Date: 02.04.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT



ELECTRICAL SCHEDULES - UNIT F

E611

Branch Panel: C1LN1

Location: ELECTRICAL 155
Supplied From: CDLN1
Mounting: Surface
Enclosure Type: Type 1
Voltage: 208Y/120
Phase: 3
Wire: 4
Ground: EQUIPMENT GROUND BUS
Branch: NORMAL
A.I.C. Rating: TBD
Main Type: MLO
Main Rating: 100A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1	154_ F-GWH-1, CP-1, F-HWRP-1	20 A	1	1.3	0.5					1	20 A	184_ UH-1	2
3	154_ F-GWH-2 & CP-2	20 A	1			1.1	4.8			1	20 A	184_ Receps	4
5	154_ Receps	20 A	1					4.8	2.4	1	20 A	Exterior_ West Receps	6
7	154_ Water Softners	20 A	1	2.4	0					1	20 A	SPARE	8
9	SPARE	20 A	1			0	0			1	20 A	SPARE	10
11	SPARE	20 A	1					0	0	1	20 A	SPARE	12
13	SPARE	20 A	1	0	0					1	20 A	SPARE	14
15	SPARE	20 A	1			0	0			1	20 A	SPARE	16
17	SPARE	20 A	1					0	0	1	20 A	SPARE	18
19	SPARE	20 A	1	0	0					1	20 A	SPARE	20
21	SPARE	20 A	1			0	0			1	20 A	SPARE	22
23	SPARE	20 A	1					0	0	1	20 A	SPARE	24
25	SPARE	20 A	1	0	0					1	20 A	SPARE	26
27	SPARE	20 A	1			0	0			1	20 A	SPARE	28
29	SPARE	20 A	1					0	0	1	20 A	SPARE	30
31	SPARE	20 A	1	0	0					1	20 A	SPARE	32
33	SPARE	20 A	1			0	0			1	20 A	SPARE	34
35	SPARE	20 A	1					0	0	1	20 A	SPARE	36
37	SPARE	20 A	1	0	0					1	20 A	SPARE	38
39	SPARE	20 A	2			0	0			2	30 A	SPARE	40
41								0	0				42
		Total Load:		4.3 kVA		5.9 kVA		7.2 kVA					

Load Sumamry:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Receptacle	15798 VA	81.65%	12899 VA		
Mechanical	1528 VA	100.00%	1528 VA	**Total Conn. Load:**	17326 VA
				Total Est. Demand:	14427 VA
				Total Conn. Current:	48.1 A
				Total Est. Demand Current:	40.0 A

Remarks:

Branch Panel: C1LN2

Location: MECHANICAL 166
Supplied From: CDLN1
Mounting: Surface
Enclosure Type: Type 1
Voltage: 208Y/120
Phase: 3
Wire: 4
Ground: EQUIPMENT GROUND BUS
Branch: NORMAL
A.I.C. Rating: TBD
Main Type: MLO
Main Rating: 200A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1	170_ Dryer	30 A	2	2.1	2.1					2	30 A	167_ Dryer	2
3						2.1	2.1						4
5	170_ Dryer	30 A	2					2.1	2.1	2	30 A	167_ Dryer	6
7				2.1	2.1								8
9	170_ Washer	20 A	1			1	1			1	20 A	167_ Washer	10
11	170_ Washer	20 A	1					1	1	1	20 A	167_ Washer	12
13	169_ Receps	20 A	1	0.4	0.4					1	20 A	166_ 166	14
15	168_ Vending Machine	20 A	1			1.4	1.4			1	20 A	165_ Vending Machine	16
17	168_ Vending Machine	20 A	1					1.4	1.4	1	20 A	165_ Vending Machine	18
19	168_ Bunk Receps	20 A	1	0.7	0.7					1	20 A	165_ Bunk Receps	20
21	168_ TV & Kiosk	20 A	1			0.4	0.4			1	20 A	165_ TV & Kiosk	22
23	203_ Bunk Receps	20 A	1					1.1	1.1	1	20 A	202_ Bunk Receps	24
25	203_ Bunk Receps	20 A	1	1.1	1.1					1	20 A	202_ Bunk Receps	26
27	203_ Bunk Receps	20 A	1			1.1	4.1			1	20 A	153,157,158,183, Ext_ Receps	28
29	203_ Bunk Receps	20 A	1					0.7	0	1	20 A	SPARE	30
31	SPARE	20 A	1	0	0					1	20 A	SPARE	32
33	SPARE	20 A	1			0	0			1	20 A	SPARE	34
35	SPARE	20 A	1					0	0	1	20 A	SPARE	36
37	SPARE	20 A	1	0	0					1	20 A	SPARE	38
39	SPARE	20 A	1			0	0			1	20 A	SPARE	40
41	SPARE	20 A	1					0	0	1	20 A	SPARE	42
43	SPARE	20 A	1	0	0					1	20 A	SPARE	44
45	SPARE	20 A	1			0	0			1	20 A	SPARE	46
47	SPARE	20 A	1					0	0	1	20 A	SPARE	48
49	SPARE	20 A	1	0	0					1	20 A	SPARE	50
51	SPARE	20 A	1			0	0			1	20 A	SPARE	52
53	SPARE	20 A	1					0	0	1	20 A	SPARE	54
55	SPARE	20 A	1	0	0					1	20 A	SPARE	56
57	SPARE	20 A	2			0	0			2	30 A	SPARE	58
59								0	0				60
		Total Load:		12.6 kVA		15.0 kVA		11.9 kVA					

Load Sumamry:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Receptacle	39540 VA	62.65%	24770 VA		
				Total Conn. Load:	39540 VA
				Total Est. Demand:	24770 VA
				Total Conn. Current:	109.8 A
				Total Est. Demand Current:	68.8 A

Remarks:

Branch Panel: C1LN3

Location: MECHANICAL 166
Supplied From: CDLN1
Mounting: Surface
Enclosure Type: Type 1
Voltage: 208Y/120
Phase: 3
Wire: 4
Ground: EQUIPMENT GROUND BUS
Branch: NORMAL
A.I.C. Rating: TBD
Main Type: MLO
Main Rating: 200A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1	164_ Dryer	30 A	2	2.1	2.1					2	30 A	161_ Dryer	2
3						2.1	2.1						4
5	164_ Dryer	30 A	2					2.1	2.1	2	30 A	161_ Dryer	6
7				2.1	2.1								8
9	164_ Washer	20 A	1			1	1			1	20 A	161_ Washer	10
11	164_ Washer	20 A	1					1	1	1	20 A	161_ Washer	12
13	163_ Recep	20 A	1	0.4	0.4					1	20 A	160_ Receps	14
15	162_ Vending Machine	20 A	1			1.4	1.4			1	20 A	159_ Vending Machine	16
17	162_ Vending Machine	20 A	1					1.4	1.4	1	20 A	159_ Vending Machine	18
19	162_ Bunk Receps	20 A	1	0.4	0.4					1	20 A	159_ Bunk Receps	20
21	162_ TV & Kiosk	20 A	1			0.4	0.4			1	20 A	159_ TV & Kiosk	22
23	201_ Bunk Receps	20 A	1					0.7	1.1	1	20 A	200_ Bunk Receps	24
25	201_ Bunk Receps	20 A	1	1.1	1.1					1	20 A	200_ Bunk Receps	26
27	201_ Bunk Receps	20 A	1			0.7	1.1			1	20 A	200_ Bunk Receps	28
29	137, 149_ Receps	20 A	1					0.7	0.7	1	20 A	200_ Bunk Receps	30
31	144,145,146,147,148_ Reeceps	20 A	1	1.9	1.5					1	20 A	148_ Hand Dryer	32
33	149_ Vending Machine	20 A	1			1.2	3.6			1	20 A	153 & Exterior_ Receps	34
35	149_ Vending Machine	20 A	1					1.2	0	1	20 A	SPARE	36
37	149_ Vending Machine	20 A	1	1.2	0					1	20 A	SPARE	38
39	SPARE	20 A	1			0	0			1	20 A	SPARE	40
41	SPARE	20 A	1					0	0	1	20 A	SPARE	42
43	SPARE	20 A	1	0	0					1	20 A	SPARE	44
45	SPARE	20 A	1			0	0			1	20 A	SPARE	46
47	SPARE	20 A	1					0	0	1	20 A	SPARE	48
49	SPARE	20 A	1	0	0					1	20 A	SPARE	50
51	SPARE	20 A	1			0	0			1	20 A	SPARE	52
53	SPARE	20 A	1					0	0	1	20 A	SPARE	54
55	SPARE	20 A	1	0	0					1	20 A	SPARE	56
57	SPARE	20 A	2			0	0			2	30 A	SPARE	58
59								0	0				60
		Total Load:		16.5 kVA		16.4 kVA		13.5 kVA					

Load Sumamry:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Receptacle	46344 VA	60.79%	28172 VA		
				Total Conn. Load:	46344 VA
				Total Est. Demand:	28172 VA
				Total Conn. Current:	128.6 A
				Total Est. Demand Current:	78.2 A

Remarks:

Branch Panel: C1LN4

Location: MECHANICAL 167
Supplied From: CDLN1
Mounting: Surface
Enclosure Type: Type 1
Voltage: 208Y/120
Phase: 3
Wire: 4
Ground: EQUIPMENT GROUND BUS
Branch: NORMAL
A.I.C. Rating: TBD
Main Type: MLO
Main Rating: 200A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1	172_ Dryer	30 A	2	2.1	2.1					2	30 A	176_ Dryer	2
3						2.1	2.1						4
5	172_ Dryer	30 A	2					2.1	2.1	2	30 A	176_ Dryer	6
7				2.1	2.1								8
9	172_ Washer	20 A	1			1	1			1	20 A	176_ Washer	10
11	172_ Washer	20 A	1					1	1	1	20 A	176_ Washer	12
13	173_ Receps	20 A	1	0.4	0.4					1	20 A	175_ Receps	14
15	171_ Vending Machine	20 A	1			1.4	1.4			1	20 A	174_ Vending Machine	16
17	171_ Vending Machine	20 A	1					1.4	1.4	1	20 A	174_ Vending Machine	18
19	171_ Bunk Receps	20 A	1	0.7	0.7					1	20 A	174_ Bunk Receps	20
21	171_ TV & Kiosk	20 A	1			0.4	0.7			1	20 A	174_ Bunk Receps	22
23	204_ Bunk Receps	20 A	1					1.1	0.4	1	20 A	174_ TV & Kiosk	24
25	204_ Bunk Receps	20 A	1	1.1	1.1					1	20 A	205_ Bunk Receps	26
27	204_ Bunk Receps	20 A	1			1.1	1.1			1	20 A	205_ Bunk Receps	28
29	204_ Bunk Receps	20 A	1					0.7	0.7	1	20 A	205_ Bunk Receps	30
31	152_ Receps	20 A	1	2.4	0					1	20 A	SPARE	32
33	SPARE	20 A	1			0	0			1	20 A	SPARE	34
35	SPARE	20 A	1					0	0	1	20 A	SPARE	36
37	SPARE	20 A	1	0	0					1	20 A	SPARE	38
39	SPARE	20 A	1			0	0			1	20 A	SPARE	40
41	SPARE	20 A	1					0	0	1	20 A	SPARE	42
43	SPARE	20 A	1	0	0					1	20 A	SPARE	44
45	SPARE	20 A	1			0	0			1	20 A	SPARE	46
47	SPARE	20 A	1					0	0	1	20 A	SPARE	48
49	SPARE	20 A	1	0	0					1	20 A	SPARE	50
51	SPARE	20 A	1			0	0			1	20 A	SPARE	52
53	SPARE	20 A	1					0	0	1	20 A	SPARE	54
55	SPARE	20 A	1	0	0					1	20 A	SPARE	56
57	SPARE	20 A	2			0	0			2	30 A	SPARE	58
59								0	0				60
		Total Load:		15.0 kVA		12.3 kVA		11.9 kVA					

Load Sumamry:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Receptacle	39240 VA	62.74%	24620 VA		
				Total Conn. Load:	39240 VA
				Total Est. Demand:	24620 VA
				Total Conn. Current:	108.9 A
				Total Est. Demand Current:	68.3 A

Remarks:

