



ADDENDUM NO. 1 TO PROJECT NO. 44811

**REPLACE THE HVAC SYSTEMS, BUILDINGS 29 AND 66
INDUSTRY LIMITED SECURE CENTER
375 RUSH-SCOTTSVILLE ROAD
RUSH, NY**

February 17, 2015

NOTE: This Addendum forms a part of the Contract Documents. Insert it in the Project Manual.
Acknowledge receipt of this Addendum in the space provided on the Bid Form.

CONSTRUCTION SPECIFICATIONS

1. Refer to Specification Section 051201 - Structural Steel:
 - A. Replace with revised Specification Section 051201, noted Revised 2-13-2015, included with this Addendum.
2. Add new Specification Section 053100 - Fluted Steel Decks, noted Added 2-13-2015, included with this Addendum.
3. Add new Specification Section 055000 - Metal Fabrications, noted Added 2-13-2015, included with this Addendum.
4. Add new Specification Section 083113 - Access Doors, noted Added 2-13-2015, included with this Addendum.
5. Refer to Specification Section 323113 - Chain Link Fence, Revised 2-13-2015:
 - A. Refer to Article 2.04. Replace Article 2.04 with the following:

"2.04 SWING GATE POSTS

 - A. Single width of gate 6'-0" to 12'-0" wide or over 10'-0" high:
 1. Pipe: 4 inches OD, 9.11 pounds per linear foot (Schedule 40).
 2. Class B Steel Tubing: 4 inches OD, 6.56 pounds per linear foot.
 3. Square Tubing: 3 inches OD, 9.10 pounds per linear foot.
 4. Roll Formed C-Section: ASTM A570 Grade 45, 3.5 inches by 3.5 inches by 0.128 inch thick, with minimum bending strength of 486 pounds under a 6 foot cantilever load.

- B. Single width of gate over 18"-0" wide:
 - 1. Pipe: 8.625 inches OD, 24.70 pounds per linear foot (Schedule 30)."

- B. Refer to Article 2.08. Add new Paragraph E to read as follows:
 - "E. Vinyl Screening Slats: Bottom lock, double wall tubular, as selected from the following:
 - 1. PDS Fence Products by PEXCO.
 - 2. Privacy Link.
 - 3. Ameristar Fence Products."

HVAC SPECIFICATIONS

- 1. Refer to Specification Section 230923 - Direct Digital Building Control System:
 - A. Replace with revised Specification Section 230923, noted Revised 2-13-2015, included with this Addendum.

CONSTRUCTION DRAWINGS

- 1. Refer to Drawings A-101 - Building 29 - First Floor Plan, A-102 - Second Floor Plan, A-103 - Third Floor Plan and A-104 - Second Floor Reflected Ceiling Plan:
 - A. Add the following to the end of Building 29 Construction Note 10:

"...At each location, provide prefinished 12" x 12" metal access door for maintenance of fire damper. Coordinate with HVAC for exact location in wall. Refer to Specification Section 023113 - Access Doors for access door information."

- 2. Refer to Drawing S-001 - Structural Notes:
 - A. Replace with addendum Drawing S-001 - Structural Notes, dated 2-13-2015, included with this Addendum.

- 3. Refer to Drawing S-101 - Partial Foundation Plan and Sections:
 - A. Replace with addendum Drawing S-101 - Partial Foundation Plan and Sections, dated 2-13-2015, included with this Addendum.

HVAC DRAWINGS

- 1. Refer to Drawing M-501 - Details:
 - A. Refer to Detail 5/M-501. Add 1 in. size to discharge pipe from relief valve.

- 2. Refer to Drawing M-504 - Details:
 - A. Refer to Details 5/M-504 and 6/M-504. Add the following note to each detail:

"Provide rubber and spring type vibration isolators in FCU split threaded hanger rods below ceiling."

ELECTRICAL DRAWINGS

1. Refer to Drawing E-001 - Symbol List and Abbreviations:
 - A. Refer to Electrical General Notes. Delete Note "P" in its entirety and replace with the following Note P:

"P. Test existing Simplex fire alarm systems prior to making any modifications to the systems. Tests shall be scheduled and witnessed by the Director's Representative. Contractor shall pay for all new devices and associated costs for fire alarm system modifications added to the project and final fire alarm testing."

2. Refer to Drawings E-102 and E-103 - Second and Third Floor - Electrical - Removals:
 - A. Add the following new Note C:

"C. Include in bid the cost to disconnect and remove three (3) existing cameras and turnover to the facility (Director's Representative). Relocate and reinstall back box and extend conduit to new location. Allow for 10 ft. of conduit relocation. Refer to E-107 for reinstallation location and additional requirements. Facility vendor will reinstall camera."

END OF ADDENDUM

Margaret F. Larkin
Executive Director
Design and Construction

SECTION 051201

STRUCTURAL STEEL

PART 1 GENERAL

1.01 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Anchor Bolts: Installed under Section 032100.

1.02 REFERENCES

- A. Except as shown or specified otherwise, the Work of this Section shall meet the requirements of the following:
 1. Design, Fabrication, and Erection: "Specification for Structural Steel Buildings, Load and Resistance Factor Design" (LRFD), December 1, 1993, by the American Institute of Steel Construction (AISC Specification).
 2. Standard Practice: Fabrication and erection practices shall comply with the "Code of Standard Practice for Steel Buildings and Bridges", June 10, 1992, by the American Institute of Steel Construction (AISC Code).
 3. Welding: Welding shall comply with the provisions of the "Structural Welding Code - Steel, AWS D1.1", by the American Welding Society (AWS Code).
 4. High-Strength Bolting: High-strength bolting shall comply with the "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" approved by the Research Council on Structural Connections of the Engineering Foundation on November 13, 1985 (Specification for Structural Joints).
 5. Cleaning Steel: Comply with the appropriate specifications (SSPC SP-X) by the Steel Structures Painting Council.

1.03 DEFINITIONS

- A. AISC Manual: Where reference is made to the AISC Manual, it shall mean the Manual of Steel Construction, LRFD, Second Edition, of the American Institute of Steel Construction.

1.04 REQUIREMENTS FOR CONNECTIONS

- A. General:
 1. Except where Type FR (fully restrained) connections are indicated, the design has been prepared on the basis of Type PR (simple or partially restrained) connections, complying with the provisions of Section A2.2 of the AISC Specification.
 2. Do not use connection details which depend upon sharing the stress between any combination of high-strength bolts in bearing-type connections and welds.
 3. Size connections for the loads indicated on the drawings. If the loads are not indicated, use a connection whose capacity is half the total uniform load capacity shown in the "Maximum factored uniform loads in kips for beams laterally supported" tables in the AISC Manual for the given shape, span, and steel specification of the beam in question, unless otherwise indicated.

4. Delete Paragraph J 1.8. of the AISC Specification. Whenever axially loaded members are connected by groups of welds or bolts not located symmetrically with respect to the gravity axis or axes of the connected member, the welds or bolts shall resist both the axial load and the moment produced by their eccentricity in the plane of the connection.
 - a. For end connections of axially loaded angles not subject to repeated variation in stress, fillet welds may resist axial load only, with the following limitations: The length of fillet weld at the heel of the angle shall be not less than 1/2 nor more than 2/3 of the total length required for the axial load. The length of fillet weld at the toe of the angle shall be not less than 1/3 nor more than 1/2 of the total length required for the axial load.
 5. All bolted connections shall have a minimum of two bolts.
- B. Shop Connections: Unless otherwise indicated, all shop connections shall be welded or high strength bolted. Field connections required to be welded or fully-tensioned high-strength bolted shall meet the same requirements when fabricated in the shop.
- C. Field Connections:
1. The following field connections shall be welded or fully-tensioned high-strength bolted as shown or noted on the Drawings or, when not shown or noted, shall be either welded or fully-tensioned high-strength bolted at the Contractor's option:
 - a. Column splices.
 - b. Roof truss splices.
 - c. Column bracing.
 - d. Connections for supports of machinery.
 - e. All connections of trusses to columns.
 - f. All connections of eave struts, eave purlins, first interior purlins, ridge beams, and ridge purlins to rigid frames and trusses.
 2. All other bolted field connections need only be tightened to the snug tight condition.
 3. When steel members of any cross section are to be spliced by welding in the field, a detailed welding procedure shall be submitted to the Director for approval. The procedure shall be detailed on shop drawings, submitted and approved prior to the fabrication of structural steel. The detailed field welding procedure shall include the method of supporting members during welding. All field welded splices shall be subject to non-destructive testing, Radiographic Testing (RT), or Ultrasonic Testing (UT), as determined by the Director. Field splice locations, when specifically shown on contract documents, shall not be relocated nor shall splices be added without written approval of the Director.
- D. Standard Beam Connections:
1. Unless otherwise shown on the Drawings or required in the Specifications, all beam connections shall be in accordance with Volume II of the AISC Manual, with sizes and lengths of angles and welds and with fastener spacings as shown therein.
 2. Standard beam connections shown on the Drawings shall be fabricated as detailed. Substitutions will not be approved.

- E. Special Beam Connections:
1. Where special conditions make it impracticable to provide connections complying with Paragraphs A thru D, and no details for such connections are shown on the Drawings, special connections shall be used. Such special connections shall, in general, comply with the provisions of the AISC Manual.
 2. Typical details of proposed special connections shall be shown on the job standards.
 3. Special connections shown on the Drawings shall be fabricated as detailed. Substitutions will not be approved.
- F. High-Strength Bolted Connections (Amendments to the Specification for Structural Joints):
1. In Item 3(b) of the specification, change the second sentence to read "Burrs shall be removed."
 2. In Item 3(c) of the specification, delete the last two sentences, and add the following sentence: "Flame cut surfaces shall be ground smooth."
 3. In Item 7(b)(1) of the specification, add the following to the last sentence: ", except that oversize holes shall not be used in connections with galvanized faying surfaces."
 4. In Item 7(b)(2) of the specification, add the following to the last sentence: ", except that short slotted holes shall not be used in connections with galvanized faying surfaces when the force on the joint is in a direction other than normal to the axis of the slot."
 5. In Item 7(b)(3) of the specification, add the following to the last sentence: ", except that long slotted holes shall not be used in connections with galvanized faying surfaces when the force on the joint is in a direction other than normal to the axis of the slot."
 6. Change Item 7(c)(3) of the specification to read as follows: "All fully-tensioned high-strength bolts shall have a hardened washer under the element (nut or bolt head) turned in tightening, regardless of the method of tightening."
 7. In Item 8(b) of the specification, change the first sentence to read: "A tension measuring device shall be required at all work sites where fully-tensioned high-strength bolts are being installed."
 8. In Item 8(c)(1) of the specification, delete the second sentence and add the following sentence: " The snug-tight condition is defined as the tightness attained by either a few impacts of an impact wrench or the full effort of a worker with an ordinary spud wrench that brings the connected plies into firm contact."
 9. In Item 9(b) of the specification, delete "Arbitration" from the heading. Also change the first paragraph to read: "When high-strength bolts have been installed by any of the tightening methods in Item 8(d), the following inspection procedure shall be used."
 10. In Item 9(c) of the specification, delete "arbitration" from the last sentence.
 11. In Item 9 of the specification, the inspection of bolt tightening shall be as specified under Item 9(b). Furnish the calibration device and the inspection torque wrench, and make them available, upon request, to representatives of the State or designated inspection laboratory during the entire period when steel is being fabricated and erected. The inspection torque wrench shall be capable of indicating that the job inspecting torque has been reached by a second method in addition to direct observation of the wrench dial. The inspection wrench calibration and the bolt tightening inspection shall be performed by the

Contractor, and shall be witnessed by a representative of the Director or the designated inspection laboratory.

- G. Design, Fabrication and Erection (Amendments to the AISC Specification):
1. In Item A6. of the specification, change "American Welding Society" to "American Welding Society (Latest Adoption Date)". Delete the date from all referenced AWS Codes.
 2. In Item J1.6. of the specification, change the last sentence to read: "Weld access holes and beam copes in other shapes shall be ground smooth, but need not be inspected by dye penetrant or magnetic particle methods."
 3. In Item J2. of the specification, delete the words "except Chapter 10 - Tubular Structures, which is outside the scope of this specification, and" from the introductory sentence.
 4. In Item J3.2. of the specification, change the first sentence in the fourth paragraph to read as follows: "Oversized holes are permitted in any or all plys of slip-critical connections, except those with galvanized faying surfaces. Oversized holes shall not be used in slip-critical connections with galvanized faying surfaces, or in bearing-type connections."
 5. In Item J3.2. of the specification, change the second sentence in the fifth paragraph to read as follows: "Short-slotted holes are permitted without regard to direction of loading in slip-critical connections, except those with galvanized faying surfaces. The length of the slot shall be normal to the direction of the load in slip-critical connections with galvanized faying surfaces and in bearing-type connections."
 6. In Item J3.2. of the specification, change the second sentence in the sixth paragraph to read as follows: "Long-slotted holes are permitted without regard to direction of loading in slip-critical connections, except those with galvanized faying surfaces. The length of the slot shall be normal to the direction of the load in slip-critical connections with galvanized faying surfaces and in bearing-type connections."
 7. In Item M2.2. of the specification, delete the first two paragraphs.
 8. In Item M2.5. of the specification, delete the fourth paragraph.
 9. In Item M4.5. of the specification, delete the first paragraph.
 10. Delete Item M5.4. of the specification in its entirety.
- H. Fabrication and Erection (Amendments to the AISC Code):
1. In Item 4.1. of the code, delete the last sentence of the first paragraph.
 2. In Item 5.1. of the code, change the first paragraph to read: "Contract Drawings are not considered released for construction. Orders for materials may be placed only after approval of erection drawings or written approval of the Director."