Branch Panel: C1LN5

Location: MECHANICAL 167
Supplied From: CDLN1
Mounting: Surface
Enclosure Type: Type 1
Voltage: 208Y/120
Phase: 3
Wire: 4
Ground: EQUIPMENT GROUND BUS
Branch: NORMAL
A.I.C. Rating: TBD
Main Type: MLO
Main Rating: 200A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1	179_ Dryer	30 A	2	2.1	2.1					2	30 A	182_ Dryer	2
3						2.1	2.1						4
5	179_ Dryer	30 A	2					2.1	2.1	2	30 A	182_ Dryer	6
7				2.1	2.1								8
9	179_ Washer	20 A	1			1	2.1			2	20 A	182_ Dryer	10
11	179_ Washer	20 A	1					1	2.1				12
13	178_ Receps	20 A	1	0.4	1					1	20 A	182_ Washer	14
15	177_ Vending Machine	20 A	1			1.4	1			1	20 A	182_ Washer	16
17	177_ Vending Machine	20 A	1					1.4	1	1	20 A	182_ Washer	18
19	177_ Bunk Receps	20 A	1	0.7	0.4					1	20 A	181_ Receps	20
21	177_ Bunk Receps	20 A	1			0.7	1.4			1	20 A	180_ Vending Machine	22
23	177_ TV & Kiosk	20 A	1					0.4	1.4	1	20 A	180_ Vending Machine	24
25	206_ Bunk Receps	20 A	1	1.1	1.1					1	20 A	180_ Bunk Receps	26
27	206_ Bunk Receps	20 A	1			0.7	0.7			1	20 A	180_ Bunk Receps	28
29	206_ Bunk Receps	20 A	1					0.7	0.4	1	20 A	180_ TV & Kiosk	30
31	140,150_ Receps	20 A	1	0.7	0.7					1	20 A	207_ Bunk Receps	32
33	139,140,141,142_ Receps	20 A	1			0.7	0.7			1	20 A	207_ Bunk Receps	34
35	150_ Vending Machine	20 A	1					1.4	1.1	1	20 A	207_ Bunk Receps	36
37	150_ Vending Machine	20 A	1	1.4	1.1					1	20 A	207_ Bunk Receps	38
39	150_ Vending Machine	20 A	1			1.4	2.3			2	30 A	140_ F-EWH-5	40
41	152 & Ext_ Receps	20 A	1					3.6	2.3				42
43	SPARE	20 A	1	0	0					1	20 A	SPARE	44
45	SPARE	20 A	1			0	0			1	20 A	SPARE	46
47	SPARE	20 A	1					0	0	1	20 A	SPARE	48
49	SPARE	20 A	1	0	0					1	20 A	SPARE	50
51	SPARE	20 A	1			0	0			1	20 A	SPARE	52
53	SPARE	20 A	1					0	0	1	20 A	SPARE	54
55	SPARE	20 A	1	0	0					1	20 A	SPARE	56
57	SPARE	20 A	2			0	0			2	30 A	SPARE	58
59								0	0				60
		Total Load:		16.9 kVA		18.4 kVA		20.9 kVA					

Load Sumamry:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Receptacle	51720 VA	59.67%	30860 VA		
Mechanical	4500 VA	100.00%	4500 VA	**Total Conn. Load:**	56220 VA
				Total Est. Demand:	35360 VA
				Total Conn. Current:	156.1 A
				Total Est. Demand Current:	98.1 A

Remarks:

PLAN NOTES

#	NOTE
1	ALL ELECTRICAL EQUIPMENT SHALL BE RATED TO WITHSTAND THE AVAILABLE FAULT CURRENT FROM THE UTILITY. SERIES RATED DEVICES ARE NOT ACCEPTABLE. AVAILABLE FAULT CURRENT SHALL BE CONFIRMED WITH UTILITY AND FAULT ANALYSIS COMPLETE AS PER SPECIFICATIONS SECTION 26 05 73 PRIOR TO FINAL EQUIPMENT APPROVAL.

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	ADD-02	02/21/2022

Project #: 20-700-151-2
Designed By: JAF
Drawn By: JAF
Checked By: DLJ
Date: 02.04.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT

ELECTRICAL SCHEDULES - UNIT F

E612

PLAN NOTES

#	NOTE
1	ALL ELECTRICAL EQUIPMENT SHALL BE RATED TO WITHSTAND THE AVAILABLE FAULT CURRENT FROM THE UTILITY. SERIES RATED DEVICES ARE NOT ACCEPTABLE. AVAILABLE FAULT CURRENT SHALL BE CONFIRMED WITH UTILITY AND FAULT ANALYSIS COMPLETE AS PER SPECIFICATIONS SECTION 26 05 73 PRIOR TO FINAL EQUIPMENT APPROVAL.

Branch Panel: C1LN6

Location: MECHANICAL 166
Supplied From: CDLN1
Mounting: Surface
Enclosure Type: Type 1

Voltage: 208Y/120
Phase: 3
Wire: 4
Ground: EQUIPMENT GROUND BUS

Branch: NORMAL
A.I.C. Rating: TBD
Main Type: MAIN CIRCUIT BREAKER
Main Rating: 200A

General Panel Comments:

Circuit Number	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	Circuit Number
1	125_ Receps	20 A	1	1.1	1.1					1	20 A	100A,100B,101,102,104_ Receps	2
3	111_ Receps	20 A	1			1.2	1			1	20 A	100B_ Electric Water Coolers	4
5	110_ Receps	20 A	1					1.2	1.2	1	20 A	116_ Receps	6
7	108_ Receps	20 A	1	1.2	1.2					1	20 A	118_ Receps	8
9	106_ Receps	20 A	1			1.2	1.1			1	20 A	119_ Receps	10
11	122,126,127,128,124_ Receps	20 A	1					1.1	1.1	1	20 A	117_ Receps	12
13	109,123,107,105,121,120_ Receps	20 A	1	3.1	0.8					1	20 A	115_ Receps	14
15	103, 112_ Receps	20 A	1			1.3	0.7			1	20 A	115_ Receps	16
17	129,130,131_ Receps	20 A	1					0.7	0.7	1	20 A	132,133,134,135_ Receps	18
19	107_ Ref	20 A	1	1.2	1					1	20 A	120_ Body Scan	20
21	107_ Micro	20 A	1			1.2	1.7			2	30 A	120_ Body Scan	22
23	107_ Overcounter Recep	20 A	1					1	1.7				24
25	107_ Overcounter Recep	20 A	1	1	1.5					2	20 A	104_ F-EWH-2	26
27	114_ F-EWH-3	20 A	2			1.5	1.5						28
29								1.5	0.5	1	20 A	ROOF_ AHU-F3 Lights & Receps	30
31	109_ F-EWH-1	30 A	2	2.3	0.5					1	20 A	ROOF_ AHU-F1 Lights & Receps	32
33						2.3	0.5			1	20 A	ROOF_ ERV-F4 Lights & Receps	34
35	132_ F-EWH-4	30 A	2					2.3	0.5	1	20 A	ROOF_ AHU-F2 Lights & Receps	36
37				2.3	1					1	20 A	113_ VAV Box Transformer(s)	38
39	105_ HCP-F1	20 A	1			0.5	1			1	20 A	105_ VAV Box Transformer(s)	40
41	105_ DDC Panels	20 A	1					1	1.5	1	20 A	102_ Hand Dryer	42
43	125_ HCP-F3	20 A	1	0.5	1.5					1	20 A	114_ Hand Dryer	44
45	132_ HCP-F2	20 A	1			0.5	1.5			1	20 A	104_ Hand Dryer	46
47	113_ DDC Panel	20 A	1					0.5	1.5	1	20 A	101_ Hand Dryer	48
49	Exterior_ East Receps	20 A	1	3.6	1.5					1	20 A	123_ Hand Dryer	50
51	100A_ CUH-F1	20 A	1			0.5	1.5			1	20 A	133_ Hand Dryer	52
53	107_ Dispose	20 A	1					1.2	0	1	20 A	SPARE	54
55	SPARE	20 A	1	0	0					1	20 A	SPARE	56
57	SPARE	20 A	1			0	0			1	20 A	SPARE	58
59	SPARE	20 A	1					0	0	1	20 A	SPARE	60
61	SPARE	20 A	1	0	0					1	20 A	SPARE	62
63	SPARE	20 A	1			0	0			1	20 A	SPARE	64
65	SPARE	20 A	1					0	0	1	20 A	SPARE	66
67	SPARE	20 A	1	0	0					1	20 A	SPARE	68
69	SPARE	20 A	1			0	0			1	20 A	SPARE	70
71	SPARE	20 A	1					0	0	1	20 A	SPARE	72
		Total Load:		26.1 kVA		20.6 kVA		19.0 kVA					

Load Summary:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Motor	1584 VA	100.00%	1584 VA		
Receptacle	48592 VA	60.29%	29296 VA	**Total Conn. Load:**	65704 VA
Mechanical	15528 VA	100.00%	15528 VA	**Total Est. Demand:**	46408 VA
				Total Conn. Current:	182.4 A
				Total Est. Demand Current:	128.8 A

Remarks:

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	ADD-02	02/21/2022

Project #: 20-700-151-2
Designed By: JAF
Drawn By: JAF
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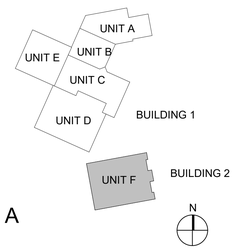
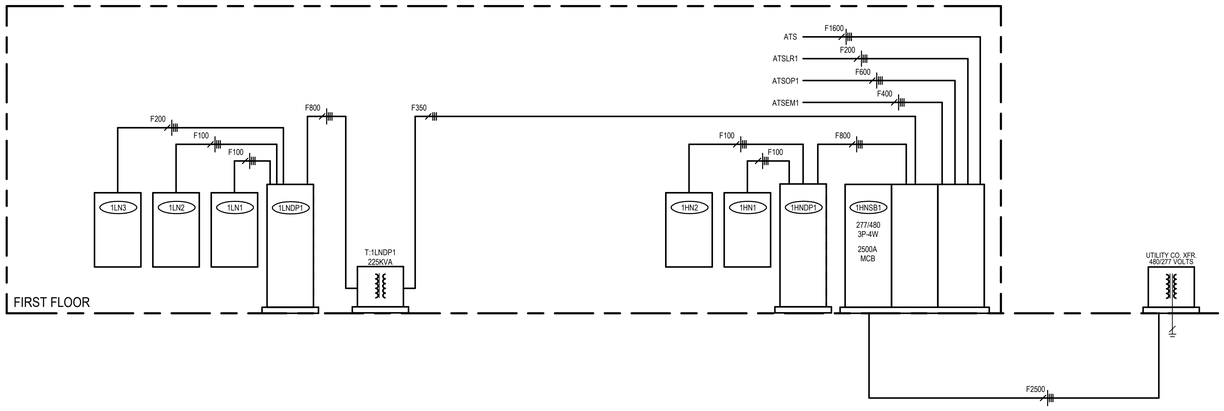
Date: 02.04.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT

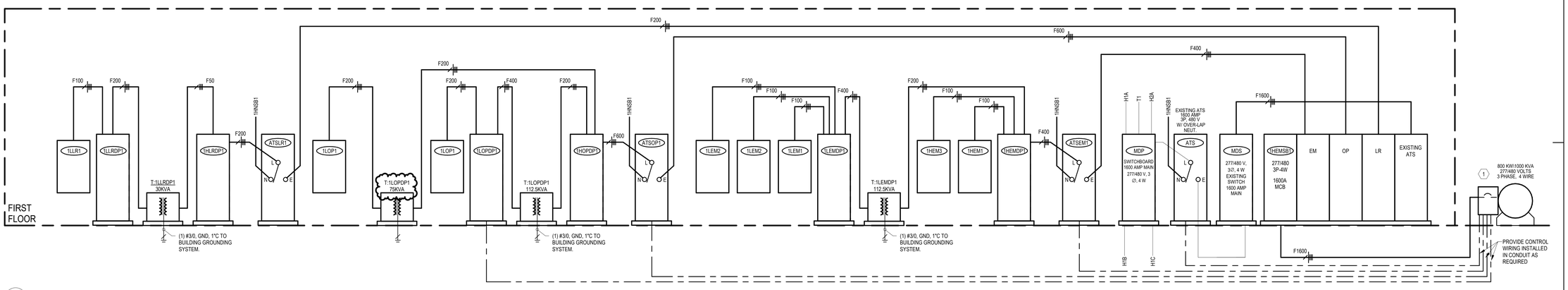


ELECTRICAL SCHEDULES - UNIT F

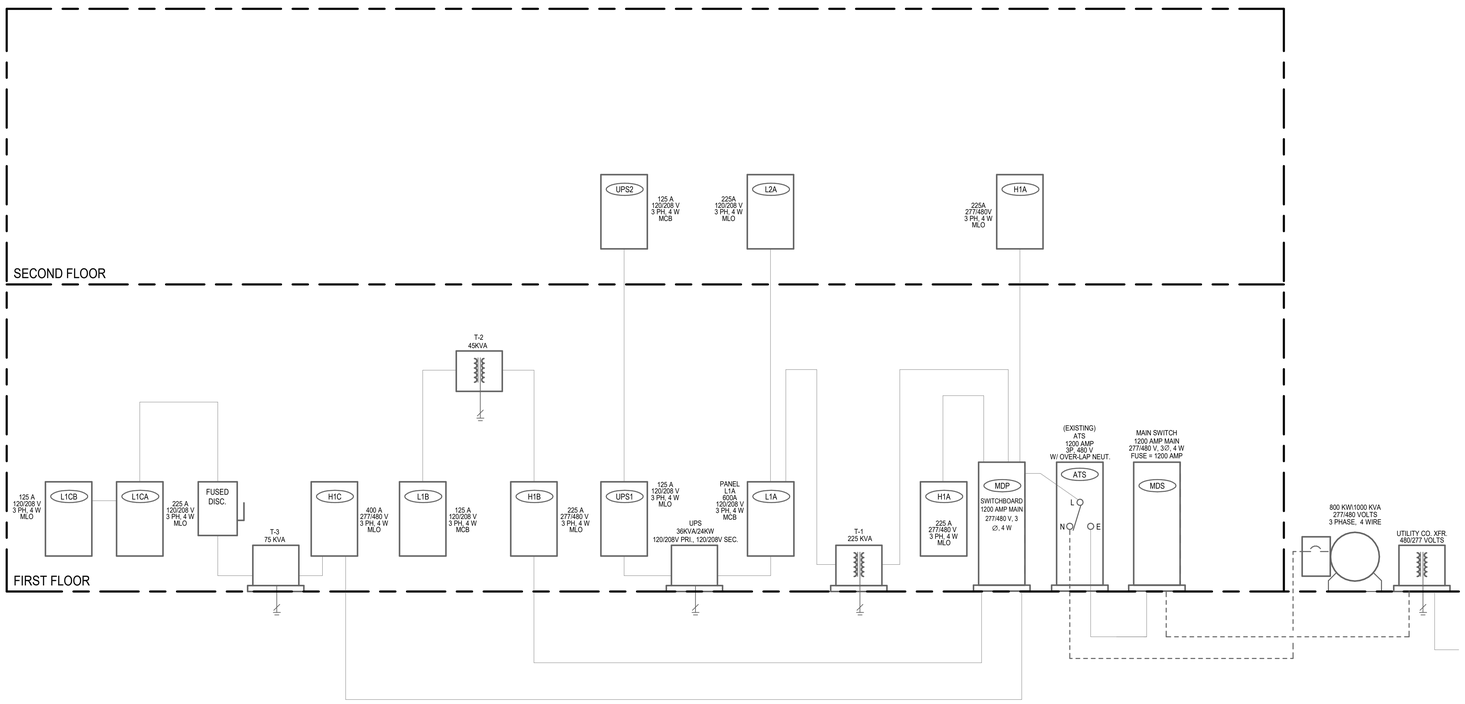
E613



5 E700 ELECTRICAL NORMAL POWER ONELINE RISER DIAGRAM - NEW
NO SCALE



4 E700 ELECTRICAL EMERGENCY POWER ONELINE RISER DIAGRAM - NEW
NO SCALE



1 E700 ELECTRICAL ONELINE RISER DIAGRAM - EXISTING
NO SCALE

VOLTAGE DROP FOR 20A BRANCH CIRCUITS

FEEDER SIZE TO USE	MAXIMUM DISTANCE ALLOWED	
	120V	277V
F20	100 FEET	200 FEET
F30	150 FEET	360 FEET
F40-50	240 FEET	550 FEET
F60	385 FEET	885 FEET

NOTES

1. CONDUCTORS FOR 20 AMP BRANCH CIRCUITS SHALL BE SIZED FOR VOLTAGE DROP. WIRE SIZES ARE NOT INDICATED ON THE DRAWINGS TO COMPENSATE FOR VOLTAGE DROP FOR THESE CIRCUITS. CONTRACTOR SHALL UTILIZE WIRE SIZE SHOWN ABOVE FOR THE DISTANCES LISTED ABOVE.
2. VOLTAGE DROP WIRE SIZES WILL BE STRICTLY ENFORCED. CONTRACTOR SHALL SUBMIT A LIST OF CIRCUITS THA WILL EXCEED THE DISTANCES ALLOWED AND INDICATE WIRE SIZE TO BE USED PRIOR TO ANY WIRE BEING INSTALLED.
3. PROVIDE SEPARATE, INDEPENDENT NEUTRAL CONDUCTORS FOR ALL BRANCH CIRCUITS. DO NOT SHARE NEUTRALS BETWEEN CIRCUITS.

GENERAL NOTES:

A. REFER TO SHEET E001 FOR ELECTRICAL SYMBOLS AND ADDITIONAL GENERAL NOTES.

B. REFER TO PANEL SCHEDULES ON E600-SERIES DRAWINGS FOR BREAKER QUANTITIES, SPARES, AND SPACES.

C. ALL EQUIPMENT SHALL BE RATED TO WITHSTAND THE AVAILABLE FAULT CURRENT FROM THE UTILITY. SERIES RATED DEVICES ARE NOT ACCEPTABLE.

PLAN NOTES

#	NOTE
1	GENERATOR CONTROLS SHALL BE CAPABLE OF PROVIDING 3 STEPS, FIRST PRIORTY BEING THE EMERGENCY BRANCH, SECOND PRIORTY BEING THE LEGALLY REQUIRED BRANCH, AND THIRD PRIORITY BEING THE OPTIONAL STANDBY BRANCH.
2	MAXIMUM WIRE LENGTH BETWEEN CIRCUIT BREAKER AND VOLTAGE SURGE SUPPRESSOR SHALL BE LESS THAN THREE (3) FEET.

FEEDER SIZING TABLE

DESIGNATION	CONDUCTOR SIZE PER CONDUIT			CONDUIT SIZE AND QUANTITY				
FXXX	PHASE & NEUTRAL	ISOLATED GROUND	BUILDING GROUND	OR 1P, 1N, 1G 2P, 1G	OR 2P, 1N, 1G 3P, 1G	3P, 1N, 1G	3P, 3N, 1G	3P, 1N, 2G
F20	12	12	12	3/4"	3/4"	3/4"	3/4"	3/4"
F30	10	10	10	3/4"	3/4"	3/4"	3/4"	3/4"
F40-F50	8	10	10	3/4"	3/4"	3/4"	1"	3/4"
F60	6	10	10	3/4"	3/4"	1"	1"	1"
F70-F80	4	8	8	3/4"	1"	1-1/4"	1-1/4"	1-1/4"
F90-F100	3	8	8	1"	1"	1-1/4"	1-1/2"	1-1/4"
F110	2	6	6	1"	1-1/4"	1-1/4"	1-1/2"	1-1/4"
F125	1	6	6	1-1/4"	1-1/4"	1-1/2"	2"	1-1/2"
F150	1/0	6	6	1-1/4"	1-1/2"	1-1/2"	2"	2"
F175	2/0	6	6	1-1/4"	1-1/2"	2"	2-1/2"	2"
F200	3/0	6	6	1-1/4"	2"	2"	2-1/2"	2"
F225	4/0	4	4	1-1/2"	2"	2-1/2"	2-1/2"	2-1/2"
F250	250	4	4	2"	2"	2-1/2"	3"	2-1/2"
F300	350	4	4	2"	2-1/2"	3"	3-1/2"	3"
F301	350	2	2	2-1/2"	3"	3"	4"	3"
F350	500	3	3	2-1/2"	3"	3"	4"	3"
F400	3/0	3	3		(2) 2"	(2) 2-1/2"	(2) 3"	(2) 2-1/2"
F401	3/0	1/0	1/0		(2) 2-1/2"	(2) 3"	(2) 3-1/2"	(2) 3"
F450	4/0	2	2		(2) 2"	(2) 2-1/2"	(2) 3"	(2) 2-1/2"
F500	250	2	2		(2) 2"	(2) 2-1/2"	(2) 3"	(2) 2-1/2"
F600	350	1	1		(2) 2-1/2"	(2) 3"	(2) 3-1/2"	(2) 3"
F700	500	1/0	1/0		(2) 3"	(2) 3"	(2) 4"	(2) 3-1/2"
F800	350	1/0	1/0		(3) 2-1/2"	(3) 3"	(3) 3-1/2"	(3) 3"
F900	350	2/0	2/0		(3) 2-1/2"	(3) 3"	(3) 3-1/2"	(3) 3"
F1000	500	2/0	2/0		(3) 3"	(3) 3"	(3) 4"	(3) 3-1/2"
F1200	350	3/0	3/0		(4) 2-1/2"	(4) 3"	(4) 3-1/2"	(4) 3"
F1600	500	4/0	4/0		(5) 3"	(5) 3"	(5) 4"	(5) 3-1/2"
F2000	500	250	250		(6) 3"	(6) 3-1/2"	(6) 4"	(6) 3-1/2"
F2500	500	350	350		(7) 4"	(7) 4"	(7) 4"	(7) 4"
F3000	500	500	500		(8) 4"	(8) 4"	(8) 4"	(8) 4"

NOTES:

1. 20 A BRANCH CIRCUITS SHALL BE SIZED FOR VOLTAGE DROP. WIRE SIZES ARE NOT INDICATED ON THE DRAWINGS TO COMPENSATE FOR VOLTAGE DROP. FOR THESE CIRCUITS, CONTRACTOR SHALL UTILIZE WIRE SIZE SHOWN ABOVE FOR DISTANCES LISTED ABOVE.
2. VOLTAGE DROP WIRE SIZES WILL BE STRICTLY ENFORCED. CONTRACTOR SHALL SUBMIT A LIST OF CIRCUITS THAT WILL EXCEED THE DISTANCES ALLOWED AND INDICATE WIRE SIZE TO BE USED PRIOR TO ANY WIRE BEING INSTALLED.
3. DO NOT SHARE NEUTRAL CONDUCTORS FOR ANY BRANCH CIRCUITS. ALL BRANCH CIRCUIT SHALL HAVE SEPARATE, INDEPENDENT NEUTRAL CONDUCTORS.
4. ALL CONDUIT PENETRATIONS THRU THE FLOOR SLAB SHALL BE MADE WITH CAUTION. CONTRACTOR SHALL COORDINATE ALL HOLE LOCATIONS WITH STRUCTURAL ENGINEER PRIOR TO CUTTING ANY NEW HOLES. NEW HOLES SHALL BE ADJUSTED AS REQUIRED TO MISS REBAR AS DETERMINED BY THE STRUCTURAL ENGINEER.
5. VOLTAGE DROP IN NOT SHOWN ON THE DRAWINGS. CONTRACTOR SHALL BE RESPONSIBLE FOR ADJUSTING ALL BRANCH CIRCUIT AND FEEDER SIZES TO COMPLY WITH STATE AND LOCAL VOLTAGE DROP REQUIREMENTS.
   A. VOLTAGE DROP ON ALL BRANCH CIRCUITS SHALL NOT EXCEED 3%.
   B. VOLTAGE DROP ON ALL FEEDERS SHALL NOT EXCEED 2%.

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	ADD-02	02/21/2022

Project #: 20-700-151-2

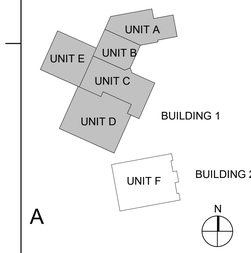
Designed By: EAE

Drawn By: EAE

Checked By: DLJ

Date: 02.04.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT



ELECTRICAL RISER DIAGRAMS - UNIT A, B, C, D, & E

E700

Interiors General Notes

REFERENCE A-001 FOR GENERAL PLAN NOTES. ALL NOTES MAY NOT APPLY TO THIS SHEET.

GENERAL

1. FURNITURE IS NOT PROVIDED IN THIS CONTRACT, LAYOUTS AND FINAL DESIGN WILL BE DETERMINED BY THE OWNER.
2. APPLIANCES (REFRIGERATORS,VENDING MACHINES, MONEY LOADING MACHINES, ETC.) AND TV DISPLAYS ARE PROVIDED BY OWNER.
3. REFERENCE INTERIOR ELEVATIONS, WHERE PROVIDED, FOR ADDITIONAL FINISH INFORMATION.
4. PROVIDE SAMPLES OF ALL FINISHES TO ARCHITECT/DESIGNER FOR REVIEW INCLUDING INSTALLATION, JOINT AND SEAM LAY-OUTS.
5. ALTERNATES WILL NOT BE ACCEPTED WITHOUT WRITTEN APPROVAL OF ARCHITECT/DESIGNER. SAMPLES, WHEN APPLICABLE, SHALL BE SUBMITTED FOR REVIEW.
6. ALL CASEWORK TO BE LOCKABLE. PROVIDE INDIVIDUAL KEYS AND A MASTER FOR ALL LOCKS.

FLOORING

7. GENERAL CONTRACTOR IS RESPONSIBLE FOR INSPECTING FLOOR SUBSTRATE PRIOR TO INSTALLATION OF ANY FLOOR FINISH AND IS TO PERFORM NECESSARY REPAIRS AS REQUIRED FOR FULL INSTALLATION OF FLOOR FINISHES.
8. FLOOR FINISHES ARE TO EXTEND UNDER BUILT-IN MILLWORK AND CASEWORK.
9. SEALER IS NOT TO BE USED ON CONCRETE WHERE TILE IS TO BE INSTALLED.
10. ALL FLOOR TILE TO BE THIN SET.
11. TRANSITION STRIPS TO BE INSTALLED BETWEEN ALL UNLIKE FLOORING SURFACES. COLOR TO BE SELECTED BY DESIGNER.
12. FABRIC REINFORCED FLUID APPLIED MEMBRANE TO BE APPLIED OVER ENTIRE FLOOR AND 12" UP WALL, WHERE TILE FLOORS ARE INDICATED.
13. ALL FLOORING TRANSITIONS BETWEEN TILE AND SEALED CONCRETE ARE TO HAVE A FEATHERED EDGE SKIM COAT TO INSURE THE FINISHED FLOORS ARE AT THE SAME HEIGHT AND TRANSITIONS ARE FLUSH.
14. SEE SHEET **I-500** FOR TRANSITION STRIP DETAILS FOR TRANSITIONS BETWEEN UNLIKE FLOORING SURFACES. COLOR TO BE SELECTED BY ARCHITECT/DESIGNER.

WALLS (GENERAL)

15. APPLY SEALANT AND BACKER ROD AT ALL JUNCTIONS BETWEEN DIFFERENT MATERIALS (I.E. CMU BLOCK WALL AND DRYWALL, STOREFRONT AND PRECAST).
16. APPLY SEALANT AND BACKER ROD AT ALL THROUGH WALL AND FLOOR PENETRATION JOINTS.
17. INSTALL TOOLED JOINT AT ALL LOCATIONS WHERE CMU BLOCK WALL MEETS SEALED CONCRETE FLOOR.
18. CORNER GUARDS SHOULD NOT BE APPLIED TO CMU WALLS. FIELD VERIFY ALL LOCATIONS IN PLANS.
19. APPLY SEALANT AT ALL JUNCTIONS BETWEEN WALLS AND COUNTERTOPS AND MILLWORK.
20. CAULK/SEALANT COLOR TO MATCH ADJACENT SURFACES.
21. ALL WET WALLS TO RECEIVE CEMENTIOUS BACKER BOARD, INCLUDING BUT NOT LIMITED TO TOILETS, SHOWERS, SINKS, DRINKING FOUNTAINS, ETC.
22. PROVIDE 5/8" TILE BACKER UNITS ON ALL WALLS AT WALL TILE INSTALLATIONS.
23. SEE DETAIL FOR TILE WALL TO TILE OR SEALED CONCRETE FLOOR JOINT.
24. WHERE APPLICABLE, TILE BASE TO BE USED ON WALLS THAT DO NOT HAVE WALL TILE.