1.05 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for all structural steel required by this Contract. Machine-duplicated copies of Contract Drawings will not be accepted as shop drawings. Shop drawings shall be standard 24 by 36 inch size sheets, except that erection drawings may be larger. The margin line shall be drawn a minimum of 1/2 inch from edge of sheet. The title block shall be placed in the lower right hand corner of the drawing, and shall contain the fabricator's name, address, and telephone number. Failure to submit legible drawings of required size will be cause for their disapproval without review. If

the drawings are not prepared by a detailer under the direct control of the fabricator, the fabricator shall stamp each drawing and initial or sign the stamp to certify review and approval of the drawings, and conformance with the fabricator's shop practice and capability.

1. Include the following in the initial submission:
 - a. Drawings of proposed job standards for shop and field connections, including standard and special connections, complying with the requirements.
 - b. Erection drawings indicating sizes, weights, and locations of all structural members.
 - c. Anchor bolt and base plate plans.
2. Do not submit detail drawings, other than for anchor bolts and base plates, until after approval of the job standards and the erection drawings.
3. Include the following in subsequent submissions:
 - a. Index sheets and revised erection drawings to which erection marks have been added.
 - b. Detail drawings of all structural members.
4. Indicate all required shop and field welds by Standard AWS Welding Symbols in accordance with AWS A2.4.
5. Indicate shop painting requirements.
6. When shop drawings are marked "Approved as Noted", promptly resubmit copies of corrected shop drawings for formal approval and record.
7. Contract Drawings are not considered released for construction. Orders for materials may be placed only after approval of erection drawings or written approval of the Director.

B. Product Data:

1. Shop Paint: Manufacturer's name and printed product literature, including storage and application instructions.

C. Quality Control Submittals:

1. Test Reports: Submit 3 copies of each of the following:
 - a. Steel manufacturer's mill test reports, covering physical and chemical tests, for all main material.
 - b. Bolt manufacturer's test reports, covering physical and chemical tests, for each lot of high strength bolts supplied.
 - c. Test reports shall be submitted no later than the end of the week covered by the reports.
2. Certificates: Whenever any structural steel items other than main members, such as anchor bolts, base plates and detail material, are supplied either from plant stock or from a warehouse, submit 3 copies of evidence of compliance of the material with the applicable requirements of this Specification. Such evidence shall consist of certification as to the source of the material and copies of purchase orders, manufacturer's certifications or, in the case of stock material, copies of the latest mill orders or purchase orders for routine replacement of such stock material.
3. Fabricator's and Erector's Qualifications Data: Name and experience of fabricator and erector.
 - a. Include a summary of their QC programs.

4. Welding Procedure Specifications: Submit procedure specifications for each joint to be welded by submerged arc or flux cored arc welding.
5. Welder's Certification: Submit each welder's welding certification for each type weld and position before fabrication.

1.06 QUALITY ASSURANCE

- A. Fabricator's Qualifications: The fabricator of the structural steel shall be regularly engaged in the fabrication of structural steel, and shall be subject to the approval of the Director. AISC Quality Certified Fabricators (latest list issued) are approved.
- B. Erector's Qualifications: The structural steel erector shall be regularly engaged in the erection of structural steel, and shall be subject to the approval of the Director.
- C. Welders' Qualifications: Welding shall be performed only by welders, welding operators, and tackers who have been qualified by tests as prescribed in the AWS Code to perform the type of welding required.
- D. Do not deviate from the requirements of the Contract Documents except where an option is specifically mentioned. The Director, however, may accept deviations proposed by the Contractor when it is deemed in the best interest of the State and if the deviations are consistent with sound and accepted engineering practice. Requests for deviations shall be made prior to the submission of shop drawings to preclude delay in the expeditious preparation and approval of the required shop drawings. In addition, design calculations or other data may be required to establish conformity of such deviations with the applicable Standards.
- E. Galvanizing: Stamp galvanized items with galvanizer's name, weight of coating, and applicable ASTM number.

1.07 INSPECTION

- A. Quality Control Inspection: Maintain Quality Control (QC) inspection during the fabrication and erection of structural steel.
 1. Submit for approval a summary of the QC programs of the proposed fabricator and erector, including a list of their QC personnel and respective duties. Failure to obtain approval of the QC programs will result in rejection of the proposed fabricator and erector. AISC Quality Certified Fabricators submit copy of QC Certificate (Submission of QC program summary is waived).
 2. At least one of the fabricator's and one of the erector's QC personnel shall be an American Welding Society Certified Welding Inspector (CWI). If the fabricator and/or the erector find it necessary to temporarily employ an independent CWI, they shall not utilize Professional Service Industries/PTL Division and Jersey Technology Laboratories (under contract to the State) for structural steel inspection.
 3. The fabricator's CWI shall make minimum QC inspections as follows and shall prepare daily reports of such inspections:
 - a. At the start of fabrication to review welder qualifications, welding procedure specifications and qualifications, welding equipment and consumables, structural steel identification and tracking procedures and to perform all other CWI duties appropriate to start up of the specific project.

- b. Periodically during the preparation and fit up of material for groove welding.
 - c. At all times that full penetration groove welding is being performed.
 - d. As necessary to ensure that all welding related requirements of this section are being complied with.
 - e. Minimum QC inspection time by the CWI shall be one-half day every other day that any welding related structural steel fabrication is being performed.
4. The erector's CWI shall make minimum QC inspections as follows, and shall prepare daily reports of such inspections:
- a. Prior to commencement of field welding operations to review welder qualifications, welding procedure specifications and qualifications, welding equipment and consumables and to perform all other CWI duties appropriate to start up of field welding for the specific project.
 - b. Periodically during fit-up of material for full penetration groove welds.
 - c. At all times that full penetration groove welding is being performed.
 - d. As necessary to ensure that all welding related requirements of this section are being complied with.
 - e. Minimum QC inspection time shall be one-half day on at least three separate days for every week that any structural steel field welding is being performed. This minimum time may be reduced if, in the opinion of the Director's Representative, such reduction is appropriate.
- B. Quality Assurance (QA) inspection of structural steel fabrication and field welding and high-strength bolting may be made at the discretion of the Director. The qualification of welding procedures, welders, and tackers will be covered by such QA inspection. Representatives of the Director and/or designated inspection laboratory shall be given free and easy access to fabrication shop and field at all times that work is in progress. QA inspections will be made without cost to the Contractor.
- 1. If QA inspection is made by the State, it shall not relieve the Contractor, fabricator, and erector of responsibility for their own QC programs.
 - 2. When QA inspection is made by the State, schedule and perform the Work as required to minimize the cost to the State for QA inspection. When failure to schedule and perform the Work, or to coordinate with the QA inspectors, results in excessive QA inspection costs, the State will backcharge such excess cost to the Contractor.
 - 3. When non-destructive testing, Radiographic Testing (RT) or Ultrasonic Testing (UT), is required by the contract documents, it shall be performed by the State or its designated inspection laboratory, at the State's expense.
 - 4. When QA inspection is made by the State, send 3 additional copies of required material certifications and mill test reports to the designated inspection laboratory, or to OGS Design & Construction, Division of Construction when no inspection laboratory has been designated.
 - 5. Keep copies of the results of welder qualification test on file and make them available to the QA inspector upon request.
 - 6. Do not ship structural steel, except anchor bolts and base plates, from the fabricating shop prior to QA inspection and approval by the State or designated inspection laboratory, unless such inspection is waived by the Director. A waiver of prior QA inspection and approval shall not reduce the Contractor's responsibility to provide structural steel in conformance with the Contract Documents.

1.08 WELDING PROCESSES

- A. Use only shielded metal arc, submerged arc, or flux cored arc welding.

1.09 WELDING PROCEDURE QUALIFICATION

- A. Shielded metal arc welding procedures which conform to the provisions of the AWS Code shall be considered to be prequalified.
- B. The welding procedures for submerged arc and flux cored arc welding shall be qualified in accordance with the following subparagraphs. Welding, specimen preparation, specimen testing, and test results required shall be in accordance with Procedure Qualification Sheets A thru F. Welding and machining shall be at the fabricator's expense. Prepared specimens shall be turned over to the Director's Representative for testing at the State's expense.
 - 1. For welding procedures not previously approved by the Director, the test plate and required specimens shall be as shown on Procedure Qualification Sheet A.
 - 2. For welding procedures previously approved by the Director, the test plate and required specimens shall be as shown on Procedure Qualification Sheet B.
 - 3. To qualify a fillet welding procedure, the requirements of the appropriate foregoing subparagraph shall be met. In addition, a T-test fillet weld shall be made and tested in accordance with paragraph 5.10.3.1 of the AWS code.
- C. Procedure Qualification Sheets A thru F will be supplied to the Contractor upon request.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver anchor bolts and other devices which are to be embedded in cast-in-place concrete or masonry construction, for anchorage of structural steel, one week prior to the start of that Work, unless otherwise required.
- B. Receiving Shop Paint: Receive paint in original, unopened containers bearing paint manufacturer's printed label.
 - 1. Label shall show manufacturer's name, trade name of paint, Federal Specification compliance (if applicable), shelf life, and date of manufacture.
- C. Protection:
 - 1. Upon delivery to the site, promptly cover and protect steel items (which are not required to receive shop paint) from rusting.
 - 2. Store shop paint in accordance with paint manufacturer's printed instructions.

1.11 ENVIRONMENTAL REQUIREMENTS FOR SHOP PAINTING

- A. Comply with the following conditions for the application of paint unless otherwise stated in the paint manufacturer's printed directions.
 - 1. Minimum ambient, steel surface, and paint temperatures: 40 degrees F.
 - 2. Maximum steel surface temperature: 100 degrees F.
 - 3. Maximum relative humidity: 85 percent.
 - 4. Surface of steel: Dry.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Structural Steel: ASTM A 36, except as specified or shown otherwise.
- B. Wide Flange Structural Steel: ASTM A-992
- C. Steel for Anchor Bolts, Tie Rods, Sag Rods, and other Detail Material Not Proportioned for Calculated Stress: ASTM A 36; or ASTM A 675, Grade 70.
- D. Steel for Shims and Fillers: ASTM A 569.
- E. Exterior Lintels: ASTM A 36, galvanized.
- F. High-Strength Threaded Fasteners (High-Strength Bolts): ASTM A 325 heavy hexagon structural bolts, nuts, and hardened washers.
- G. Steel Pipe: ASTM A 53, Type E or S, Grade B.
- H. Steel Structural Tubing: ASTM A 500, Grade B; or ASTM A 501.
- I. Weld Filler Metal:
 - 1. General: Weld filler metal shall be in accordance with Table 4.1.1 of the AWS Code, except as follows:
 - a. Only electrode and flux combinations complying with AWS Classifications F7AX-EXXX or F7AX-EXXX-a, (a = B2, Ni1, Ni2, Ni3 or W), shall be used for submerged arc welding.
 - b. Only electrode and shielding gas combinations complying with AWS Classifications E 7XT-1 or E 7XT-5 shall be used for flux cored arc welding.
 - 2. Weld filler metal for shielded metal arc welding which conforms to AWS Specifications A5.1 or A5.5 shall be considered to be prequalified.
 - 3. Weld filler metal for submerged arc and flux cored arc welding shall be qualified by performing the procedure qualification tests required under Part 1 of this Section.
- J. Steel Studs: Automatic arc welded studs complying with Section 7 of the AWS Code.
- K. Cold Galvanizing Compound: Single component compound giving 93 percent pure zinc in the dried film, and meeting the requirements of DOD-P-21035A (NAVY).
- L. Shop Paint (General): Steel primer selected from the following:
 - 1. TNEMEC 10-99 (Red), 10-99G (Green) or 10-1009 (Gray).
 - 2. Rust-Oleum 769.
 - 3. Valspar 13-R-53.
 - 4. Sherwin-Williams "Kromik".
- M. Shop Paint for Galvanized Steel: FS TT-P-641, Type II.