WALLS (FINISHES)

25. PAINT ALL NEW WALLS **PT1** UNLESS OTHERWISE NOTED. BLOCK FILL IF NEEDED.
26. ALL WALLS RECEIVING ACCENT PAINT TO BE PAINTED FLOOR TO CEILING, AND CORNER TO CORNER.
27. ALL OFFICES, CONFERENCE ROOMS, BREAK ROOMS, TRAINING, WORK AREAS, KITCHENETTE, OPEN OFFICE, AND LOBBY TO HAVE 2 ACCENT WALLS, TO BE CHOSEN BY DESIGNER.
28. ALL EXPOSED METAL SURFACES (I.E. GRILLS, HEATERS, AND FIRE EXTINGUISHER CABINETS) TO MATCH ADJACENT SURFACE.
29. UNLESS SPECIFICALLY NOTED, USE GENERAL WALL FINISHES NOTED IN ROOM.

BULKHEADS AND CEILINGS

30. REFERENCE ARCHITECTURAL CEILING PLANS FOR CEILING HEIGHTS AND ALTERNATE BULKHEAD AND CEILING COLOR DESIGNATION.
31. PAINT ALL BULKHEADS AND BULKHEADS THAT ARE FLUSH WITH WALLS TO MATCH ADJACENT WALL, UNLESS OTHREWISE NOTED.
32. PAINT ALL EXPOSED CEILINGS **PT2,** UNLESS OTHERWISE NOTED.
33. PAINT ALL DRYWALL CEILINGS **PT2,** UNLESS OTHERWISE NOTED.

WINDOWS

34. PROVIDE MANUAL WINDOW SHADES AT ALL NOTED LOCATIONS.
35. ALL WINDOW STOOLS TO BE **SS1**. SEE FINISH LEGEND. EXISTING WINDOW STOOLS TO REMAIN.
36. PROVIDE WINDOW COVERINGS AT ALL EXTERIOR WINDOWS.

FINISHES BY ROOM SCHEDULE

ROOM NAME	ROOM #	WALL BASE	FLOOR FINISH	WALL FINISH
VESTIBULE	100A			
PUBLIC LOBBY	100B	PORC2	PORC1	PT1, WT5, WT6
WOMEN RR	101	PORC2	PORC1	WT1
MEN RR	102	PORC2	PORC1	WT1
STAFF WORK AREA	103	VB1	LVT1	
STAFF RR	104	PORC2	PORC1	WT1
STORAGE	105	VB1	LVT1	
OFFICE	106	VB1	CPT1	
BREAK ROOM	107	VB1	LVT1	PT1, WT3, WT4
OFFICE	108	VB1	CPT1	
JAN.	109		SC1	
OFFICE	110	VB1	CPT1	
OFFICE	111	VB1	CPT1	
CORRIDOR	112	VB1	LVT1	
DATA	113	VB1	LVT1	
STAFF RR	114	PORC2	PORC1	WT1
CONFERENCE	115	VB1	CPT1	
OFFICE	116	VB1	CPT1	
PROGRAMMING	117	VB1	CPT2	
OFFICE	118	VB1	CPT1	
OFFICE	119	VB1	CPT1	
BODY SCAN	120	VB1	SC1	
WAITING	121	VB1	SC1	
DRUG TEST RR	122	VB1	SC1	
RR	123		SC1	
CORRIDOR	124		SC1	
PROGRAMMING	125	VB1	CPT2	
WOMEN'S CORRIDOR	126		SC1	
EXIT CORRIDOR	127		SC1	
WOMEN'S LOCKER	128		SC1	
WAITING	129	VB1	SC1	
DRUG TEST RR	130	VB1	SC1	
MEN'S LOCKER	131		SC1	
JAN.	132		SC1	
RR	133		SC1	
MEN'S CORRIDOR	134		SC1	
EXIT CORRIDOR	135		SC1	
MED. STORAGE	136	VB1	SC1	
JANITOR	137		SC1	
MED. STORAGE	138	VB1	SC1	
COMMISSARY	139	VB1	SC1	
JANITOR	140		SC1	
OBSERVATION	141		SC1	
STORAGE	142	VB1	SC1	
MEAL PREP	144	VB1	SC1	
IT	145	VB1	SDT	
OBSERVATION	146		SC1	
COMMISSARY	147		SC1	
STAFF RR	148	PORC2	PORC1	WT1
WOMEN'S CORRIDOR	149		SC1	
MEN'S CORRIDOR	150		SC1	
CONTROL	151		LVT1, CPT2	
MECHANICAL	152		SC1	
MECHANICAL	153		SC1	
MECHANICAL	154		SC1	
ELECTRICAL	155		SC1	
ELECTRICAL	156		SC1	
SECURE VEST.	157		SC1	
SECURE VEST.	158		SC1	
DAYROOM	159		SC1	
RR/SHOWER	160		SC1	
LAUNDRY	161		SC1	
DAYROOM	162		SC1	
RR/SHOWER	163		SC1	
LAUNDRY	164		SC1	
DAYROOM	165		SC1	
RR/SHOWER	166		SC1	
LAUNDRY	167		SC1	
DAYROOM	168		SC1	
RR/SHOWER	169		SC1	
LAUNDRY	170		SC1	
DAYROOM	171		SC1	
RR/SHOWER	172		SC1	
LAUNDRY	173		SC1	
DAYROOM	174		SC1	
RR/SHOWER	175		SC1	
LAUNDRY	176		SC1	
DAYROOM	177		SC1	
RR/SHOWER	178		SC1	
LAUNDRY	179		SC1	
DAYROOM	180		SC1	
RR/SHOWER	181		SC1	
LAUNDRY	182		SC1	
SALLYPORT	183		SC1	
STORAGE	184		SC1	
MEZZANINE	200		SC1	
MEZZANINE	201		SC1	
MEZZANINE	202		SC1	
MEZZANINE	203		SC1	
MEZZANINE	204		SC1	
MEZZANINE	205		SC1	
MEZZANINE	206		SC1	
MEZZANINE	207		SC1	
WAITING	1110		SC1	
VID COURT 1/OFFICE	1111		SC1	
PADDED	1112		PD	
RR	1113		SC1	
PADDED	1114		PD	
PADDED	1115		PD	
RR	1117		SC1	
VID COURT 2	1118		SC1	
NURSE OFFICE	1120	VB1	LVT1	
RR	1121		SC1	
PADDED	1122		PD	
DRESS	1123		SC1	
STAFF RR	1124	PORC2	PORC1	
PROPERTY STORAGE	1125		SC1	
NURSE STORAGE	1126	VB1	LVT1	

FINISHES BY ROOM SCHEDULE

ROOM NAME	ROOM #	WALL BASE	FLOOR FINISH	WALL FINISH
STOR.	1127	VB1	LVT1	
EXAM	1128A		SC1	
EXAM	1128B		SC1	
DRESS	1129		SC1	
SECURED CORRIDOR	1130		SC1	
ISO	1132		SC1	
ISO	1133		SC1	
ISO	1134		SC1	
ISO	1135		SC1	
ISO	1136		SC1	
ISO	1137		SC1	
ISO	1138		SC1	
PADDED	1139A		PD	
RR	1139B		SC1	
ELECT.	1245	VB1	SC1	
ELECT.	1246	VB1	SC1	
ELECT.	1247	VB1	SC1	
MECH.	1248		SC1	
SECURE CORR.	1307		SC1	
KITCHEN	1309		EXISTING	
COOLER	1310		SC1	
FREEZER	1311		SC1	
DRY STORAGE	1312		SC1	
RR	1313		SC1	
SALLY PORT	1314		SC1	
OFFICE	1315	VB1	LVT1	
CART STOR.	1316		MATCH 1309 EXISTING	
CHEM. STR.	1318		EXISTING	
SALLYPORT	1501		SC1	
MATERIAL STORAGE	1502		SC1	
MAINTENANCE WORK AREA	1503		SC1	
MAINT. OFFICE	1504		SC1	
PRE-PROCESS	1505		SC1	
PREPROCESS HOLD	1506		SC1	
PREPROCESS HOLD	1507		SC1	
GROUP HOLD	1508		SC1	
FILE STOR.	1509		SC1	
BREATH	1510		SC1	
BOOK IN CENTER	1511		SC1	
BOOK IN COUNTER	1512	VB1	CPT1, LVT1	
GROUP HOLD	1513		SC1	
IT ROOM	1514	VB1	SDT	
STAFF RR	1515	VB1	SC1	
OFFICE	1516	VB1	LVT1	
JAN	1517		SC1	
DAYROOM	1518		SC1	
ISO.	1519		SC1	
ISO.	1521		SC1	
GROUP HOLDING	1522		SC1	
ISO.	1523		SC1	
ISO.	1525		SC1	
ISO.	1526		SC1	
ISO.	1528		SC1	
ISO.	1529		SC1	
SHOWER	1531		SC1	
STORAGE	1531A		SC1	
MECHANICAL	1532		SC1	
WASH AREA	1534			
Room	1535			
KITCHEN STORAGE	1542	VB1	SC1	
DETENTION CORRIDOR	1601		SC1	
OUTDOOR RECREATION	1602		SC1	
PROGRAMMING	1603		SC1	
STOR.	1604	VB1	SC1	
VIDEO COURT	1605		SC1	
STOR.	1606	VB1	SC1	
JAN.	1607	VB1	SC1	
INDOOR/OUTDOOR REC	1608		SC1	
RR	1609		SC1	
SALLYPORT	1610		SC1	
STOR.	1611	VB1	SC1	
MECHANICAL	1612		SC1	
DAYROOM	1614		SC1	
RESTROOM	1614A		SC1	
DAYROOM	1615		SC1	
RESTROOM	1615A		SC1	
DAYROOM	1616		SC1	
4 BED ADA CELL	1617		SC1	
4 BED CELL	1618		SC1	
4 BED CELL	1619		SC1	
4 BED CELL	1620		SC1	
DAYROOM	1621		SC1	
4 BED CELL	1622		SC1	
4 BED CELL	1623		SC1	
4 BED CELL	1624		SC1	
ATRNY/CLIENT	1639		SC1	
ATRNY/CLIENT	1640		SC1	
CLASSROOM	1641		SC1	
OFFICE	1642	VB1	CPT1	
OFFICE	1643	VB1	CPT3	
TRAINING ROOM	1644	VB1	CPT4	
STORAGE	1644A	VB1	CPT4	
STORAGE	1645	VB1	SC1	
MECHANICAL	1659		SC1	
MECH.	1660		SC1	
MECHANICAL	1661		SC1	
MECH.	1662		SC1	
CORRIDOR	2601	VB1	SC1	
CONTROL	2602	VB1	CPT4, LVT1	PT#
IT	2603	VB1	SDT	
RR	2604	VB1	SC1	PT#
STORAGE	2605	VB1	SC1	
DORM MEZZANINE	2606		SC1	
RESTROOM	2606A		SC1	
DORM MEZZANINE	2607		SC1	
RESTROOM	2607A		SC1	
MEZZ.	2608		SC1	
4 BED CELL	2609		SC1	
4 BED CELL	2610		SC1	
4 BED CELL	2611		SC1	
4 BED CELL	2612		SC1	
MEZZ.	2613		SC1	
4 BED CELL	2614		SC1	
4 BED CELL	2615		SC1	
4 BED CELL	2616		SC1	
STAIRS	ST01	VB1	SC1	PT#

FINISH LEGEND

CARPET (CPT)

CPT1
MANUFACTURER: ARMSTRONG
COLLECTION: STAGLAG SVIRA
COLOR: DOVE RAIN
SIZE: 50cm X 50cm
INSTALLATION: MONOLITHIC
LOCATIONS: BOOK IN COUNTER 1512, OFFICE 1654, DIRECTOR'S OFFICE 110, OFFICE 108, OFFICE 106, OFFICE 116, OFFICE 118, OFFICE 119, OFFICE 111, CONFERENCE 115
NOTE: UNIT A, UNIT D, AND UNIT F

CPT2
MANUFACTURER: ARMSTRONG
COLLECTION: ABSOLUTE
COLOR: WETLAND
SIZE: 50cm X 50cm
INSTALLATION: QUARTER TURN
LOCATIONS: PROGRAMMING 125, PROGRAMMING 117, CONTROL 151
NOTE: UNIT F

CPT3
MANUFACTURER: MATCH EXISTING
SIZE: 24" X 24"
INSTALLATION: QUARTER TURN
LOCATIONS: OFFICE 1655
NOTE: UNIT D

CPT4
MANUFACTURER: ARMSTRONG
COLLECTION: STAGLAG SVIRA
COLOR: STARDUST
SIZE: 50cm X 50cm
INSTALLATION: QUARTER TURN
LOCATIONS: TRAINING ROOM 1657, CONTROL ROOM 2601
NOTE: UNIT D

LUXURY VINYL TILE (LVT)