- N. Shop Paint for Steel to receive Sprayed-On Fireproofing: Primer paint, if any, recommended by the manufacturer of the fireproofing material approved for use on this Project.
- O. Shop Paint for Exterior Equipment Supports (High-Ratio Water Based Zinc Silicate): Steel primer selected from the following:
 - 1. Inorganic Coatings IC 531
 - 2. Valspar 13-R-53
 - 3. Ameron Dimetcote 21-7
- P. Bedding Mortar:
 - 1. Cement Grout: Portland cement complying with ASTM C 150, Type I or III, and clean uniformly graded natural sand complying with ASTM C 404, size No. 2; mixed at a ratio (by volume) of 1.0 part cement to 3.0 parts sand, with only the minimum amount of water required for placement and hydration.
 - 2. Shrink-Resistant Grout (Ferrous): Factory-packaged, non-catalyzed, ferrous aggregate mortar grouting compound selected from the following:
 - a. Embeco 636 by Master Builders, 23700 Chagrin Blvd., Cleveland, OH 44122 (800) 227-3350.
 - b. Ferrolith G-NC by Sonneborn, Chemrex, Inc., 57-46 Flushing Ave., Maspeth, NY 11378, (800) 433-9517.
 - c. Ferro-Grout by L&M Construction Chemicals, 14851 Calhoun Rd., Omaha, NB 68152, (800) 362-3331.
 - d. Vibra-Foil by A.C. Horn, Inc., Tamm Industries, 7405 Production Dr., Mentor, OH 44060, (800) 862-2667.
 - 3. Shrink-Resistant Grout (Non-Staining): Factory-packaged, non-ferrous mortar grouting compound selected from the following:
 - a. Masterflow 713 by Master Builders, 23700 Chagrin Blvd., Cleveland, OH 44122 (800) 227-3350.
 - b. SonogROUT by Sonneborn, Chemrex, Inc., 57-46 Flushing Ave., Maspeth, NY 11378, (800) 433-9517.
 - c. Five Star Grout by Five Star Products, Inc., 425 Stillson Rd., Fairfield, CT 06430, (800) 243-2206.
 - d. Crystex by L&M Construction Chemicals, 14851 Calhoun Rd., Omaha, NB 68152, (800) 362-3331.
 - e. Non-Corrosive, Non-Shrink Grout by A.C. Horn, Inc., Tamm Industries, 7405 Production Dr., Mentor, OH 44060, (800) 862-2667.

2.02 FABRICATION

- A. Do not commence fabrication until the fabricator has been approved and the fabrication schedule has been coordinated with the designated Quality Assurance inspection agency (independent inspection laboratory or the State).
 - 1. Give the Director's Representative one week advance notice of the commencement of fabrication.
- B. Progress shop fabrication from "Approved" or "Approved as Noted" detail drawings only.
 - 1. When detail drawings are "Approved as Noted", progress fabrication in strict accordance with notes thereon.

2. Fabrication progressed from "DISAPPROVED" or "RETURNED FOR CORRECTION" detail drawings will be rejected. The contractor shall have no claim against the State for any costs or delays due to rejection of items fabricated from "DISAPPROVED" or "RETURNED FOR CORRECTION" detail drawings.
- C. Finish column ends at base plates and at load carrying cap plates to a true plane square to the column, with a maximum American National Standards Institute surface roughness value of 500 microinches.
- D. Pipe and Tube Columns: Cap columns with a closure plate shop welded to the top of the columns to exclude water and foreign material from entering the column.
- E. Loose Lintels: Loose lintels bearing on masonry or concrete shall have a minimum end bearing length of 6 inches at each end, unless otherwise noted.
- F. Make provision for connections of other Work, including all cutting and punching of structural members where required by the Drawings, or for which information is furnished prior to approval of the shop drawings.
- G. Weld and inspect steel studs in accordance with Section 7 of the AWS Code.
- H. Remove extension bars or run-off plates upon the completion and cooling of groove welds. Grind the ends of the welds smooth and flush with the edges of the abutting parts.
- I. Remove tack welds not incorporated into the final weld, and temporary welds. Grind affected surfaces smooth and flush.
- J. Detail all fillet welded joints so as to permit the welding electrode or wire to be positioned at a minimum angle of 30 degrees from the face of any material upon which weld metal is to be deposited.
- K. Prepare material in accordance with Section 3 of the AWS Code. Do not use gas or air carbon-arc cutting to cut or enlarge bolt holes.

2.03 GALVANIZING

- A. Unless otherwise specified or noted, items indicated to be galvanized shall receive a zinc coating by the hot-dip process, after fabrication, complying with the following:
 1. ASTM A 123 for plain and fabricated material.
 2. ASTM A 153 for iron and steel hardware.

2.04 SHOP PAINTING

- A. Thoroughly clean all structural steel. Remove oil, grease, and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning". Remove loose mill scale, loose rust, weld slag and spatter, and other detrimental material in accordance with SSPC SP-2 "Hand Tool Cleaning", SSPC SP-3 "Power Tool Cleaning", SSPC SP-6 "Commercial Blast Cleaning" or SSPC SP-7 "Brush-Off Blast Cleaning".
- B. Galvanized Items:

1. Galvanized items which are to be finish painted under Section 099101 shall be rinsed in hot alkali or in an acid solution and then in clear water.
 2. Welded and abraded galvanized surfaces shall be wire brushed and repaired with a coating of cold galvanizing compound applied in accordance with compound manufacturer's instructions.
- C. Exterior Equipment Supports:
1. Provide surface profile range of 1.5-2.0 mils for structural steel to receive High-Ratio Water Based Zinc Silicate.
 2. Apply a stripe coat of High-Ratio Water Based Zinc Silicate paint on all horizontal and vertical edges of exterior equipment support members, 2.0 mils dry film thickness.
- D. Apply one coat of shop paint to all steel surfaces except as follows:
1. Do not paint steel members designated "NP" on the Drawings.
 2. Paint steel surfaces inaccessible after assembly, except surfaces in contact, with two coats of shop paint before assembly.
 3. Do not paint steel surfaces to be field welded, contact surfaces of high-strength bolted slip-critical connections, steel to be encased in cast-in-place concrete, steel receiving sprayed-on fireproofing (if recommended by manufacturer of the fireproofing material approved for use on this Project), and the top flange of beams and girders in composite construction.
 4. Do not paint galvanized items which are not to be finish painted under Section 099101.
 5. Apply two shop coats of High-Ratio Water Based Zinc Silicate to all exterior equipment support member surfaces.
- E. Apply paint and compound to the following minimum thickness per coat:
1. Shop Paint (General): 4.0 mils wet film.
 2. Shop Paint for Galvanized Steel: 3.0 mils wet film.
 3. Cold Galvanizing Compound: 2.0 mils dry film.
 4. Shop Paint for Steel to receive Sprayed-On Fireproofing: Follow manufacturer's recommendations.
 5. Shop Paint (Water-Based Zinc Silicate): 3.0 mils dry film.

PART 3 EXECUTION

3.01 ERECTION

- A. Erect steel in accordance with the AISC Specification, the AISC Code, the AWS Code and the Specification for Structural Joints, except as otherwise specified.
- B. Prepare and place shrink-resistant grout in accordance with grout manufacturer's printed instructions.
 1. Comply with manufacturer's instructions for preparation of surfaces in contact with the grout, and for curing and protection of the grout.
- C. Install and inspect steel studs in accordance with Section 7 of the AWS Code.

- D. Remove extension bars and run-off plates upon the completion and cooling of groove welds. Grind the ends of the welds smooth and flush with the edges of the abutting parts.
- E. Remove tack welds not incorporated into the final weld, and temporary welds. Grind affected surfaces smooth and flush.
- F. Delete Paragraph M2.2. of the AISC Specification. Prepare material in conformance with Section 3 of the AWS Code. Do not use gas or air carbon-arc cutting to cut or enlarge bolt holes.
- G. Do not make corrections or alterations to fabricated steel without prior written approval by the Director's Representative.

3.02 SCHEDULE OF GALVANIZED STRUCTURAL STEEL

- A. In addition to members indicated on the Drawings, hot-dip galvanize structural steel members as indicated below:
 - 1. All exterior exposed steel.
 - 2. All loose lintels in exterior walls.
 - 3. All framing supporting refrigerator/freezer equipment.
 - 4. Nuts, washers and the top 12 inches of exterior anchor bolts.
- B. Two shop coats of High-Ratio Water Based Zinc Silicate paint may be substituted in lieu of hot-dip galvanizing.

END OF SECTION

SECTION 053100

FLUTED STEEL DECKS

PART 1 GENERAL

1.01 REFERENCES

- A. Comply with the following reference standards unless otherwise shown or specified:
 - 1. Design: "Specification for the Design of Cold-Formed Steel Structural Members" by the American Iron and Steel Institute (AISI Specification).
 - 2. Welding: "Structural Welding Code - Sheet Steel, AWS D 1.3", by the American Welding Society (AWS Code).

1.02 SUBMITTALS

- A. Shop Drawings: Show application to project. Prepare separate drawings, coordinated with, but not superimposed on, joist drawings or structural steel erection drawings.
- B. Product Data: Manufacturer's printed specifications and installation instructions.

1.03 HANDLING AND STORAGE

- A. Handle and stack materials carefully in order to prevent deformation or damage. During unloading and hoisting, take extra care to prevent damage to ends and sides of individual metal deck panels. Do not place panels in direct contact with the ground. Protect panels from the elements and keep panels dry.
 - 1. If mud, dirt, or other foreign matter is accumulated on panels, remove such accumulation completely prior to installation.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fluted Deck and Metal Accessories: Sheet steel conforming to ASTM A 611 Grade C or ASTM A 653 SQ Grade 33. Before fabrication, sheet steel shall receive ASTM A653, Class G 90, hot dip zinc coating. Finish shall be evenly coated with no cracking after fabrication. Accessories shall be fabricated of not lighter than 18 US Standard Gage sheet steel.
- B. Self-Drilling Fasteners: No. 12-14 x 3/4 inch, hex washer head, self-drilling fastener with pilot point.
- C. Flexible Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber closure strips.

2.02 FABRICATION

- A. Steel deck shall be formed with maximum distance of 2-5/8 inches between flutes at upper faces and a minimum distance of 2 inches at lower flute faces. Furnish units in lengths to be continuous over 3 spans wherever possible.
- B. Steel deck shall conform to the following properties:
 - 1. Unit depth: 1.5 in
 - 2. Minimum section modulus at supports for negative bending in continuous spans: 0.198 in³/ft
 - 3. Minimum section modulus for positive bending: 0.189 in³/ft
 - 4. Minimum moment of inertia: 0.177in⁴/ft
 - 5. Minimum US Standard Gage: 22
 - 6. Flute spacing: 6 in
- C. Unless otherwise indicated or approved, fabricate deck for predetermined openings, and reinforce where required to maintain deck strength, alignment, and profile.
 - 1. Small openings, as recommended by the deck manufacturer, may be field cut.
- D. Accessories: Shop fabricated accessories, compatible with steel deck, as required to complete the Work, including, but not limited to, the following:
 - 1. Sheet metal cants beneath flashings when required for roofing over steel deck.
 - 2. Closures to close deck at ridges, valleys, and hips on roof deck slopes exceeding 1/2 inch per foot.
 - 3. Pour stops and girder fillers for concrete fill.
 - 4. Column closures, end closures, Z closures, and cover plates.
- E. Progress shop fabrication from “APPROVED” or “APPROVED AS NOTED” detail drawings only.
 - 1. When detail drawings are “APPROVED AS NOTED”, progress fabrication in strict accordance with notes thereon.
 - 2. Fabrication progressed from “DISAPPROVED” or “RETURNED FOR CORRECTION” detail drawings will be rejected. The contractor shall have no claim against the State for any costs or delays due to rejection of items fabricated from “DISAPPROVED” or “RETURNED FOR CORRECTION” detail drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.
- B. Do not start installation of metal deck until corresponding steel framework has been plumbed, aligned and completed and until temporary shoring, where required, has been installed. Coordinate installation sequence of metal deck with concrete encasement of steel beams.