LVT1
MANUFACTURER: ARMSTRONG FLOORING
COLLECTION: NATURAL CREATIONS WITH DIAMOND 10 TECHNOLOGY
STYLE: AVILA OAK
COLOR: PERUVIAN COCOA
SIZE: 6x36 PLANK
INSTALLATION: PER MANUFACTURER INSTRUCTION
LOCATIONS: STAFF WORK AREA 103, BREAK ROOM 107, CORRIDOR 112, WAITING 121, DRUG TEST RR 122, WAITING 129, DRUG TEST RR 130, MEAL PREP 144
NOTE: UNIT F

VINYL BASE (VB)

VB1
MANUFACTURER: ARMSTRONG FLOORING
COLOR: SMOKEY GRAY R48SG
SIZE: COVED ROLL 4"
LOCATION: ALL LVT1 LOCATIONS, BOOK IN COUNTER 1512, STORAGE 1604, STORAGE 1606, JANITOR 1607, STORAGE 1611, AND STAIRS ST01
NOTE: UNIT A, UNIT D, UNIT F

SEALED CONCRETE (SC)

SC1 NOTE: SEE ARCHITECTURAL DRAWINGS

FLOOR TILE (PORC)

PORC1
MANUFACTURER: DALTILE
COLLECTION: ASTRONOMY
COLOR: SOLSTICE ATT2
FINISH: MATTE
INSTALLATION: ASHLAR
SIZE: 12x24
LOCATION: LOBBY 100, WOMEN RR 101, MEN RR 102, STAFF RR 104, STAFF RR 114, STAFF RR 148
NOTE: UNIT F

PORC2
MFR: DALTILE
COLLECTION: ASTRONOMY
COLOR: SOLSTICE ATT2
FINISH: MATTE
INSTALLATION: WALL BASE
SIZE: P-36/3TB
LOCATION: ALL PORC1 LOCATIONS
NOTE: UNIT F

WALL TILE (WT)

WT1
MANUFACTURER: DALTILE
COLLECTION: MYTHOLOGY
COLOR: AURA MY95
FINISH: GLOSSY
INSTALLATION: ASHLAR, 1/16" GROUT JOINT
GROUT: TEC POWERGROUT DELOREAN GRAY 934
SIZE: 4x12 UNDULATED
LOCATION: STAFF RR 104, STAFF RR 114, STAFF RR 148
NOTE: UNIT F

WT2
MANUFACTURER: DALTILE
COLLECTION: MYTHOLOGY
COLOR: AURA MY95
FINISH: GLOSSY
INSTALLATION: ALL WT1 LOCATIONS. SEE ELEVATIONS
GROUT: TEC POWERGROUT DELOREAN GRAY 934
SIZE: 12" JOLLY S-1212J
LOCATION: STAFF RR 104, STAFF RR 114, STAFF RR 148
NOTE: UNIT F

WT3
MANUFACTURER: DALTILE
COLLECTION: MYTHOLOGY
COLOR: HARMONIA MY92
FINISH: GLOSSY
INSTALLATION: DOT-MOUNTED MOSAIC, 1/8" GROUT JOINT
GROUT: TEC POWERGROUT BRIGHT WHITE 910
SIZE: PICKET MOSAIC - UNDULATED
LOCATION: BREAKROOM 107
NOTE: UNIT F

WT4
MANUFACTURER: DALTILE
COLLECTION: MYTHOLOGY
COLOR: HARMONIA MY92
FINISH: GLOSSY
INSTALLATION: ALL WT3 LOCATIONS. SEE ELEVATIONS
GROUT: TEC POWERGROUT BRIGHT WHITE 910
SIZE: 12" JOLLY S-1212J
LOCATION: BREAKROOM 107
NOTE: UNIT F

WT5
MANUFACTURER: DALTILE
COLLECTION: MYTHOLOGY
COLOR: CHRONOS MY93
FINISH: GLOSSY
INSTALLATION: MONOLITHIC, 1/16" GROUT JOINT
GROUT: TEC POWERGROUT DELOREAN GRAY 934
SIZE: 4x12 WAVE CREST
LOCATION: LOBBY 100. SEE ELEVATION IN203-3E. A1
NOTE: UNIT F

FINISH LEGEND

PAINT (PT)

PT1
MANUFACTURER: SHERWIN-WILLIAMS
COLOR: MISTY - SW6232
FINISH: SATIN
LOCATION: ALL OVER
NOTE: UNIT A, UNIT B, UNIT D, AND UNIT F

PT2
MANUFACTURER: SHERWIN-WILLIAMS
COLOR: CEILING BRIGHT WHITE - SW7007
FINISH: SATIN
LOCATION: ALL CEILINGS
NOTE: UNIT A, UNIT B, UNIT D, AND UNIT F

PT3
MANUFACTURER: SHERWIN-WILLIAMS
COLOR: GRAYS HARBOR - SW6236
FINISH: SATIN ON WALLS
LOCATION: ACCENT: TRAINING ROOM 1657
NOTE: UNIT D

PT4
MANUFACTURER: SHERWIN-WILLIAMS
COLOR: DRIZZLE - SW6479
FINISH: SATIN ON WALLS AND MATTE ON ALL EXPOSED METAL SURFACES
LOCATION: ACCENT IN COMMUNITY CORRECTIONS ADMINSTRATION OFFICES AND RAILINGS, STAIRS, TRIM, AND DOOR FRAMES IN FEMALE COMMUNITY CORRECTIONS DAYROOMS
NOTE: UNIT F

PT5
MANUFACTURER: SHERWIN-WILLIAMS
COLOR: EDAMAME - SW7729
FINISH: SATIN ON WALLS AND MATTE ON ALL EXPOSED METAL SURFACES
LOCATION: ACCENT IN COMMUNITY CORRECTIONS ADMINSTRATION OFFICES AND RAILINGS, STAIRS, TRIM, AND DOOR FRAMES IN MALE COMMUNITY CORRECTIONS DAYROOMS
NOTE: UNIT F

PT6
MANUFACTURER: SHERWIN-WILLIAMS
COLOR: LOYAL BLUE - SW6510
FINISH: MATTE ON ALL EXPOSED METAL SURFACES
LOCATION: RAILINGS, STAIRS, TRIM, DOORS AND DOOR FRAMES IN JAIL POD DAYROOMS
NOTE: UNIT D

PT7
MANUFACTURER: SHERWIN-WILLIAMS
COLOR: COCONUT HUSK - SW6111
FINISH: SATIN
LOCATION: ADMINISTRATION OFFICE 1655
NOTE: UNIT D

PT8
MANUFACTURER: SHERWIN-WILLIAMS
COLOR: BEACH HOUSE - SW7518
FINISH: SATIN
LOCATION: ADMINISTRATION OFFICE 1655
NOTE: UNIT D

CASEWORK (PS)

PS1
MANUFACTURER: ARISTOKRAFT
COLOR: STONE GRAY
FINISH: PURESTYLE
DOOR STYLE: ELLIS
LOCATION: ALL CASEWORK IN STAFF RR, NURSES STATION 1120
NOTE: UNIT A, UNIT B, UNIT C, UNIT D, AND UNIT F

PS2
MANUFACTURER: ARISTOKRAFT
COLOR: ADMIRAL
FINISH: PURESTYLE
DOOR STYLE: ELLIS
LOCATION: CASEWORK IN EXAM ROOMS, BREAKROOM 107, STAFF WORK AREA 103
NOTE: UNIT B AND UNIT F

SOLID SURFACE (SS)

SS1
MANUFACTURER: CORIAN
COLOR: ARROWROOT
LOCATION: ALL CASEWORK
NOTE: UNIT A, UNIT B, UNIT C, UNIT D, AND UNIT F

MARKER BOARDS

M1
MANUFACTURER: CLARIDGE
COLLECTION: GLASS
COLOR: BRILLIANT WHITE

STATIC DISSIPATIVE TILE (SDT)

SDT1
MANUFACTURER: ARMSTRONG
COLLECTION: EXCELON SDT
COLOR: COAL (51959)
SIZE: 12" x 12" x 1/8"
INSTALLATION: FULL SPREAD PER MANUFACTURER INSTRUCTIONS
LOCATIONS: IT 1514 AND DATA 113
NOTE: UNIT A AND UNIT F

DETENTION GRADE MIRROR

DGM1
MANUFACTURER: NORIX
COLLECTION: IRONMAN WALL MOUNT MIRRORS
MODEL# AND SIZE: RS66-411, 11" x 17" x 1/4"
INSTALLATION: MANUFACTURER INSTRUCTIONS
LOCATIONS: RR/SHOWER 151, RR/SHOWER 153, RR/SHOWER 156, RR/SHOWER 159, RR/SHOWER 163, RR/SHOWER 165, RR/SHOWER 171
NOTE: UNIT F

RQAW ARCHITECTURE

KNOX COUNTY JUSTICE CAMPUS

KNOX COUNTY BOARD OF COMMISSIONERS

2375 OLD DECKER RD. VINCENNES, IN 47591

BID SET

#	Revision	Date
1	Addendum #1	02.14.2022
2	Addendum #2	02.21.2022

Project #: 20-700-151-2

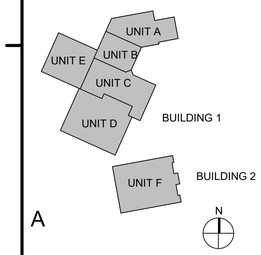
Designed By: LD/SP

Drawn By: WD

Checked By: LD/EV

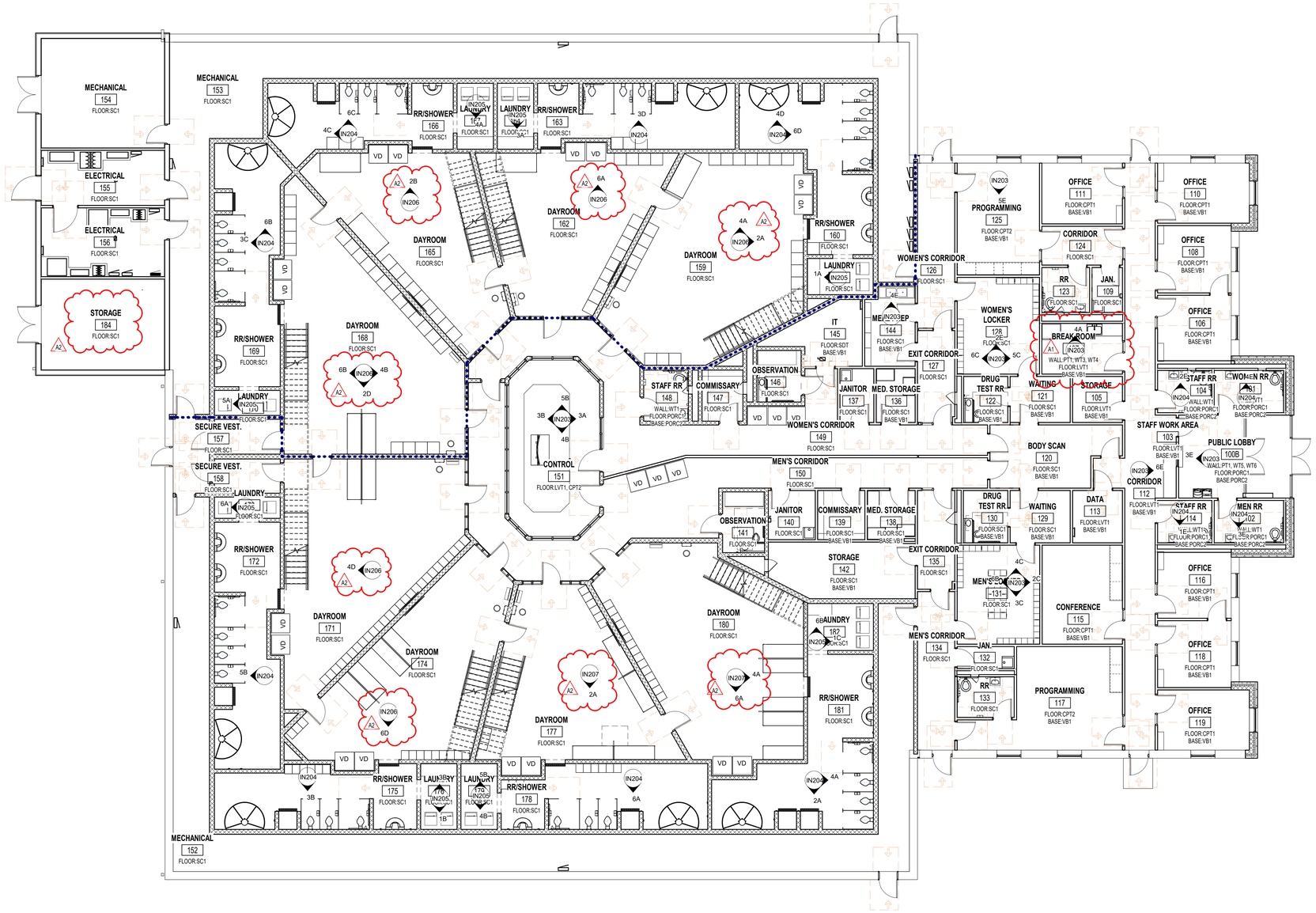
Date: 02.21.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT



INTERIOR NOTES AND LEGENDS

IN 001



6A UNIT F - FIRST FLOOR INTERIOR FINISH PLAN
1/8" = 1'-0"