- C. Steel surfaces to which materials, provided under this Section, are to be welded, shall be free of paint, ice, water, oil, dirt, rust and other materials detrimental to welding.
- D. Locate decking bundles to prevent overloading of supporting members

3.02 INSTALLATION

- A. Install the Work of this Section in accordance with the manufacturer's printed instructions except where shown or specified otherwise.
 - 1. Welding shall comply with the AWS Code.
 - 2. Perform welding free of sharp points.
- B. Place deck units on supporting steel framework and adjust to final position with ends bearing on supporting members and flutes in straight and true alignment through entire length of run before being permanently fastened. Do not stretch or contract side lap interlocks. Install temporary shoring before placing single span deck panels when required to meet manufacturer's recommendations.
- C. End Bearing: Install deck units over supporting framing with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. Non-Composite Deck End Joints: Lapped 2 inches minimum.
 - 2. Composite Deck End Joints: Butted.
- D. Deck Fastening: Fasten deck units at ends and intermediate supports with arc spot welds (puddle welds) not less than 3/4 inch diameter, at 12 inches on centers, along the supporting members, unless more stringent requirements are indicated on the drawings or required by the fire resistance ratings indicated on the drawings. Weld the first and last deck flutes. Use welding washers for all deck lighter than 20 gage. Deck units may be fastened to steel supports 0.18 inches or less in thickness (cold-formed metal framing) with No.12-14 x 3/4 inch self-drilling fasteners at 12 inches on center at ends and intermediate supports.
- E. Side lap fastening: Fasten side laps at intervals not exceeding 36 inches, using one of the following methods, unless more stringent requirements are indicated on the drawings or required by the fire resistance ratings indicated on the drawings:
 - 1. Mechanically fasten with self-drilling No.12 diameter or larger carbon steel screws.
 - 2. Mechanically button punch.
- F. Perimeter Edge Fastening: Weld starting and finishing side edges in bearing to supporting members at 36 inches on centers maximum, unless more stringent requirements are indicated on the drawings or required by the fire resistance ratings indicated on the drawings.
- G. Neatly field cut required openings, other than shop fabricated openings, after installation in accordance with the manufacturer's recommendations.
- H. Closures: Install flexible closure strips to effectively seal underside of flutes where fluted decks extend over exterior walls and also above interior partitions where there are no ceilings below the fluted deck.

END OF SECTION

SECTION 055000

METAL FABRICATIONS

PART 1 GENERAL

1.01 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Anchor Bolts: Installed under Section 033000.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Structural Steel: Section 051201.

1.03 REFERENCES

- A. Except as shown or specified otherwise, the Work of this Section shall meet the requirements of the following:
 - 1. Design, Fabrication, and Erection: "Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design" adopted by the American Institute of Steel Construction, June 1, 1989 (AISC Specification).
 - a. Design and Fabrication of Cold-Formed Shapes: "Specification for the Design of Cold-Formed Steel Structural Members", by the American Iron and Steel Institute (AISI Specification).
 - 2. Welding: "Structural Welding Code - Steel, AWS D1.1", or "Structural Welding Code - Sheet Steel, AWS D1.3", by the American Welding Society (AWS Codes).
- B. Organizations:
 - 1. AISC: American Institute of Steel Construction, One East Wacker Dr., Suite 700, Chicago, IL 60601-1802, 866-275-2472, www.aisc.org.
 - 2. AISI: American Iron and Steel Institute, 1140 Connecticut Ave., NW, Suite 705, Washington, D.C. 20036, (202) 452-7100, www.steel.org.
 - 3. AWS: American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126, (800) 443-9353, www.aws.org.
 - 4. ANSI: American National Standards Institute, 1819 L Street, NW, 6th Floor, Washington, DC 20036, (202) 293-8020, www.ansi.org.
 - 5. ASME: ASME International, 3 Park Ave., New York, NY 10016-5990, (800) 843-2763, www.asme.org.
 - 6. ASTM: ASTM International, 100 Barr Harbor Dr., PO Box C700, West Conshohocken, PA, 19428-2959, (610) 832-9500, www.astm.org.
 - 7. MPI: The Master Painters Institute Inc., 2808 Ingleton Ave., Burnaby, BC, V5C 6G7, (888) 674-8937, www.specifypaint.com.
 - 8. SSPC: The Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburgh PA 15222-4656, (877) 281-7772, www.sspc.org.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. Show application to project. Furnish setting drawings and templates for installation of bolts and anchors in other Work. Indicate shop and field welds by standard AWS welding symbols in accordance with AWS A2.4.
 - 2. Fixed Aluminum Ships Ladder – Provide Shop Drawing of Ships Ladder in relation to field conditions at ceiling attic door.
- B. Product Data: Catalog sheets, specifications, and installation instructions for each fabricated item specified including Fixed Aluminum Ships Ladder, except submit data for fasteners only when directed.

1.05 QUALITY ASSURANCE

- A. Galvanizing: Stamp galvanized items with galvanizer's name, weight of coating, and applicable ASTM number.

1.06 DELIVERY AND STORAGE

- A. Coordinate delivery of items to be built into other construction to avoid delay.
- B. Promptly cover and protect steel items delivered to the Site.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel Shapes, Plates, and Bars: ASTM A 36.
- B. Steel Plates to be Bent or Cold-Formed: ASTM A 283, Grade C.
- C. Steel Bars and Bar-Size Shapes: ASTM A 675, Grade 70; or ASTM A 36.
- D. Merchant Quality Steel Bars: ASTM A 575, grade as selected by fabricator.
- E. Cold-Finished Steel Bars: ASTM A 108, grade as selected by fabricator.
- F. Hot-Rolled Carbon Steel Sheet and Strip: ASTM A 569, pickled and oiled.
- G. Cold-Rolled Carbon Steel Sheet: ASTM A 366, oiled.
- H. Galvanized Steel Sheet: ASTM A 526, with G90 hot-dip process zinc coating complying with ASTM A653.
- I. Steel Tubing: Hot-formed, welded or seamless, structural tubing; ASTM A 501.
- J. Cold-Drawn Steel Tubing: ASTM A 512, buttwelded, cold-finished carbon steel tubing, sink drawn and stress relieved.

- K. Cast Iron Castings: ASTM A 48, gray iron castings, Class 30.
- L. Malleable Iron Castings: ASTM A 47, grade as selected by fabricator.
- M. Steel Castings: ASTM A 27, grade and class as required by use of item.
- N. Steel Pipe: ASTM A 53, type as selected, Grade A; black finish unless galvanizing is required; standard weight (Schedule 40), unless otherwise shown or specified.
- O. Rolled Steel Floor Plate, Raised Pattern: ASTM A 786; raised herringbone pattern unless otherwise indicated.
- P. Stainless Steel: Type 302/304; ASTM A 666 for plate, sheet and strip; ASTM A 276 for bars and shapes; ASTM A 269 for tubing.
- Q. Anchors: Except where shown or specified, select anchors of type, size, style, grade, and class required for secure installation of metal fabrications. For exterior use and where built into exterior walls, anchors shall be galvanized or of corrosive-resistant materials.
 - 1. Threaded-Type Concrete Inserts: Galvanized ferrous casting, internally threaded to receive 3/4 inch diameter machine bolt; either malleable iron or cast steel.
 - 2. Wedge-Type Concrete Inserts: Galvanized box-type ferrous casting, designed to accept 3/4 inch diameter bolt having special wedge-shaped head; either malleable iron or cast steel.
 - a. Bolts: Carbon steel bolts having special wedge-shaped heads, nuts, washers and shims.
 - 3. Slotted-Type Concrete Inserts: Galvanized 1/8 inch thick pressed steel plate complying with ASTM A 283; box-type welded construction with slot designed to receive 3/4 inch diameter square head bolt and with knockout cover.
 - 4. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent test agency.
 - a. Carbon Steel: Zinc-Plated; ASTM B 633, Class Fe/Zn 5.
 - b. Stainless Steel: Bolts, Alloy Group 1 or 2; ASTM F593, Nuts; ASTM F 594.
- R. Fasteners: Except where shown or specified, select fasteners of type, size, style, grade, and class required for secure installation of metal fabrications. For exterior use and where built into exterior walls, fasteners shall be galvanized.
 - 1. Standard Bolts and Nuts: ASTM A 307, Grade A, regular hexagon head.
 - 2. Stainless Steel Fasteners: ASTM A 666; Type 302/304 for interior Work; Type 316 for exterior Work; Phillips flathead (countersunk) screws and bolts for exposed Work unless otherwise specified.
 - 3. Eyebolts: ASTM A 489.
 - 4. Machine Bolts: ASME B18.5 or ASME B18.9, Type, Class, and Form as required.
 - 5. Machine Screws: ASME B18.6.3.
 - 6. Lag Screws: ASME B18.2.1.

7. Wood Screws: Flat head, ASME B18.6.1.
 8. Plain Washers: Round, ASME B18.22.1.
 9. Lock Washers: Helical, spring type, ASME B18.21.1.
 10. Toggle Bolts: Spring Wing Type; Wing AISI 1010, Trunion Nut AISI1010 or Zamac Alloy, Bolt Carbon Steel ANSI B18.6.3.
- S. Shop Paint (General): Universal shop primer; fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- T. Shop Paint for Galvanized Steel: Epoxy zinc-rich primer; complying with MPI#20 and compatible with topcoat.
- U. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- V. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.02 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Fabricate metal framing and supports to support related items required by the Work. Fabricate of welded construction unless otherwise indicated. Preassemble to largest extent possible.
- B. When required to be built into other Work, equip units with integral anchors spaced not more than 24 inches on center.
- C. Galvanize exterior steel framing and supports.

2.03 MISCELLANEOUS STEEL TRIM

- A. Fabricate trim of shapes, sizes, and profiles shown, with continuously welded joints and smooth exposed edges, unless otherwise indicated or approved. Use concealed field splices wherever possible. Furnish necessary cutouts, fittings, and anchorages.
- B. Galvanize exterior steel trim.

2.04 FIXED ALUMINUM SHIPS LADDERS

- A. Fabricate ladders to span between elevations at locations indicated and detailed. Comply with the requirements of American Ladder Institute Standard A14.3, American National Standard for Ladders-Fixed – Safety Requirements, unless otherwise shown or specified. The standard can be ordered online at: www.americanladderinstitute.org.

- B. Basis of Design:
 - Model 775H-60 Ships Ladder (60 degree slope) by ALACO Ladder Co.
 - 5167 G Street, Chino, CA 91710-5143
 - Phone: (888) 310-7040
 - Web Site: www.alacoladder.com
 - (or Architect-approved equal)
- C. ALACO aluminum ladders and their components are fabricated from 6061-T6 aluminum alloy for added safety, strength and long-lasting durability, with no painting required. Model 775H-60 ships ladders feature extra heavy duty capacity of 1000 lb. total, 500 lb. per step, 6" (153 mm) wide steps with non-slip ridges mounted on 12" (305 mm) centers. These 24" (610 mm) wide ladders are equipped with 4 mounting brackets. Flush handrails consist of 1-1/4" schedule 40 (42 mm OD) round aluminum pipe with cast aluminum fittings.
- D. Finish: Mill finish
- E. Warranty: Provide manufacturer's standard limited warranty of 5 years.

2.05 LOOSE BEARING PLATES

- A. Steel plates fabricated flat, free from warp or twist, and of required thickness and bearing area. Drill plates as required for anchor bolts and for grouting access. Furnish bearing plates where shown and where required for steel items bearing on masonry or concrete construction.

2.06 LOOSE LINTELS

- A. Structural steel shape lintels, fabricated for openings and recesses in masonry walls and partitions as indicated. Loose lintels bearing on masonry or concrete shall have a minimum end bearing length of 6 inches at each end, unless otherwise shown.
- B. Galvanize lintels to be installed in exterior walls.

2.07 FABRICATION

- A. Use materials of size and thickness indicated. If not indicated, use material of required size and thickness to produce adequate strength and durability for the intended use of the finished product. Furnish suitable, compatible anchors and fasteners to support assembly.
- B. Fabricate items to be exposed to view of material entirely free of surface blemish, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove surface blemishes by grinding or by welding and grinding prior to cleaning, treating, and finishing. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise shown.
- C. Joints: Fabricate accurately for close fit. Weld exposed joints continuously unless otherwise indicated or approved. Dress exposed welds flush and smooth.

- D. Connections: Form exposed connections with flush, smooth, hairline joints. Use concealed fasteners wherever possible. Use Phillips flathead (countersunk) bolts or screws for exposed fasteners, unless otherwise shown or specified.
 - 1. Furnish flat washer under connections requiring raised bolt heads.
 - 2. Furnish lock washer under nuts when through-bolting occurs.

- E. Punch, reinforce, drill, and tap metal Work as required to receive hardware and other appurtenant items.

- F. Galvanizing:
 - 1. In addition to specific items specified or noted to be galvanized, galvanize items attached to, embedded in, or supporting exterior masonry (including interior wythe of exterior masonry walls) and concrete Work.
 - 2. Unless otherwise specified or noted, items indicated to be galvanized shall receive a zinc coating by the hot-dip process, after fabrication, complying with the following:
 - a. ASTM A 123 for plain and fabricated material, and assembled products.
 - b. ASTM A 153 for iron and steel hardware.

- G. Shop Painting:
 - 1. Cleaning Steel: Thoroughly clean all steel surfaces. Remove oil, grease, and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning". Remove loose mill scale, loose rust, weld slag and spatter, and other detrimental material in accordance with SSPC SP-2 "Hand Tool Cleaning", SSPC SP-3 "Power Tool Cleaning", or SSPC SP-7 "Brush-Off Blast Cleaning".
 - 2. Galvanized Items:
 - a. Galvanized items which are to be finish painted under Section 099101 shall be rinsed in hot alkali or in an acid solution and then in clear water.
 - b. Welded and abraded areas of galvanized surfaces shall be wire brushed and repaired with a coating of cold galvanizing compound.
 - 3. Apply one coat of shop paint to all steel surfaces except as follows:
 - a. Do not shop paint steel surfaces to be field welded and steel to be encased in cast-in-place concrete.
 - b. Apply 2 coats of shop paint, before assembly, to steel surfaces inaccessible after assembly or erection, except surfaces in contact.
 - c. Do not paint galvanized items which are not to be finished painted under Section 099101.
 - 4. Apply paint and compound on dry surfaces in accordance with the manufacturer's printed instructions, and to the following minimum thickness per coat:
 - a. Shop Paint (General): 4.0 mils wet film.
 - b. Shop Paint for Galvanized Steel: 3.0 mils wet film.
 - c. Cold Galvanizing Compound: 2.0 mils dry film.

PART 3 EXECUTION

3.01 PREPARATION

- A. Temporarily brace and secure items which are to be built into concrete, masonry, or similar construction.
- B. Isolate non-ferrous metal surfaces to be permanently fastened in contact with ferrous metal surfaces, concrete, or masonry by coating non-ferrous metal surface with bituminous mastic, prior to installation.

3.02 INSTALLATION

- A. Fit and set fabricated metal Work accurately in location, alignment, and elevation. Securely fasten in place. Cut off exposed threaded portion of bolts flush with nut.
- B. Set loose items on cleaned bearing surfaces, using wedges or other adjustments as required. Solidly pack open spaces with bedding mortar or grout.
- C. Attached Work: Fasten to concrete and solid masonry with expansion anchors and to hollow masonry with toggle bolts in cells, unless otherwise indicated. Drill holes for fasteners to exact required size using power tools.
- D. Railings: Adjust railings prior to securing in place to insure alignment and proper matching at joints. Plumb posts in each direction. Secure posts and rail ends to construction as follows:
 - 1. Anchor posts in concrete with post sleeves preset into the concrete. After the posts have been inserted into the sleeves, fill the annular space between post and sleeve solid with molten lead or an exterior quick-setting hydraulic cement. Cover anchorage joint with a cover flange.
 - 2. Anchor posts to steel with steel flanges, angle type or floor type as required. Weld flanges to posts, and bolt to the steel supporting members.
 - 3. Anchor rail ends to concrete and masonry with round steel flanges. Weld flanges to rail ends, and anchor into the wall construction with expansion anchors.
 - 4. Anchor rail ends to steel with steel oval or round flanges. Weld flanges to rail ends, and weld or bolt to the steel supporting members.

END OF SECTION

SECTION 083113

ACCESS DOORS

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data: Catalog sheets, specifications, and installation instructions.

PART 2 PRODUCTS

2.01 NON-FIRE RATED ACCESS DOORS FOR WALLS AND CEILINGS

- A. Frames: Minimum 16 gage steel.
 - 1. Flange: Integral exposed flange not less than 3/4 inch wide around the perimeter.
 - 2. Plaster Applications: Expanded metal lath and exposed casing bead welded to perimeter of frame, in place of integral exposed flange.
 - 3. Finish: Match door panel.
 - 4. Anchorage, Except for New Concrete or Masonry Construction: Predrilled holes in frame for anchoring with fasteners.
- B. Door Panel: Flush type, minimum 14 gage steel.
 - 1. Hinges: Concealed type set to open a minimum of 135 degrees; continuous type, or sufficient number to support the door size.
 - 2. Finish: Factory-applied rust inhibitive baked enamel over phosphate treated steel.
- C. Cam Locks: Flush, screwdriver operated; sufficient number to hold door panel in flush, smooth plane when closed.

2.02 FABRICATION

- A. Assemble access doors as integral units complete with all parts and ready for installation. Fabricate units of continuous welded steel construction unless otherwise indicated or specified. Grind welds smooth and flush with adjacent surfaces. Anchorage devices shall be of size and type required to secure access doors to types of supports indicated on the Drawings.
 - 1. Allowable Size Variations: Manufacturer's standard size units which vary slightly from the sizes indicated may be acceptable, subject to the approval of the Director.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install the access doors in accordance with the manufacturer's printed installation instructions, except as shown or specified otherwise.
- B. Coordinate access door installation with installation of supporting construction.
- C. Set units accurately in position and securely attach to supports with face panel plumb or level in relation to adjoining finish surface.

3.02 ADJUSTING

- A. Adjust hardware and doors for proper operation.

3.03 SCHEDULE

- A. Provide non-fire rated access doors in non-fire rated construction and fire rated access doors in fire rated construction.

END OF SECTION

SECTION 230923

DIRECT DIGITAL BUILDING CONTROL SYSTEM

PART 1 GENERAL

1.01 OVERVIEW

- A. The intent of this specification is to provide a peer-to-peer, networked, stand-alone, distributed control system by companies in the HVAC control field.
- B. BACnet, Lontalk, Arcnet or Ethernet communication protocols will be used as the primary communication network for communications between multi-BAS/EMS vendors systems in a non-proprietary manner. Project implementation, as specified, requires transferring, receiving and controlling information that resides in multi-BAS/EMS Vendors' "building controllers".
- C. BACnet, Lontalk, Arcnet or Ethernet communications protocol will be used as the communication network between BAS/EMS Vendor Terminal Equipment Controllers (TECs) and secondary network management devices, and between network management devices and future "smart devices and sensors", as they become available. Secondary communications data protocol shall operate on a peer-to-peer open protocol communication network. Minimum system speed shall be 76k baud.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Deliver the following item to the Director's Representative upon completion of the System Acceptance Test.
 - 1. Portable Operators Terminal (POT), with associated CD-Rom(s).
 - a. Do not turn over the above listed items directly to facility staff.
 - b. The Director's Representative will turn over these items to the facility representative responsible for computer inventory.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Video Training Programs: Section 017900.
- B. Wiring for Motors and Motor Controllers: Section 260523.
- C. Basic Electrical Materials and Methods for Direct Digital Building Control System: Section 260502.
- D. Ductwork Accessories: Section 233300.
- E. Optical Fiber Cables: Section 271525.

1.04 REFERENCES

- A. ASHRAE Standard 135 - 1995 (1995; Publication pending) BACnet - A Data Communication Protocol for Building Automation and Control Networks
- B. ASHRAE Standard 114 - 1986 (1986; to be re-named as Guideline 13P) Recommended practices guide for verification of end-to-end accuracy in Energy Management and Control Systems (EMCS)
- C. NFPA 70 (1994) National Electric Code
- D. UL 916 (1984; Rev thru Dec 1992) Energy Management Equipment
- E. UL UUKL 864 (1991); Smoke Control Equipment

1.05 ABBREVIATIONS AND ACRONYMS

CSIP	Control System Interface Panel
BMS	Building Management System
DCP	Distributed Control Processors
DDC	Direct Digital Control
EEPROM	Electrically Erasable Programmable Read Only Memory
EMS	Energy Management System
EPROM	Erasable Programmable Read Only Memory
FAIP	Fire Alarm Interface Panel
FTT	Free Topology Transceiver
GDU	Graphic Display Unit
HOA	Hand-Off-Automatic
OS	Operating System
NAE	Network Automation Engine
NIE	Network Integration Engine
NCE	Network Control Engine
FEC	Field Equipment Controller
IOM	Input/Output Module
NS	Network Sensors
PCP	Digital Plant Control Processors
POS	Primary Operator Station
POT	Portable Operators Terminal
RAP	Remote Access Panel
TEC	Terminal Equipment Controllers
TP	Time Programs
VAV	Variable Air Volume

1.06 SYSTEM DESCRIPTION

- A. The system shall operate as an integrated Direct Digital Building Control System (DDC).
 - 1. Remove existing pneumatic and electronic control systems and provide new DDC systems including associated equipment and accessories. Provide each control system complete, and operating as specified. Manufacturer's products, including design, materials, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASHRAE Standard 114 - 1986, ASME B31.1 and NFPA 70, except as modified herein or indicated otherwise.
 - 2. Provide the DDC systems to maintain stable temperature control and all other conditions as indicated. The end-to-end accuracy of the system, including temperature sensor error, wiring error, A/D conversion, and display, shall be 1 degree F.
 - 3. Changes in the status of monitored points are detected by the microprocessor based Primary Operators Station (POS) utilizing a primary data communication peer bus and microprocessor based distributed control processors (DCPs) located throughout the facility.
 - 4. Secondary networks managed by the DCPs may be employed to monitor status terminal equipment controllers (TECs).
 - 5. This system provides overall monitoring and control of all HVAC control functions for all analog and digital (binary, on/off, open/close) input control signals to microprocessor based digital controllers. The digital controllers perform all of the control logic, analog output and digital output signals to the HVAC field equipment.
 - 6. Alarms will be transmitted to printers located in Shop/Maintenance Building 37.
 - 7. Existing spare optical fiber cable running between Buildings 37, Building 1 and Building 29 are to be used for DDC network communications between these buildings. Direct buried fiber optical fiber cable for DDC network communication between Buildings 29 and 66 is to be provided under this project as part of the DDC system. Provide terminations, switches, routers, etc., as required to connect optical fiber cabling.
 - 8. The HVAC Work Contractor shall integrate the Direct Digital Building Control Work System and the existing Building 29 boiler sequencing controls. As well as existing electrical control valves for fin radiation to remain in Building 66.

- B. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.

- C. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

- D. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions.

2. Enterprise-level information and control access.
 3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 4. Diagnostic monitoring and reporting of BMS functions.
 5. Offsite monitoring and management access.
 6. Energy management
 7. Standard applications for terminal HVAC systems.
- E. This system will have interface ports to allow connection to a terminal, portable computer, and a central site computer utilizing a BACnet, Lonmark, Arcnet or Ethernet communication protocol. BAS/EMS equipment will provide day to day control of HVAC systems, allowing system operators to enable and disable equipment, change set points, change operating schedules, receive trends and alarms, while dynamically uploading and downloading control programs.

1.07 DESIGN REQUIREMENTS

- A. The system shall be designed by the engineering staff of the Company producing the system or the engineering staff of a Company that specializes in the design of Direct Digital Building Control Systems.
- B. For Lonmark System Architectures: Provide Certificate of Interoperability for each Lonmark device proposed for this project.

1.08 SUBMITTAL

- A. Waiver of Submittal: The “Waiver of Certain Submittal Requirements” in Section 013300 does not apply to this Section.
- B. Submittal Package: Submit the shop drawings, product data, and quality control submittal specified below at the same time as a package.
 1. Certificate of Interoperability is required for each Lonmark device submitted for the project.
- C. Shop Drawings:
 1. Provide a system architecture drawing that diagrammatically shows all DCPs, their locations, how they connect to the overall communication riser, and the specified HVAC systems they each serve. The system architecture wiring layout must match specific site requirements.
 2. Sketches of all graphics.
 3. Graphic penetration tree showing all graphics and all points.
 4. Flow diagram of pneumatic portion of the system as proposed to be installed (standard diagrams will not be acceptable).
 5. Composite wiring and/or schematic diagrams of the complete system as proposed to be installed (standard diagrams will not be acceptable).
 - a. Include wiring diagrams showing interconnection with other Contractors systems.
 6. Scaled floor plan and elevation drawings showing location of all major components associated with the system.

7. Scaled drawings of each primary operators station (POS) showing layout of, and indicating the function of each switch, button, lamp, and accessory.
 - a. Show front view and plan view of primary operators station console, including overall dimensions, and detail of each console section.
 - b. Show scale drawing (plan view and elevation) of each primary operators station console layout in its site location.
 8. Scaled drawings of each distributed control processor (DCP) showing layout of, and indicating the function of each module and accessory.
- D. Product Data:
1. Catalog sheets, specifications and installation instructions.
 2. Bill of materials.
 3. Detailed description of system operation.
 4. Point description, program list, and sequences.
 5. Data from the Company producing the system, proving that:
 - a. The system is UL listed.
 6. Total electrical load of the system which will be connected to the uninterruptible power supply system.
 7. Name, address and telephone number of nearest fully equipped service organization.
- E. Quality Control Submittal:
1. Installer's Qualifications Data:
 - a. Name of each person who will be performing the Work and their employer's name, business address and telephone number.
 - b. Names and addresses of 3 similar projects that each person has worked on during the past 3 years.
 2. Company Field Advisor Data: Include:
 - a. Name, business address and telephone number of Company Field Advisor secured for the required services.
 - b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
 - c. Services and each product for which authorization is given by the Company, listed specifically for this project.
- F. Contract Closeout Submittal:
1. System acceptance test report.
 2. Certificates:
 - a. Affidavit, signed by the Company Field Advisor and notarized, certifying that the system meets the contract requirements and is operating properly.
 3. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Director's Representative. Include:
 - a. Operation and maintenance data for each product installed in system.
 - b. Original licensed versions of all software loaded into the system, with disks and manuals.
 - c. Complete point to point wiring diagrams of entire system as installed. Identify all conductors and show all terminations and splices. (Identification shall correspond to markers installed on each conductor.)