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

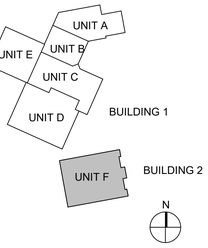
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
1	Addendum #1	02.14.2022
2	Addendum #2	02.21.2022

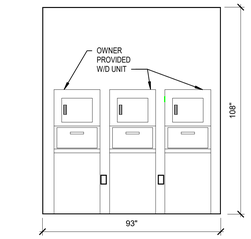
Project #: 20-700-151-2
Designed By: LD/SP
Drawn By: WD
Checked By: LD/EV
Date: 02.21.2022

ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT

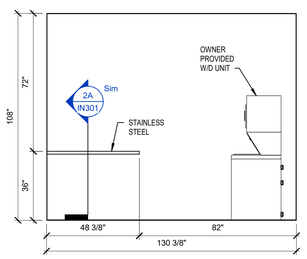


FIRST FLOOR INTERIOR FINISH PLAN- UNIT F

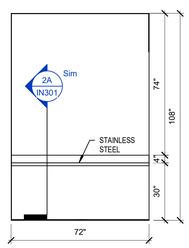
IN107 2F1



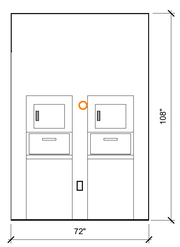
1C **UNIT F - 182 LAUNDRY - EAST ELEVATION**
3/8" = 1'-0"



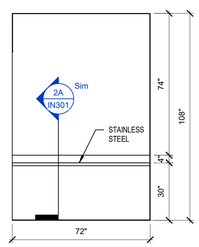
6B **UNIT F - 182 LAUNDRY - NORTH ELEVATION**
3/8" = 1'-0"



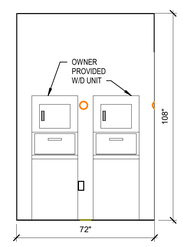
5B **UNIT F - 179 LAUNDRY - NORTH ELEVATION**
3/8" = 1'-0"



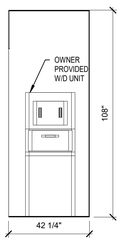
4B **UNIT F - 179 LAUNDRY - SOUTH ELEVATION**
3/8" = 1'-0"



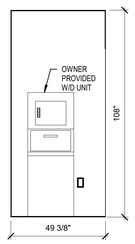
3B **UNIT F - 176 LAUNDRY - NORTH ELEVATION**
3/8" = 1'-0"



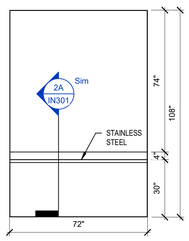
1B **UNIT F - 176 LAUNDRY - SOUTH ELEVATION**
3/8" = 1'-0"



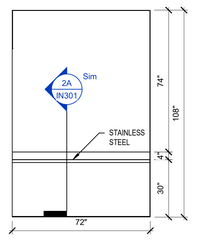
6A **UNIT F - 173 LAUNDRY - WEST ELEVATION**
3/8" = 1'-0"



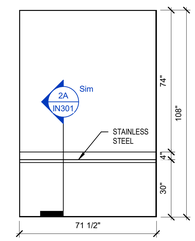
5A **UNIT F - 170 LAUNDRY - WEST ELEVATION**
3/8" = 1'-0"



4A **UNIT F - 167 LAUNDRY - SOUTH ELEVATION**
3/8" = 1'-0"



3A **UNIT F - 164 LAUNDRY - SOUTH ELEVATION**
3/8" = 1'-0"



1A **UNIT F - 161 LAUNDRY - WEST ELEVATION**
3/8" = 1'-0"

RQAW
ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

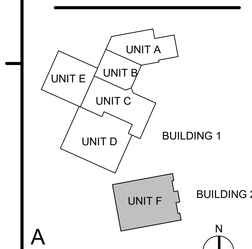
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
2	Addendum #2	02.21.2022

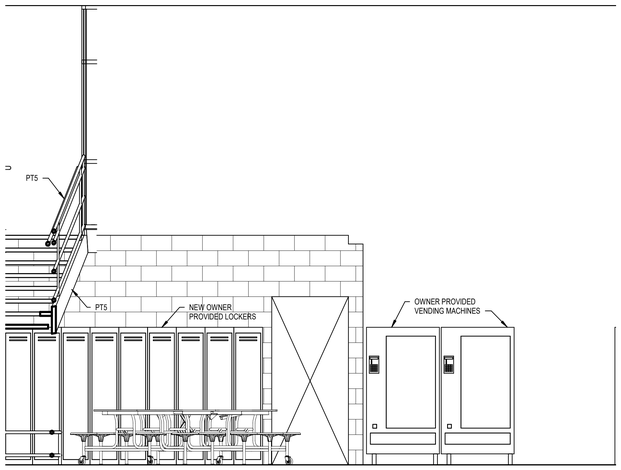
Project #: 20-700-151-2
Designed By: LD/SP
Drawn By: WD
Checked By: LD/EV
Date: 02.21.2022

ERIC S. WEFLEN
REGISTERED
No. AR11500136
STATE OF
INDIANA
ARCHITECT

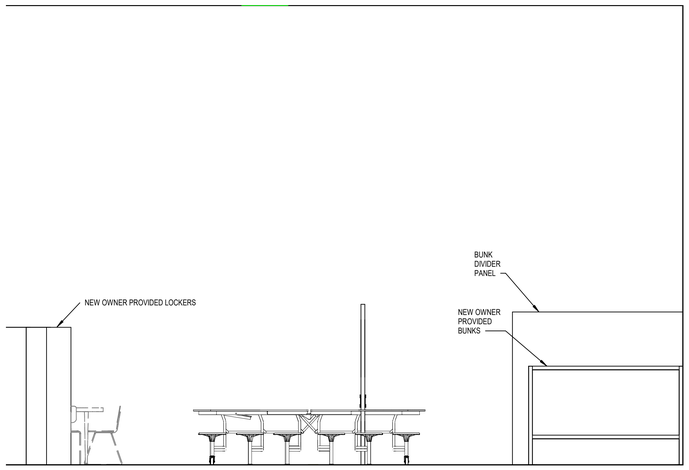


LAUNDRY INTERIOR ELEVATIONS

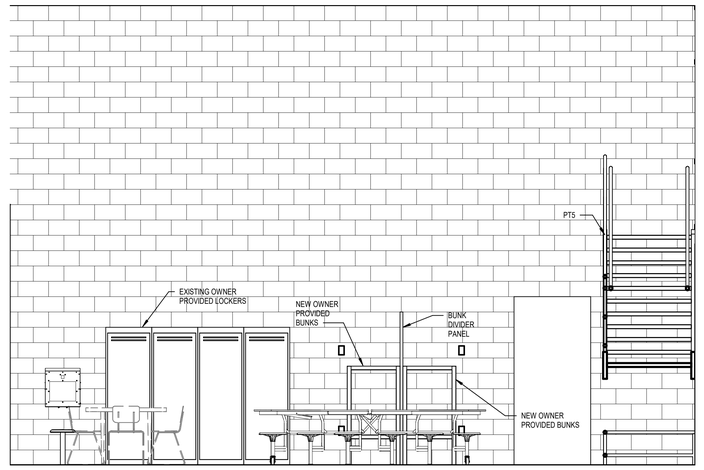
IN205



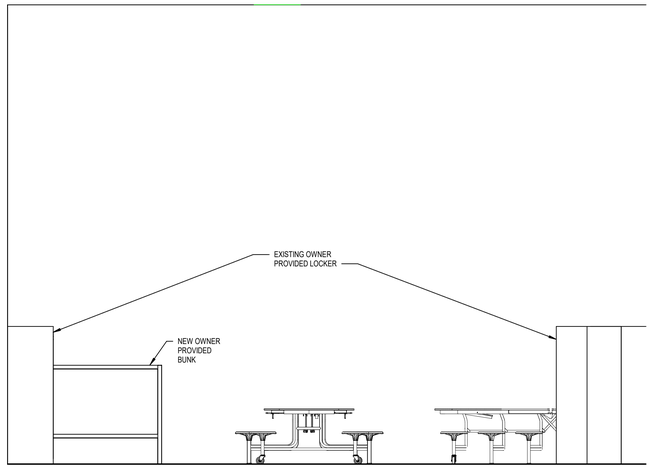
6D **UNIT F - 174 DAYROOM - SOUTH ELEVATION**
3/8" = 1'-0"



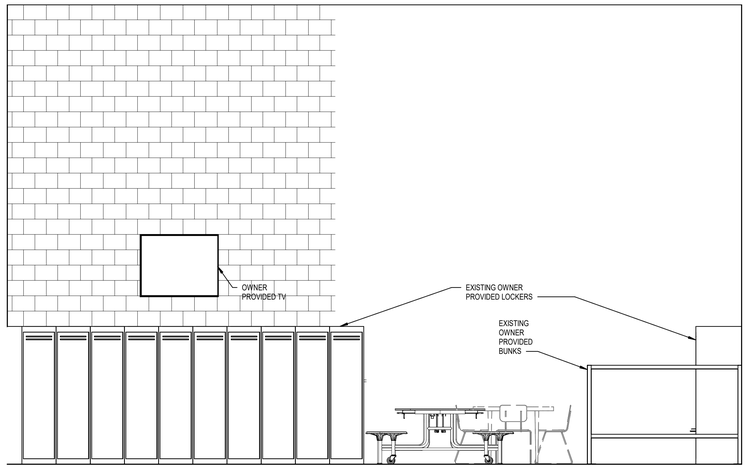
4D **UNIT F - 171 DAYROOM - WEST ELEVATION**
3/8" = 1'-0"



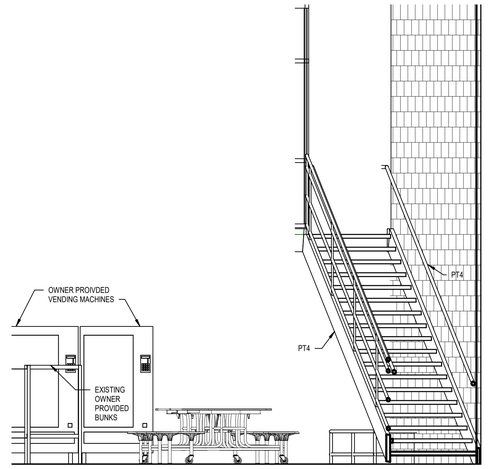
2D **UNIT F - 168 DAYROOM - SOUTH ELEVATION**
3/8" = 1'-0"



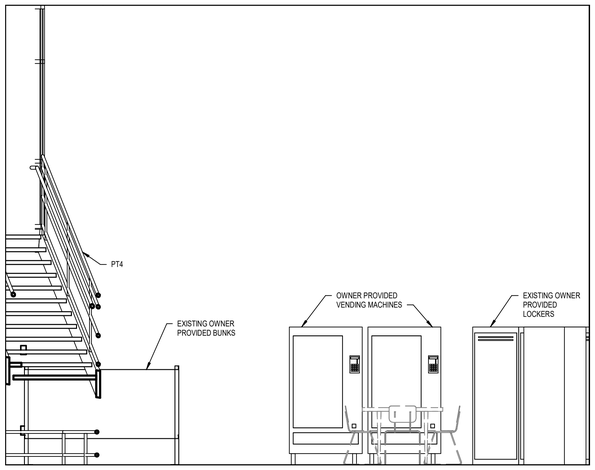
6B **UNIT F - 168 DAYROOM - WEST ELEVATION**
3/8" = 1'-0"



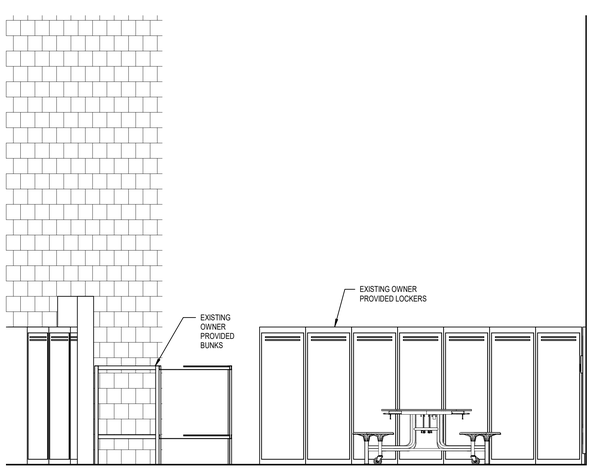
4B **UNIT F - 168 DAYROOM - EAST ELEVATION**
3/8" = 1'-0"



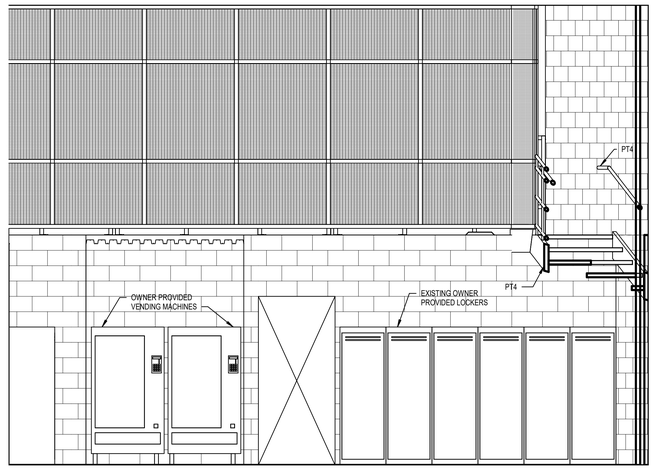
2B **UNIT F - 165 DAYROOM - NORTH ELEVATION**
3/8" = 1'-0"