- d. Name, address, and telephone number of nearest fully equipped service organization.
4. Provide 2 hard copy back-up disks and CD-ROM backup of all software programs and configurations as the system exists at final acceptance.
 - a. Deliver one set of back-up disks to the Directors Representative for turnover to the facility.
 - b. Deliver one set of back-up disks and the CD-ROM to:
 - Office of General Services
 - Facilities Services Unit
 - Service Team Leader
 - 34th Floor, Corning Tower
 - Albany, NY 12242
 - c. Upon closeout with the first year, send updated disks and CD-ROM to the above listed personnel.
5. Provide all revisions and/or upgrades made to the system software during the one year guarantee warranty period, at no additional cost to the State.

1.09 QUALITY ASSURANCE

- A. Equipment Qualifications For Products Other Than Those Specified:
 1. At the time of submission provide written notice to the Director of the intent to propose an “or equal” for products other than those specified. Make the “or equal” submission in a timely manner to allow the Director sufficient time to review the proposed product, perform inspections and witness test demonstrations.
 2. If products other than those specified are proposed for use furnish the name, address, and telephone numbers of at least 5 comparable installations that can prove the proposed products have performed satisfactorily for 3 years. Certify in writing that the owners of the 5 comparable installations will allow inspection of their installation by the Director's Representative and the Company Field Advisor.
 - a. Make arrangements with the owners of 2 installations (selected by the Director) for inspection of the installations by the Director's Representative. Also obtain the services of the Company Field Advisor for the proposed products to be present. Notify the Director a minimum of 3 weeks prior to the availability of the installations for the inspection, and provide at least one alternative date for each inspection.
 - b. Only references from the actual owner or owner’s representative (Security Supervisor, Maintenance Supervisor, etc.) will be accepted. References from dealers, system installers or others, who are not the actual owners of the proposed products, are not acceptable.
 - 1) Verify the accuracy of all references submitted prior to submission and certify in writing that the accuracy of the information has been confirmed.
 3. The product manufacturer shall have test facilities available that can demonstrate that the proposed products meet the contract requirements.
 - a. Make arrangements with the test facility for the Director's Representative to witness test demonstrations. Also obtain the services of the Company Field Advisor for the proposed product to be present at the test facility. Notify the Director a minimum of 3 weeks prior to the availability of the test facility, and provide at least one alternative date for the testing.
 4. Provide written certification from the manufacturer that the proposed products are compatible for use with all other equipment proposed for use for this system and meet all contract requirements.

- B. UL Listing: The system shall be UL listed for Energy Management UL 916.
- C. Qualifications: The persons installing the Work of this Section and their Supervisor shall be personally experienced in building control system work and shall have been regularly employed by a Company installing direct digital building control systems for a minimum of 3 years.
 - 1. For LonMark System Architectures: BAS/EMS vendors shall be certified in LonMark system installation.
- D. Test Facility: The Company producing the system shall have test facilities available which can demonstrate that the proposed system meets contract requirements.
- E. Company Field Advisor: Secure the services of a Company Field Advisor for a minimum of 80 working hours for the following:
 - 1. Render advice regarding installation and final adjustment of the system.
 - 2. Assist in initial programming of the system.
 - 3. Render advice on the suitability of each monitor and control device for its particular application.
 - 4. Witness final system test and then certify with an affidavit that the system is installed in accordance with the contract documents and is operating properly.
 - 5. Train facility maintenance personnel in operation, programming and routine maintenance of the system.
 - a. Provide the services of competent instructors to instruct designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements, of the equipment and system specified. The training shall be oriented toward the installed system rather than being a general (canned) training course. Each instructor shall be thoroughly familiar with all aspects of the subject matter they are to teach. The number of man-days of instruction furnished shall be as specified below. All equipment and material required for classroom training shall be provided.
 - b. Provide a minimum of one complete computer (desktop or color laptop model) for every two trainees during the entire training period. The computers shall be linked as to provide real-time ability to all trainees to monitor the site's systems controlled by the EMS.
 - c. For each trainee (minimum of 8) provide workbooks, worksheets, sample problems and other printed matter to serve as illustrative reference material. Unless deemed unnecessary by OGS, Contractor shall include copies of all overheads used in the training either separately or as part of said printed matter. Contractor shall provide all overhead projectors, computer LCD panels, video players or projectors, projection screens, hands-on materials, etc. as required for the training.
 - d. Submit for OGS review and approval, at least four weeks in advance of each phase of the training, the following:
 - 1) A detailed proposed outline of training, including timing.
 - 2) All printed materials, visual aids and hands-on material.
 - 3) All overheads (transparencies or computerized)
 - 4) All other training aids.
 - 5) Qualifications of all proposed training personnel.

- e. Training Program: A training day is defined as 8 hours of instruction including two 15-minute breaks and excluding lunch time.
 - 1) For a period of 3 days prior to the acceptance test period at a time mutually agreeable between the Contractor and the State. Operating personnel will be trained in the functional operations of the installed system, the procedures employed for system operation and the maintenance of DDC equipment.
 - a) The first 2 days of training shall include:
 - (1) General System Architecture.
 - (2) Operation of Computer and Peripherals.
 - (3) Command Line Mnemonics.
 - (4) Report Generation.
 - (5) Operation Control Functions.
 - (6) Graphics Generation.
 - (7) Input Function and Identification.
 - (8) Logging ON and OFF.
 - (9) Point Naming Convention.
 - (10) Point Logs.
 - (11) Trending.
 - (12) Alarms.
 - (13) Executing Commands.
 - b) The third day of training shall include:
 - (1) General equipment layout.
 - (2) Troubleshooting of DDC components.
 - (3) Preventive Maintenance of DDC components.
 - (4) Sensor maintenance and calibration.
 - (5) Hand-held Terminal operation.
 - c) Three neatly bound vinyl notebooks shall be provided containing a summary of each topic discussed during the three phases of training.
- f. The training room shall be clean, well-lit, well ventilated and isolated from noise (including HVAC noise) and other distractions. The Contractor shall arrange, via delamping, covering fixtures or by light switches, for there to be adequate contrast lighting to take notes and fend off drowsiness.
- g. Instructor shall employ an LCD panel, video projector or other suitable device to project large images of the EMS software and/or other training images.
- h. Printed training materials shall be tailored to the task at hand and shall be well illustrated. Materials shall take students through the steps of learning the EMS and its software and shall provide sample exercises for the trainees to perform on the computers.
- i. Training must steer clear of jargon and other confusing terminology and focus instead on learning how to use the system. Specific jargon may be addressed after the trainees have demonstrated a basic understanding of system operation.
- j. Training shall involve actual field-type equipment using a training demonstration package that simulates real-time temperatures, settings, alarms, etc. Training shall also spend substantial time observing the site's actual system, include point logs, graphics, and alarms. In addition, a

- brief field visit shall be included to familiarize trainees with the equipment installed at their site.
- k. Training must include quizzes, tests, and exercises that compel trainees to demonstrate understanding of the system's most important concepts. These concepts shall include, but not be limited to, the elements of a monitoring checklist developed by the site.
 - l. The overall training approach shall be interactive and encourage students to discuss concepts, ask questions of the instructor and share experiences among one another.
6. Provide services to the Balancing Work Contractor for a minimum of 8 working hours for the following:
 - a. Render advice and assist Balancing Work Contractor during the balancing process with component calibration, repair and replacement of components, explanation of component operation, and attend meetings, etc.
 7. Explain available service programs to facility supervisory personnel for their consideration.
- F. Company Field Advisor (Existing Sub-Systems): Secure the services of a Company Field Advisor from the Company of each sub-system for a minimum of 8 working hours for the following:
1. Render advice and witness test of existing sub-systems.
 2. Render advice on the interconnection of existing sub-systems with the new system.
 3. Witness the final test of the combined new system and existing sub-systems.

1.10 MAINTENANCE

- A. Service Availability: A fully equipped service organization capable of guaranteeing response time within 8 hours to service call shall be available 24 hours a day, 7 days a week to service the completed Work.
- B. Spare Parts:
1. 10 percent spare of each type temperature sensor.
 2. 10 percent spare of each type pressure sensor.
 3. 10 percent spare of each type relay.
 4. 10 percent spare of each size valve.
 5. 10 percent spare of each type I/O board.
 6. Two sets, per printer, ink jet print cartridges.
 7. Printer paper (2 cases, 3200 sheets per case).

PART 2 PRODUCTS

2.01 GENERAL DESCRIPTION

- A. Control diagrams shown on the drawings, in general, indicate the equipment required for the control sequences specified. Variations in the selection of temperature control equipment, which will produce the required control sequences may be submitted for approval.
- B. Components and system capacity parameters specified are minimum and shall be increased as required by the Company producing the system to enable the system to perform the functions specified and indicated on the drawings
- D. Standard utility grade power will be available for operation of the system. If power conditioning is required for proper operation of the system, all equipment and labor required to provide conditioned power shall be provided as part of the system
- E. The Building Management System shall consist of the following:
 - 1. Standalone Network Automation Engine(s)
 - 2. Field Equipment Controller(s)
 - 3. Input/Output Module(s)
 - 4. Local Display Device(s)
 - 5. Portable Operator's Terminal(s)
 - 6. Distributed User Interface(s)
 - 7. Network processing, data storage and communications equipment
 - 8. Other components required for a complete and working BMS
- F. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.
- G. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
 - 1. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
 - 2. The System shall maintain all settings and overrides through a system reboot.
- H. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
- I. Basis of Design:
 - 1. Johnson Controls, Inc., Metasys

2.02 BMS ARCHITECTURE

- A. Automation Network:
 - 1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard “off the shelf” products available through normal PC vendor channels.

2. The BMS shall network multiple user interface clients, automation engines, system controllers and application-specific controllers. Provide application and data server(s) as required for systems operation.
 3. All BMS devices on the automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
 4. Network Automation Engines (NAE) shall reside on the automation network.
 5. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.
- B. Control Network:
1. Network Automation Engines (NAE) shall provide supervisory control over the control network and shall support the following communication protocol:
 - a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9
 - 1) The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 2) The NAE shall be tested and certified as a BACnet Building Controller (B-BC).
 2. DDC Controllers shall reside on the control network.
 3. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
- C. Integration:
1. BACnet Protocol Integration - BACnet
 - a. The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135-2008.
 - b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
 - c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

2.03 USER INTERFACE

- A. Dedicated Web Based User Interface:
1. Where indicated on plans the BMS Vendor/Installer shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BMS Network Automation Engines to facilitate greater fault tolerance and reliability.
 2. Dedicated User Interface Architecture - The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BMS Vendor/Installer and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards.
 - a. Microsoft Internet Explorer for user interface functions

- b. Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions
 - c. Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports
 - d. Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries
3. PC Hardware - The personal computer(s) shall be configured as follows:
- a. CPU - 4th Gen Intel Core i5 processor - Quad core, 2.9 GHz Turbo Clock Speed, 6MB cache (minimum).
 - b. Video - Integrated Intel HD Graphics 4600 (minimum).
 - c. Memory - 8 GB dual-channel 1600 MHz DDR3 SDRAM (Minimum).
 - d. Hard Drives - Dual 500 GB 7200 rpm hard drives configured for RAID 1 (minimum).
 - e. DVD +/-RW Drive - 16X performance (minimum).
 - f. I/O Ports - (4) USB 3.0, (6) USB 2.0, (1) RJ-45, (1) Serial, (1) VGA, (2) DisplayPort, (2) PS/2, (2) Line-in, (2) Line-out.
 - g. Keyboard - QWERTY, USB.
 - h. Mouse - Optical, USB.
 - i. Network Certified Interfaces and drives for BACnet, Arcnet or Ethernet networks.
 - j. Monitor Configuration:
 - 1) 20" Flat Panel, 1920 x 1080 resolution (minimum).
 - 2) Contrast - 1000:1 static, 8M:1 dynamic.
 - 3) Response Time - 5 ms.
 - 4) Signal Input Connectors - VGA, DVI-D.
4. Software:
- a. Windows 8.1 Pro (64 bit) (minimum)
 - b. Where user interface is not provided via browser, provide complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all included software, device drivers, and peripherals.
 - c. Provide original installation CDs/DVDs for all software, device drivers, and peripherals.
 - d. Provide software registration cards to the Owner for all included software.
5. Peripheral Hardware:
- a. Ink Jet Reports Printer:
 - 1) Minimum Print Speed - 11 ppm black and white at 1200 x 600 dpi, 7.5 ppm color at 4800 x 1200 dpi.
 - 2) Buffer - 64 K Input Print Buffer
 - 3) Color Printing - Include Color Kit

- B. Distributed Web Based User Interface:
1. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.
 2. The software shall run on the Microsoft Internet Explorer (6.0 or higher) browser supporting the following functions:
 - a. Configuration
 - b. Commissioning
 - c. Data Archiving
 - d. Monitoring
 - e. Commanding
 - f. System Diagnostics
 3. Minimum hardware requirements:
 - a. 1GB RAM
 - b. 2.0 GHz Clock Speed Pentium 4 Microprocessor
 - c. 100 GB Hard Drive.
 - d. 1 Keyboard with 83 keys (minimum).
 - e. SVGA 1024x768 resolution display with 64K colors and 16 bit color depth
 - f. Mouse or other pointing device
- C. Site Management User Interface Application Components:
1. Operator Interface:
 - a. An integrated browser based client application shall be used as the user operator interface program.
 - b. The System shall employ an event-driven rather than a device polling methodology to dynamically capture and present new data to the user.
 - c. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.
 - d. The user interface software shall provide help menus and instructions for each operation and/or application.
 - e. The system shall support customization of the UI configuration and a home page display for each operator.
 - f. The system shall support user preferences in the following screen presentations:
 - 1) Alarm
 - 2) Trend
 - 3) Display
 - 4) Applications
 - g. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
 - h. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
 - 1) User access for selective information retrieval and control command execution
 - 2) Monitoring and reporting

- 3) Alarm, non-normal, and return to normal condition annunciation
 - 4) Selective operator override and other control actions
 - 5) Information archiving, manipulation, formatting, display and reporting
 - 6) BMS internal performance supervision and diagnostics
 - 7) On-line access to user HELP menus
 - 8) On-line access to current BMS as-built records and documentation
 - 9) Means for the controlled re-programming, re-configuration of BMS operation and for the manipulation of BMS database information in compliance with the prevailing codes, approvals and regulations for individual BMS applications.
- i. The system shall support a list of application programs configured by the users that are called up by the following means:
 - 1) The Tools Menu
 - 2) Hyperlinks within the graphics displays
 - 3) Key sequences
 - j. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.
2. Navigation Trees:
 - a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
 - b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
 - c. The navigation trees shall be “dockable” to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar. A simple keystroke will reattach the navigation to the primary display of the user interface.
 3. Alarms:
 - a. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
 - 1) Log date and time of alarm occurrence.
 - 2) Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
 - 3) Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.

- 4) Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
- 5) Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
- 6) Configuration of which NAE offline alarms are seen by each user
- 7) Any attribute of any object in the system may be designated to report an alarm.
- b. The BMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
- c. The BMS shall allow a minimum of 4 categories of alarm sounds customizable through user defined wav.files.
- d. The BMS shall annunciate application alarms at minimum, as required by Part 3.
4. Reports and Summaries:
 - a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
 - 1) All points in the BMS
 - 2) All points in each BMS application
 - 3) All points in a specific controller
 - 4) All points in a user-defined group of points
 - 5) All points currently in alarm
 - 6) All points locked out
 - 7) All user defined and adjustable variables, schedules, interlocks and the like.
 - b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
 - c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
 - d. Provide the capability to view, command and modify large quantities of similar data in tailored summaries created online without the use of a secondary application like a spreadsheet. Summary definition shall allow up to seven user defined columns describing attributes to be displayed including custom column labels. Up to 100 rows per summary shall be supported. Summary viewing shall be available over the network using a standard Web browser.
 - e. Reports shall be selectable by date, time, area and device. Each report shall include a color visual summary of essential energy information.
5. Schedules:
 - a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
 - 1) Weekly schedules

- 2) Exception Schedules
- 3) Monthly calendars
- b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
- c. It shall be possible to define one or more exception schedules for each schedule including references to calendars.
- d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.
- e. Changes to schedules made from the User Interface shall directly modify the Network Automation Engine schedule database.
- f. Schedules and Calendars shall comply with ASHRAE SP135/2008 BACnet Standard.
- g. The Calendar object supports an option to add a reference to another Calendar Object that is designated to be the master for the facility. Any Supervisory and BAC calendars can be configured to reference a single master Global Calendar. Changes to the master global calendar are automatically synced with all calendars that are referenced.
- h. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.
- i. Software shall be provided to configure and implement optimal start and stop programming based on existing indoor and outdoor environmental conditions as well as equipment operating history.
- j. The system Solar Clock shall support the scheduling and energy management functions. The Solar Clock will calculate the sunrise, sunset, and sun angle values for a specified latitude and longitude. A time offset can also be specified. An example would be to use the Solar Clock object as a master to an interlock to turn lights on 30 minutes after sunset and off 30 minutes before sunrise.
- 6. Security/Passwords:
 - a. Multiple-level passwords access protection shall be provided via roles and permissions. The feature will allow the system to base access on a user's job title or role and allow the user/manager access interface control, display, and database manipulation capabilities based on an assigned password.
 - b. Roles may be copied and altered to meet specific roles and permissions based on the particular policies.
 - c. Each user shall have the following: a (Metasys Local) user account name (with a maximum of 30 characters), a complex password or passphrase (with a min of 8 characters and a max of 50 characters), other user account policies (such as session timeout), timesheet access based on day of the week and time of day, and specific user view.
 - d. The system shall allow each user to change his or her password at will.
 - e. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.

- f. A maximum of 150 categories may be used to determine or assign areas of responsibilities to each user account. A maximum of 13 (of the 150) named categories which are specifics such as “No Access, View, Advanced Review, Operate, Intervene, Diagnostic, Manage Item Events, Manage Every, and Configure Items”.
 - g. A minimum of 100 unique passwords shall be supported.
 - h. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
 - i. Operators shall be further limited to only access, command, and modify those buildings, systems, and subsystems for which they have responsibility. Provide a minimum of 100 categories of systems to which individual operators may be assigned.
 - j. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.
 - k. The system shall have the ability to provide a Department of Defense (DoD) specific warning banner for applicable sites that warns the user they are accessing a restricted site.
 - l. After successful login to the Site Management Portal (SMP) the last time and date that user name was previously logged in is shown on the screen.
 - m. Each login attempt is recorded in the system Audit Log with the option to record the IP address of the PC that made the login.
7. Screen Manager:
- a. The system will allow a customized image on the login screen (i.e. organization name, logo).
 - b. User View navigations can be displayed as either a set of tabs or a drop down list.
 - c. Allows user preference for assigning of a background color for when an object is Out of Service which will enable the operator to quickly distinguish points that have been commanded to this state.
 - d. The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.
8. Dynamic Color Graphics:
- a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
 - b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.

- c. Graphics runtime functions - A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
 - 1) All graphics shall be fully scalable
 - 2) The graphics shall support a maintained aspect ratio.
 - 3) Multiple fonts shall be supported.
 - 4) Unique background shall be assignable on a per graphic basis.
 - 5) The color of all animations and values on displays shall indicate the status of the object attribute.
 - 6) Graphics that represent buildings or systems shall allow natural links and transitions between related detailed tabular views of data that complement the graphic.
 - d. Operation from graphics - It shall be possible to change values (setpoints) and states in system controlled equipment directly from the graphic.
 - e. Floor Plan graphics - The user interface shall provide graphic applications that summarize conditions on a floor. Floor plan graphics shall indicate thermal comfort using dynamic colors to represent zone temperature deviations from zone setpoint(s). Floor plan graphics shall display overall metrics for each zone in the floor.
 - f. Aliasing - Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.
 - g. Graphic editing tool - A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.
 - 1) The graphic editing tool shall provide a library of standard HVAC equipment, floor plan, lighting, security and network symbols.
 - 2) The graphic editing tool shall provide for the creation and positioning of library symbols by dragging from tool bars or drop-downs and positioning where required.
 - 3) The graphics editing tool shall permit the importing of AutoCAD drawings for use in the system.
 - 4) The graphic editing tool shall be able to add additional content to any graphic by importing images in the SVG, PNG or JPG file formats.
9. Historical Trending and Data Collection:
- a. Each Automation Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:
 - 1) Any point, physical or calculated, may be designated for trending. Two methods of collection shall be allowed:
 - a) Defined time interval
 - b) Upon a change of value

- 2) Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.
 - b. Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full. Exports shall be as requested by the user or on a time scheduled basis.
 - c. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in SQL database format.
 - d. The system shall provide data to enable optimization capabilities including fault detection and diagnostics, advanced analytics and central plant optimization without the need of a gateway or additional hardware.
10. Trend Data Viewing and Analysis:
- a. Provide a trend viewing utility that shall have access to all database points.
 - b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
 - c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
 - d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
 - e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
 - f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.
 - g. The Display shall support the user's ability to change colors, sample sizes, and types of markers.
11. Database Management:
- a. Where a separate SQL database is utilized for information storage the System shall provide a Database Manager that separates the database monitoring and managing functions by supporting two separate windows.
 - b. Database secure access shall be accomplished using standard SQL authentication including the ability to access data for use outside of the Building Automation application.
 - c. The database managing function shall include summarized information on trend, alarm, event, and audit for the following database management actions:
 - 1) Backup
 - 2) Purge
 - 3) Restore

- d. The Database Manager shall support four tabs:
 - 1) Statistics - Shall display Database Server information and Trend, Alarm (Event), and Audit information on the Metasys Databases.
 - 2) Maintenance - Shall provide an easy method of purging records from the Metasys Server trend, alarm (event), and audit databases by supporting separate screens for creating a backup prior to purging, selecting the database, and allowing for the retention of a selected number of day's data.
 - 3) Backup - Shall provide the means to create a database backup file and select a storage location.
 - 4) Restore - Shall provide a restricted means of restoring a database by requiring the user to log into an Expert Mode in order to view the Restore screen.
- e. The Status Bar shall appear at the bottom of all Metasys Database Manager Tabs and shall provide information on the current database activity. The following icons shall be provided:
 - 1) Ready
 - 2) Purging Record from a database
 - 3) Action Failed
 - 4) Refreshing Statistics
 - 5) Restoring database
 - 6) Shrinking a database
 - 7) Backing up a database
 - 8) Resetting internet information Services
 - 9) Starting the Metasys Device Manager
 - 10) Shutting down the Metasys Device Manager
 - 11) Action successful
- f. The Database Manager monitoring functions shall be accessed through the Monitoring Settings window and shall continuously read database information once the user has logged in.
- g. The System shall provide user notification via taskbar icons and e-mail messages when a database value has exceeded a warning or alarm limit.
- h. The Monitoring Settings window shall have the following sections:
 - 1) General - Shall allow the user to set and review scan intervals and start times.
 - 2) Email - Shall allow the user to create and review e-mail and phone text messages to be delivered when a Warning or Alarm is generated.
 - 3) Warning - Shall allow the user to define the Warning limit parameters, set the Reminder Frequency, and link the e-mail message.
 - 4) Alarm - Shall allow the user to define the Alarm limit parameters, set the Reminder Frequency, and link the e-mail message.
 - 5) Database login - Shall protect the system from unauthorized database manipulation by creating a Read Access and a Write Access for each of the Trend, Alarm (Event) and Audit databases as well as an Expert Mode required to restore a database.
- i. The Monitoring Settings Taskbar shall provide the following informational icons:

- 1) Normal - Indicates by color and size that all databases are within their limits.
 - 2) Warning - Indicates by color and size that one or more databases have exceeded their Warning limit.
 - 3) Alarm - Indicates by color and size that one or more databases have exceeded their Alarm limit.
- j. The System shall provide user notification via Taskbar icons and e-mail messages when a database value has exceeded a warning or alarm limit.

D. Portable Operator Terminal (POT):

1. Portable operator terminal for shall be configured as follows:
 - a. 15 in. Personal Laptop Computer.
 - b. CPU - 4th Gen Intel Core i5 mobile processor - Dual core, 1.9 GHz Clock Speed, 3MB cache (minimum).
 - c. Video - Integrated Intel HD Graphics 4400 (minimum).
 - d. Memory - 8 GB dual-channel 1600 MHz DDR3 SDRAM (Minimum).
 - e. Hard Drive - 320 GB 5400 rpm hard drive (minimum).
 - f. DVD +/-RW Drive - 8X performance (minimum).
 - g. I/O Ports - (2) USB 3.0, (2) USB 2.0, (1) RJ-45, (1) VGA, (1) HDMI, (1) Line-out.
 - h. Keyboard - Internal, English, single pointing.
 - i. Network Card - Dual band Wireless 802.11 AC/A/C/B/G/N, Bluetooth 4.0.
 - j. Battery - 6-cell (65 Whr) Lithium.
 - k. Monitor configuration:
 - 1) Integral 15.6" HD, 1366 x 768 resolution (minimum).
 - 2) Anti-glare LED-backlit.
 - l. Carry Case:
 - 1) Provide hardside sturdy fabric or leather carrying case.
2. Software:
 - a. Windows 8.1 Pro (64 bit) (minimum).
 - b. Where user interface is not provided via browser, provide complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all included software, device drivers, and peripherals.
 - c. Provide original installation CDs/DVDs for all software, device drivers, and peripherals.
 - d. Provide software registration cards to the Owner for all included software.
 - e. Portable operator terminals shall support all controllers within the system on a direct-connect communications basis.
 - f. When used to access First or Second Tier controllers, the portable operator terminal shall utilize the standard operator workstation software, as previously defined.
 - g. When used to access Application Specific Controllers, the portable operator terminal shall utilize either the standard operator workstation software, as previously defined, or controller-specific utility software.
3. Connection of a POT to the network or any network device shall not interrupt nor interfere with normal network operation in any way, prevent alarms from being transmitted, or preclude remote initiated commands and system modification. Provide proper interface cable(s).