6A **UNIT F - 162 DAYROOM - NORTH ELEVATION**
3/8" = 1'-0"



4A **UNIT F - 159 DAYROOM - NORTH ELEVATION**
3/8" = 1'-0"



2A **UNIT F - 159 DAYROOM - EAST ELEVATION**
3/8" = 1'-0"

RQAW ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

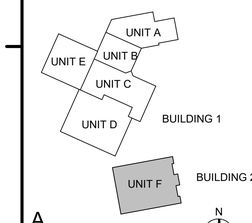
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
2	Addendum #2	02.21.2022

Project #: 20-700-151-2
Designed By: LD/SP
Drawn By: WD
Checked By: LD/EV
Date: 02.21.2022

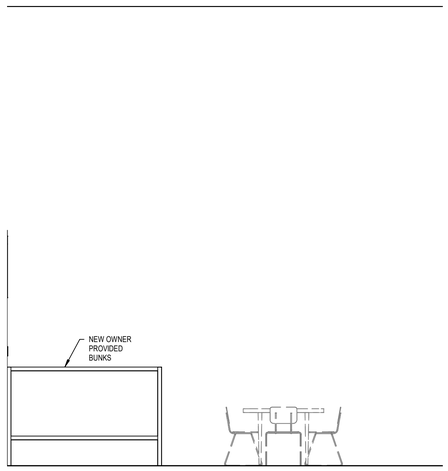
ERIC S. WEFLEN REGISTERED No. AR11500136 STATE OF INDIANA ARCHITECT



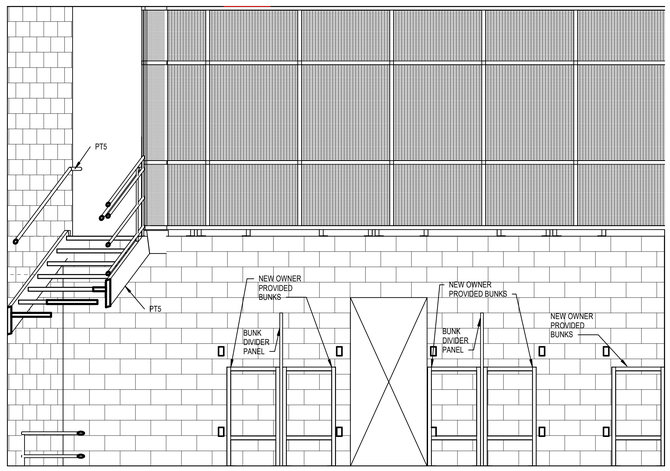
DAYROOM ELEVATIONS

A2

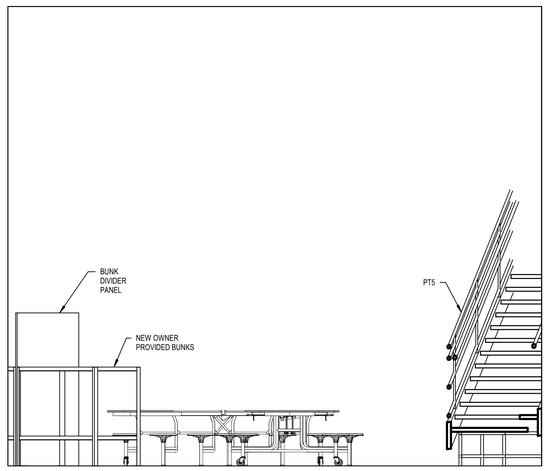
IN206



6A **UNIT F - 180 DAYROOM - SOUTH ELEVATION**
3/8" = 1'-0"



4A **UNIT F - 180 DAYROOM - EAST ELEVATION**
3/8" = 1'-0"



2A **UNIT F - 177 DAYROOM - SOUTH ELEVATION**
3/8" = 1'-0"

RQAW
ARCHITECTURE

BID SET

KNOX COUNTY BOARD OF COMMISSIONERS

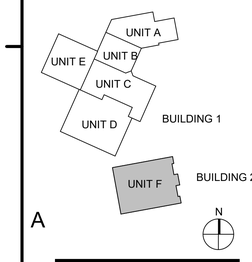
KNOX COUNTY JUSTICE CAMPUS

2375 OLD DECKER RD. VINCENNES, IN 47591

#	Revision	Date
2	Addendum #2	02.21.2022

Project #: 20-700-151-2
Designed By: LD/SP
Drawn By: WD
Checked By: LD/EV
Date: 02.21.2022

ERIC S. WEFLEN
REGISTERED
No. AR11500136
STATE OF
INDIANA
ARCHITECT



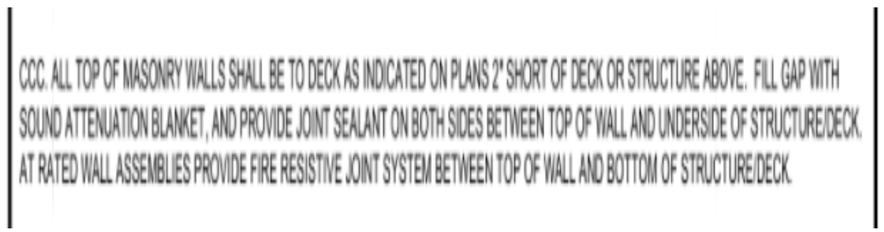
DAYROOM ELEVATIONS

IN207

A2

Bid Question Log
Project Name: Knox County Justice Center
Date: February 22, 2022

= Items in Addendum - Closed Item

Item No.	Item Description	Received From	Date Received	Date To RQAW	Response Date	Response
01	Area "C" – existing ceiling is not labeled for demolition (is this exposed as existing, Installation of new MEP will require access ?)	Garmong		2/2/2022		Added to set pre-addendum #1
02	Wall partition M10-D used on Area "D" – do not see that wall type on A002	Garmong		2/2/2022		Added to set pre-addendum #1
03	Finish Plan IN 101 1B1 – indicates new floor finishes in all rooms, excluding Kitchen (Kitchen is indicated as "existing" – are we providing new floor finish as indicated ? (New floor finishes in rooms not being remodeled will require contents removal / replacement – kitchen support areas / freezer will require shutdown)	Garmong		2/2/2022	2/16/2022	ADDN 02- Sheet IN101 1B Floor tags updated; Cart Storage 1316 flooring to match existing Kitchen 1309 flooring (Owner has attic storage product); Chemical Storage 1318 flooring to remain existing VCT (addtional VCT may be required)
04	General Note Drawing IN 001 Existing areas "B" wall paint, at all rooms ?	Garmong		2/2/2022	2/16/2022	ADDN 02 - clarified in Interiors General Notes on Sheet IN001
05	Drawing partition type details to not reflect this construction 	Garmong		2/2/2022		See sheet A 335 Addendum #2
06	A reflected ceiling plan has not been provided for Area "C" (AC 1B1 for Area B extends into Area C, but indicates the existing ceiling is to remain. (Electrical is shown from feeding 1245 - 1247 area)	Garmong		2/2/2022		Added to set pre-addendum #1 (Garmong comment: please confirm for electrical feeds)
07	Civil Drawing C-300 does not indicate domestic water route into the building. Several utility pipe sizes are indicated as "X"	Garmong		2/2/2022		These will be addressed in Addendum #2
08	Drawn A210 REF Section 3A / A321 - drawing section doesn't appear to be the correct location at the exterior wall	Garmong		2/2/2022		Added to set pre-addendum #1
09	Site Electrical E010 does not indicate primary / secondary power feed to Unit "F", or emergency generator	Garmong		2/2/2022		Added to Addendum #2
10	Site Electrical E010 does not indicate revisions to accommodate Unit "D" alternates (relocation of generator, transformer etc.)	Garmong		2/2/2022		Added to Addendum #2

Bid Question Log
Project Name: Knox County Justice Center
Date: February 22, 2022

= Items in Addendum - Closed Item

Item No.	Item Description	Received From	Date Received	Date To RQAW	Response Date	Response
11	Geotechnical Report - please provide document	Garmong		2/3/2022		Document provided
12	Volume II Index includes 05 40 00 Cold Formed Metal Framing - no specification has been included in the documents	Garmong		2/3/2022		ADDN 01 added specification
13	Specifications include Seismic Hanger sections for HVAC and Plumbing - No Seismic Hanger specification is included for Electrical	Garmong		2/3/2022		
14	A1-D5 (not in drawing index)	Garmong		2/7/2022		ADDN 01
15	AC-ALT-D1-D5 (not in drawing index)	Garmong		2/7/2022		ADDN 01
16	A400 (not in drawing index)	Garmong		2/7/2022		ADDN 01
17	S-012 (not in drawing index) S-301 (on drawing index, no physical drawings)S-302; S-303; SF-ALTD1-1; SR2D2; SR2F1 (not in drawing index)	Garmong		2/7/2022		ADDN 01 UPDATED DRAWING COVER SHEET , Addendum #2 added S-301
18	C000 & C602 (not in drawing index)	Garmong		2/7/2022		ADDN 01
19	FS100; FS300; FS400; FS500 (not in drawing index)	Garmong		2/7/2022		ADDN 01 UPDATED DRAWING COVER SHEET
20	P700; P701; P703 (not in drawing index)	Garmong		2/7/2022		ADDN 01 UPDATED DRAWING COVER SHEET
21	E001; E010, E392D (not in drawing index)	Garmong		2/7/2022		ADDN 01
22	E011; E012; E013; E110; E391D (on drawing index, no physical drawings)	Garmong		2/7/2022		E010, E011 Included in Addendum #2. E013 and E391D will be omitted.
23	E500; ~~E292D~~; ES104D; ES204D; ~~ES204D4~~ (on drawing index, no physical drawings)	Garmong		2/7/2022		ES104D and ES204D were included issued with original set.
24	ES101A; ES301; ES302; ES303; ES401; ES402 (not in drawing index)	Garmong		2/7/2022		ADDN 01 UPDATED DRAWING COVER SHEET
25	Would it be possible to get the CAD drawings for the Knox County Justice Campus project in order to establish cut & fill?	Wabash Utilities	2/8/2022	2/9/2022		

Bid Question Log
Project Name: Knox County Justice Center
Date: February 22, 2022

= Items in Addendum - Closed Item

Item No.	Item Description	Received From	Date Received	Date To RQAW	Response Date	Response
26	RQAW Specification 11 19 00 Detention Contractors - indicates to submit a bid to the General Trades Contractor - BP #07 is a stand alone package for the Detention Equipment scope of work.	Garmong		2/9/2022		ADDN 02
27	Section 033000 Cast in Place-Concrete Rev_1 shows precast items and structures. Nothing on Concrete Mix designs usually show aggregate requirements, Minimum cement, admixtures, Water Cement ratios, Slump requirements. (*specifications provided are section 33 05 13 "Manholes & Structures)*	Jones & Son	2/9/2022	2/9/2022		See 03-30-00 page 4 for agreegate requiremnts. See section 2.2 page 8 of -3-30-00 for mix design information
28	Storm drainage for Unit "F" (building roof drains) does not appear to be indicated, on either C300 or C400	Garmong	2/9/2022	2/9/2022		updated in Addendum #2
29	Civil Drawings for Unit D Alternates - have not been provided (erosion control, sanitary, storm, grading etc)	Garmong	2/9/2022	2/9/2022		This will be added in Addendum #2
30	ES302 indicates Room 1515 as IT Room - floor plans indicate 1515 as a Restroom (IT appears to be Room 1514)	Garmong	2/9/2022	2/9/2022		Addendum #2; Room should be labeled as 1514 on drawing ES302.
31	Security systems for Unit A land at SQE #06 in the existing IT Room, and then to SQE #01 in Room 2603 (new IT Room at Unit D - Level II) - will Unit "A" Security and other area systems remain operable - without SQE #01 complete and operable ?	Garmong	2/9/2022	2/9/2022		Addendum #2; New field devices for Unit "A" to terminate to SQE#3 and SQE#4. Functionality of systems in Unit "A" shall not be dependent on SQE#1 being complete and operable. Controls head-end at SQE#6 shall be updated to integrate with new controls at SQE#3 and SQE#4.
32	Sanitary site piping: please confirm depth of existing manhole, which new Unit D / F pipe runs are indicated to tie into - has sufficient depth for pipe runs (Previous project installing site contractor has indicated the existing manhole is shallow (less than 36")) New sanitary piping will cross multiple existing utilities	Wabash Utilities	2/10/2022	2/10/2022		
33	Drawing AF 1A1 Note 11 references Drawing A401 for Book In Counter details (Drawing A401 is stair details)	Garmong	2/10/2022	2/11/2022		
34	Unit "A" foundations vs. interior / exterior slabs are indicated in different locations , at the overhead door locations. Structural drawings indicate the exterior slab pours over the foundation entirely vs Architectural indicates the interior slab pouring completely over the foundation	Garmong	2/11/2022	2/11/2022		Provide slab on grade as per the structural drawings.
35	Drawing SF 1A1 contains the foundation schedules - there is no indication for 8W1, 8W2 etc., which are continuous foundations at the interior / exterior areas on several units.	Garmong	2/11/2022	2/11/2022		See 06/S-012 for CMU Wall Reinforcement Schedule
36	Drawing SR1A1 contains many section cuts referenced to Drawing S301 (no S301 drawing has been issued)	Garmong	2/11/2022	2/11/2022		S-301 was part of the bid pack. If it is missing in the prints, it will be provided as part of addendum #2

Bid Question Log
Project Name: Knox County Justice Center
Date: February 22, 2022

= Items in Addendum - Closed Item

Item No.	Item Description	Received From	Date Received	Date To RQAW	Response Date	Response
37	"Shackle Rings" are indicated at concrete benches - please provide specifications	Garmong	2/11/2022	2/11/2022		See 2B/A-405 for detail, no specification needed
38	RE: Insulation indicated on detail pages shows 4" R-13 in the roof and walls but the spec pages have R-30 simple saver roof and 6" walls. Which one is correct?	Service Partners	2/15/2022	2/15/2022		All PEMB walls are min R-13 and roofs are R-19 (no simple saver system)
39	Site Layout drawing indicates 6" curb on the west side of the drive (north side of Salleyport). Grades appear to indicate a low point, with water run off towards the west - an opening in the curbing would be needed for water passage	Garmong	2/16/2022	2/16/2022		
40	No site curbing is indicated at the asphalt paving edge / landscape area immediately east of the Salleyport. Given traffic flow radius, should curbing be placed to prevent driving into the landscape area ?	Garmong	2/16/2022	2/16/2022		
45	Civil Drawings are not included for Alternate "A" (Day Room 1533 & Cell Area)	Garmong	2/16/2022	2/16/2022		This will be addressed in Addendum #2
46	RULE 5 / CSGP - has RQAW Team applied and paid fee for Erosion Control / NOI ?	Prebid BP Contractor	2/17/2022	2/17/2022		
47	Drawing C001 "Erosion Control" Note #12 - this note conflicts with requirements indicated on Drawing C400 / Note "G"	Garmong	2/17/2022	2/17/2022		The note will be update in addendum #2 to reflect that no cut will be removed from the site
	Raw Water, Unit A - Main piping incomplete lines. Where does it come from?	HG Heinz	2/17/2022	2/17/2022		
48	Hot water piping to TMV and isolation pods in unit A. Line sizes don't make sense.	HG Heinz	2/17/2022	2/17/2022		Corrected Addendum #2.
49	Shower valve adjacent to room 1510. No fixture specified.	HG Heinz	2/17/2022	2/17/2022		
50	Detail 8 on P802 - does this apply to both mechanical rooms in units A & D?	HG Heinz	2/17/2022	2/17/2022		
51	Is there a water softener in unit A or D mechanical room? Not shown on enlarged mech room drawings. Where is RM # D109?	HG Heinz	2/17/2022	2/17/2022		
52	Is there a booster pump in Unit A or D mechanical room? Not shown on enlarged mech room drawings.	HG Heinz	2/17/2022	2/17/2022		
53	No booster pump on plumbing schedule	HG Heinz	2/17/2022	2/17/2022		
54	3" gas in mechanical room unit A? Where does this come from?	HG Heinz	2/17/2022	2/17/2022		
55	4" gas line in unit D? Where is this going?	HG Heinz	2/17/2022	2/17/2022		
56	Gas isometric and plumbing drawings don't match. Where is tie-in to existing gas located at?	HG Heinz	2/17/2022	2/17/2022		

Bid Question Log
Project Name: Knox County Justice Center
Date: February 22, 2022

= Items in Addendum - Closed Item

Item No.	Item Description	Received From	Date Received	Date To RQAW	Response Date	Response
57	CFSH-5 on drawings not shown in fixture spec	HG Heinz	2/17/2022	2/17/2022		
58	P100- The grease interceptor outside is hashed out as if it were being demoed. Is this correct? If so, is it being replaced?	Altstadt / Hoffman	2/17/2022	2/17/2022		Grease trap is existing to remain. Corrected Addendum #2.
59	P110- Note 5 says sinks and piping to remain, but they are not on P210B	Altstadt / Hoffman	2/17/2022	2/17/2022		Corrected Addendum #2.
60	P210A- There are TMV's with ½" pipe coming off of them and are running to several fixtures that are ¾" drops. Is this size correct?	Altstadt / Hoffman	2/17/2022	2/17/2022		Correctted Addendum #2.
61	P210D- Where does the water for Building D originate from?	Altstadt / Hoffman	2/17/2022	2/17/2022		
62	P210F- Rm 178, is the one toilet with the larger stall supposed to be handicapped?	Altstadt / Hoffman	2/17/2022	2/17/2022		
63	P210F- There is a prep sink in rm 144, who's responsible for that?	Altstadt / Hoffman	2/17/2022	2/17/2022		
64	P220D- Where does the 4" gas main terminate in Restroom 2606A	Altstadt / Hoffman	2/17/2022	2/17/2022		
65	(Question #9) P220F- What size are the risers for domestic water to the 2nd floor? Note 7 says 1" for hot and cold, but this is feeding 3" and 2" mains on the 2nd floor.	Altstadt / Hoffman	2/17/2022	2/17/2022		
66	P500- Drawing 1, Where do the water pipes go outside of the doors? Are they underground?	Altstadt / Hoffman	2/17/2022	2/17/2022		
67	P500- Drawing 1, Where does the 3" gas come from?	Altstadt / Hoffman	2/17/2022	2/17/2022		
68	P500- Drawing 3, Pipe sizes in this room, are they correct? Refer to my number 9 question	Altstadt / Hoffman	2/17/2022	2/17/2022		
69	P600- I do not find anything for roof drains, and there are several fixture abbreviations throughout the job with the number being X. None of these are in the schedule (TMV and ST are a couple).	Altstadt / Hoffman	2/17/2022	2/17/2022		
70	Will there be Civil drawings showing the Hydronic piping to building F?	Altstadt / Hoffman	2/17/2022	2/17/2022		
71	Alternates for D1-3: Can you color code a drawing for separating the piping between each one?	Altstadt / Hoffman	2/17/2022	2/17/2022		
72	Is there a special type of caulking for the correctional fixtures?	Altstadt / Hoffman	2/17/2022	2/17/2022		
73						
74	RQAW Specification Index : 036020 Non-shrink grout (specification issued 036200)	Garmong	2/17/2022	2/17/2022		Both 03 60 20 and 03 62 00 are included in set. Error in index only for 03 62 00
75	RQAW Specification Index: 090100 Maintenance of Finishes (specification issued 090111)	Garmong	2/17/2022	2/17/2022		Corrected Addendum #2
76	RQAW Specification Index: 087110 Door Hardware Schedule (section not included in specifications)	Garmong	2/17/2022	2/17/2022		Corrected Addendum #2
77	RQAW Specification Index: 101423 Room Indentification Signage (specification issued 10.14.23.13)	Garmong	2/17/2022	2/17/2022		Corrected Addendum #2
78	RQAW Specification Index: 105113 Metal Wardrobe Lockers (duplicate spec section with Metal Lockers)	Garmong	2/17/2022	2/17/2022		Corrected Addendum #2
79	RQAW Specification Index: 096723 Resinous Flooring (not in specification book)	Garmong	2/17/2022	2/17/2022		Removed from Spec Index, Addendum #2
80	RQAW Specification Index: 220502 Selective Demolition (not in specification book)	Garmong	2/17/2022	2/17/2022		

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81	RQAW Specification section 282300 ("End Of Section" indicates 282320)	Garmong	2/17/2022	2/17/2022		
82	RQAW Specification Section 270526 - appears to be missing part of the specification	Garmong	2/17/2022	2/17/2022		
83	HRC chiller module included in bid? Shown on chiller schedule but M500 shows it is for future. If it is not to be included in bid are recirc pumps and lines needed?	HG Heinz	2/18/2022	2/18/2022		HRC-1 module is included in the bid. The note on M500 indicates allocating space for (2) future HRCs if the owner needs additional capacity when the existing HVAC system is placed on the new hot water and chilled water plant.
84	Where is DOAS-D2. Only one DOAS is shown in D on first floor.	HG Heinz	2/18/2022	2/18/2022		DOAS-D2 is located in the alternate buildout of the Pod in unit D. Refer to drawings M290D, M291D, M390D, and M391D.
85	North roof drain piping in Unit F not shown	HG Heinz	2/18/2022	2/18/2022		
86	Duplex booster pump in Unit F mechanical room?	HG Heinz	2/18/2022	2/18/2022		
87	Pipe sizes in Unit F mech room detail are smaller than lines throughout the building. Review pipe sizes.	HG Heinz	2/18/2022	2/18/2022		
88	SK-X in Unit F not shown on fixture schedule	HG Heinz	2/18/2022	2/18/2022		
89	Door 1505 is shown as 36" - is this sufficient for passage from the Salleyport into Booking (handcuffed person + law enforcement)	Garmong	2/18/2022	2/18/2022		
90	Looks like footers on P200F with pipes going through or under them. There will be a minimum of a 2' drop from the farthest point south to the exit of the building with these drains. How thick are the footers?	Altstadt / Hoffman	02/21/2022	02/21/2022		
91	There are several fixtures not in schedule- WC-3, LV-2 FV-1, TMV-x, YCO, SK-X, RD-1 & 2, F-WF-2, F-HWRP-2	Altstadt / Hoffman	02/21/2022	02/21/2022		
92	Are the washer/dryer units by owner? Also not on schedule	Altstadt / Hoffman	02/21/2022	02/21/2022		Yes, By owner
93	P210F has CFC-7 in observation 141, P500 calls it to be CFC-2	Altstadt / Hoffman	02/21/2022	02/21/2022		
94	P500, mixing valve not labeled	Altstadt / Hoffman	02/21/2022	02/21/2022		
95	P500 #2 Unit C water heater equipment, none of this is on schedule	Altstadt / Hoffman	02/21/2022	02/21/2022		
96	P802 #4: where is this system? And is there a booster pump?	Altstadt / Hoffman	02/21/2022	02/21/2022		
97	P805 has fittings darkened, nothing in the plumbing system is pre-fabbed is it?	Altstadt / Hoffman	02/21/2022	02/21/2022		Only fixtures/equipment is pre-fabricated by the cell manufacturer. All piping is detailed on site.
98	Who provides mechanical equipment foundations / pads ?	HG Heinz	02/21/2022			General Trades contractor will provide all interior / exterior pads & foundations - for all MEP equipment
99	We are looking at bidding some section on this project. One of them being the casework / millwork. The spec would indicate that the casework would be commercial grade div 12 casework but the finish plans make reference to aristocrat cabinetry. The elevations would also indicate that the cabinet would have face frames and framed doors. Can you clarify what is to be provided?	Lee Company	02/21/2022	02/21/2022		
100	Note 36 calls for existing 24x24x72 lockers. where are these coming from? The demo plans do not show any lockers coming out of the existing building. What package is responsible for relocation / reinstallation of these lockers?	Lee Company	02/21/2022	02/21/2022		
101	Should note 35 read 12x12x72 3 tier locker? The elevations clearly show these as 12x12x72 triple tier lockers.	Lee Company	02/21/2022	02/21/2022		

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102	How many tiers are the note 34 lockers? The note just says 15x18x72 Locker. Is this the type A locker shown on Sheet A500?	Lee Company	02/21/2022	02/21/2022		
103	The spec section 105113 does not match what the architect has detailed on the drawings. The specs would indicate all of the lockers are a first responder type locker but none of these are shown or detailed on the documents.	Lee Company	02/21/2022	02/21/2022		
104	On the one-line(s), sheet E700 and E701, there are a handful of panels shown mounted on a pad. The panel schedules for these show that the amperages of these panels range between 400A-800A, with smaller amperage feeder breakers also, therefore we could quote these are a power panel or even our standard lighting panel product. The concern I have is that our power panel product does not offer feet to be able to free-stand on a pad, the enclosures would need to be bolted to the wall for support. Would this be acceptable or are you looking for more of a switchboard type?	AJ Baker	02/21/2022	02/21/2022		
105	A few of the panel schedules (1HEM1, 1HEM3, 1HEMDP1, 1HLRDP1, 1HNDP1, 1HOPDP1,1LEMDP1) call for the main breaker to be 100% rated and be individually mounted. We can do this for the necessary power panels by making our main breaker vertically mounted, so I do not see an issue here. But if we quoted panels 1HEM1 and 1HEM3 as a power panel, I feel it would be overkill on size and cost due to these panels being rated 100A with 20A/1P feeder. Can you advise if this is a typo or do they need to have 100% rated mains and have the mains individually mounted?	AJ Baker	02/21/2022	02/21/2022		
106	Switchboard 1HSNB1 – on the one-line this switchboard shows as 3 sections, in which 1 of the sections feeds (4) ATS and each of these ATS are 1600A. On this switchboard schedule there is no feeder breakers listed to feed these. Can you advise if a revision needs to be made and what amperage of feeders are necessary ?	AJ Baker	02/21/2022	02/21/2022		
107	Switchboard 1HEMSB1 – running into the same concerns as 1HSNB1	AJ Baker	02/21/2022	02/21/2022		
108	Unit F One-Line, Sheet E701 : Missing amperages on panel schedules for CDHEM1 and CDHOP1, Panel schedule is empty with no feeder breakers for C1LEM1	AJ Baker	02/21/2022	02/21/2022		
109	Under BP 2 Scope of work it states that temporary roads and snow removal is to be included but under 015000 Temporary Facilities and Controls B. 1. it states that snow removal and temp access shall be included as part of BP 1. Could you please clarity?	Kerns	02/21/2022		2/21/2022	Follow BP #2 narrative, a clarification as part of Addn #03 for 015000 will be issued
110	Does the paving near the Sallyport have to be done in phases or will it be available all at the same time?	E&B Paving	2/21/2022		2/21/2022	Include (2) Mobilizations - (1) for placing base / binder & (1) for mill (if required) / top of new and existing