- E. User Interface:
1. BMS Vendor/Installer shall provide and install all computer hardware and software required for the purpose of configuration and consolidation of information and programs required for the delivery of a Task Focused, Web Based Portal to the BMS. The Metasys User Interface shall provide a natural, complementary extension to the Metasys site management user interface previously described.
 2. The user interface architecture shall be implemented to conform to industry standards, so that it can accommodate the required applications provided by the BMS Vendor/Installer as well as communicate information to and from any size control system.
 3. The user interface shall organize and display information using customer specific locations and spaces. At a minimum, the user interface shall provide:
 - a. Organization of all space, equipment and point information in a familiar way, reducing the need for extensive training prior to use.
 - b. A navigation mechanism for users to select the specific location or space to display information for - only spaces and locations in the navigation tree, nothing more.
 - c. The ability to search for and/or bookmark any location or space by name for quick access to critical or troublesome areas.
 - d. The same navigation mechanisms apply across any client device (ex. Smart phone, tablet, personal computer) for consistency and ease of use.
 4. Plug-ins and special native app software (ex. Downloaded and installed from an app store) shall not be required to conduct daily operations of buildings and equipment.
 5. The user interface shall clearly display equipment relationships without custom graphic generation.
 6. The user interface shall provide a single display of all potential issues in a facility including items currently in alarm, warning, override, out-of-service and offline.
 7. The user interface shall provide a single display of all activity related to a specific piece of equipment including user changes, discarded user changes, pending alarms, discarded alarms and acknowledged alarms.
 8. The user interface shall provide support for up to 100 concurrent users from an unlimited number of individuals with defined password access to the system.
 9. Provide the capability to view, command and modify large quantities of similar data in tailored summaries without the use of a secondary application, like a spreadsheet. These summaries shall be automatically generated or user defined. User defined summaries shall allow up to seven user defined columns describing attributes to be displayed including custom column labels. Up to 100 rows per summary shall be supported.

- F. Ready Access Portal User Interface:
1. BMS Vendor/Installer shall provide and install all computer hardware and software required for the purpose of configuration and consolidation of information and programs required for the delivery of a Task Focused, Web Based Portal to the BMS. The Ready Access Portal shall provide a natural, complementary extension to the Metasys site management user interface previously described.
 2. Ready Access Portal Architecture - The architecture of the system shall be implemented to conform to industry standards, so that it can accommodate the required applications provided by the BMS Vendor/Installer as well as communicate information to and from the Metasys system Site Director.
 3. User Interface Application Components:
 - a. The ready access portal shall provide an intuitive user interface to key Metasys functions and tasks via web browser.
 - b. Plug-ins or special software shall not be required for access to alarm, summary, schedule and trend data.
 - c. The portal shall include the ability to view full graphical representations of systems and equipment on PC platforms
 - d. The control system shall provide Secure Sockets Level (SSL) and Active Directory service support. If the Active Directory service and Single Sign-On features are enabled and the user is logged in to the Windows desktop, the login screen does not appear and access to the system is automatic.
 - e. Provide a common tool for graphics creation, schedule creation, custom programming, user access and hardware definition
 - f. Information shall be accessible on both personal computer and handheld device platforms as follows:
 - 1) Personal computers - Internet Explorer Version 7.0 recommended.
 - 2) Handheld devices - Internet Explorer for Window Mobile Version 5.0 or 6.0 recommended, as well as Apple i-Phone, i-Touch, or i-Pad. UI is optimized for devices with a 240 x 320 pixel screen size (QVGA).
 4. Operator Interface:
 - a. Password access shall be as described previously for management portal UI.
 - b. Once logged in, the System shall display a pre-selected screen tailored to the task requirements of the individual user.
 - c. The User Interface shall utilize an intuitive navigation and display method designed for operators who access the system for casual information and control or on an infrequent basis. It shall feature three basic components.
 - 1) Radio buttons for selection of the type of information to be displayed including Alerts, Summary, Schedules and Diagnostics.
 - 2) Navigation tree for selection of the specific data to be displayed on screen for the selected type. The navigation tree may be hidden and expanded by the operator to optimize the display of information.

- 3) A display window that provides the selected information by type in a pre-configured tabular format.
- d. The user interface software shall provide help menus and instructions for each operation and/or application.
- e. The system shall provide support for up to 100 concurrent users from an unlimited universe individuals with defined password access to the system.
- f. The system shall utilize Secure Sockets Level (SSL) support as required to allow the ready access portal to communicate across a network in a way designed to prevent eavesdropping, tampering, and message forgery. It provides endpoint authentication and communications privacy over the network using cryptography.
- g. The system shall have the capability to display multiple navigation trees that correspond to the user views configured in the management portal UI.
- h. The alert summary of the ready access portal shall, at the minimum, provide the following information.
 - 1) Alert (Alarm) type
 - 2) Date and time of alert occurrence
 - 3) Priority (color coded to level)
 - 4) Item name
 - 5) Item value (if applicable)
 - 6) Message
 - 7) Any attribute of any object in the system may be designated to report an alarm
- i. A standard summary on the ready access portal shall, at the minimum, provide the following information.
 - 1) Point type graphic icon
 - 2) Item name
 - 3) Item value
 - 4) Item status
 - 5) Access to the Change Value window (if applicable) for the purpose of setting, holding or releasing an item value
- j. A custom summary on the ready access portal shall display user-specified summaries of key data sets that can be quickly filtered and sorted. Items within these custom summaries can be commanded.
- k. A graphic view on the ready access portal shall display as described previously for management portal UI.
- l. The schedule detail summary of the ready access portal shall, at the minimum, provide the following information.
 - 1) Scheduled occurrences including time and value.
 - 2) Scheduled overrides including start time, end time and value.
 - 3) A list of all scheduled items including name and attribute, value, status and priority.
 - 4) Access to the Add Temporary Override window for the purpose of adding a temporary override to the schedule.
- m. The diagnostic (trend) summary of the ready access portal as viewed on a personal computing device shall provide the following information.
 - 1) Item name
 - 2) Item status

- 3) Trend name
- 4) Trend status
- 5) Full path name
- 6) Access to trend detail summary including trended value, time and date arranged in a user selectable format of 1 hour, 12 hours, 24 hours, 48 hours or 72 hours.

2.04 NETWORK AUTOMATION ENGINES (NAE)

- A. Network Automation Engine:
1. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
 2. Automation network - The NAE shall reside on the automation network and shall support a subnet of system controllers.
 3. User Interface - Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
 - a. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
 - b. The NAE shall support up a minimum of four (4) concurrent users.
 - c. The web based user shall have the capability to access all system data through one NAE.
 - d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.
 - e. Systems that require the user to address more than one NAE to access all system information are not acceptable.
 - f. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
 - g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
 - h. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
 - 1) Configuration
 - 2) Commissioning
 - 3) Data Archiving
 - 4) Monitoring
 - 5) Commanding
 - 6) System Diagnostics
 - i. Systems that require workstation software or modified web browsers are not acceptable.
 - j. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
 4. Processor - The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.

5. Memory - Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
6. Hardware Real Time Clock - The NAE shall include an integrated, hardware-based, real-time clock.
7. The NAE shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power - On/Off
 - b. Ethernet Traffic - Ethernet Traffic/No Ethernet Traffic
 - c. Ethernet Connection Speed - 10 Mbps/100 Mbps/1000 Mbps
 - d. FC Bus A - Normal Communications/No Field Communications
 - e. FC Bus B - Normal Communications/No Field Communications
 - f. Peer Communication – Data Traffic between NAE Devices
 - g. Run - NAE Running/NAE in Startup/NAE Shutting Down/Software Not Running
 - h. Bat Fault - Battery Defective, Data Protection Battery Not Installed
 - i. 24 VAC - 24 VAC Present/Loss Of 24VAC
 - j. Fault - General Fault
8. Communications Ports - The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.
 - a. Two (2) USB port
 - b. Two (2) URS-232 serial data communication port
 - c. Two (2) RS-485 port
 - d. One (1) Ethernet port
9. Diagnostics - The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
10. Power Failure - In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
 - a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
 - b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
11. Certification - NAE shall be listed by Underwriters Laboratories (UL).
12. Controller network -The NAE shall support the following communication protocols on the controller network:
 - a. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - 1) The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 2) The NAE shall be tested and certified as a BACnet Building Controller (B-BC).

- 3) A BACnet Protocol Implementation Conformance Statement shall be provided for the NAE.
- 4) The Conformance Statements shall be submitted 10 days prior to bidding.
- 5) The NAE shall support a minimum of 100 control devices.

2.05 NETWORK INTEGRATION ENGINES

- A. Network Integration Engine:
1. The Network Integration Engine (NIE) shall be a fully user-programmable, supervisory controller. The NIE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
 2. Network Integration for Third-Party Device and Equipment - NIEx9 supervisory engines can integrate power and energy meters, lighting, HVAC, security, access control, and many proprietary systems that communicate over Modbus, M-Bus (EN1434-3) and KNX Bus.
 3. NIEx9s shall leverage standard building management communication technologies, including:
 - a. BACnet protocol – The NIEx9 supports the BACnet services and objects typically used by a workstation and a field controller device, including:
 - 1) BACnet alarm
 - 2) Scheduling
 - 3) Trend
 - 4) Event services.
 - b. MS/TP FC Bus – The BACnet MS/TP Field Controller (FC) Bus is a standard peer-to-peer, multiple-master protocol in which each master device takes turns originating messages to pass to any device on the bus.
 - c. LONWORKS protocol – Specified NIEx9 models can supervise LONWORKS devices if:
 - 1) The network interface follows current LONMARK guidelines
 - 2) Uses the Free Topology Transceiver (FTT10).
 - d. N2 Bus protocol –The N2 Bus is an open Johnson Controls field communications trunk that links Application-Specific Controllers (ASCs) and programmable controllers to a supervisory controller.
 - e. Modbus – NIEx9 supports both Modbus RTU (RS-485, RS-232) and Modbus TCP/IP connectivity.
 - f. M-Bus (EN 1434-3) M-Bus (Meter Bus) is a European standard (EN 1434-3) that applies to heat meters.
 - g. KNX protocol – KNX Bus is used to control lighting, blinds and shutters, heating, and attendance systems.
 - 1) KNX (KONNEX) was created from the EIB (European Installation Bus), BatiBUS, and EHS (European Home System) protocols.
 - 2) A KNX IP Gateway is required to connect a NIEx9 to a KNX network.
 4. User Interface – Each NIE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.

- a. The web based UI software shall be imbedded in the NIE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
- b. The NIE shall support a minimum of two (2) concurrent users.
- c. The NIE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NIE.
- d. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
- e. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
 - 1) Configuration
 - 2) Commissioning
 - 3) Data Archiving
 - 4) Monitoring
 - 5) Commanding
 - 6) System Diagnostics
- f. Systems that require workstation software or modified web browsers are not acceptable.
- g. The NIE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
- 5. The NIE shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
- 6. The NIE shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only, shall not be acceptable.
- 7. The NIE shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
- 8. The NIE shall support the following number and types of inputs and outputs:
 - a. Ten Universal Inputs - shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode
 - 2) Analog Input, Current Mode
 - 3) Analog Input, Resistive Mode
 - 4) Binary Input, Dry Contact Maintained Mode
 - 5) Binary Input, Pulse Counter Mode
 - b. Eight Binary Inputs - shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode
 - 2) Pulse Counter Mode
 - c. Four Analog Outputs - shall be configured to output either of the following
 - 1) Analog Output, Voltage Mode
 - 2) Analog Output, Current Mode
 - d. Seven Binary Outputs - shall output the following:
 - 1) 24 VAC Triac

- e. Four Configurable Outputs - shall be configured to output either of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Binary Output, 24 VAC Triac Mode
- 9. The NIE shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
 - a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The SA Bus shall support a minimum of 10 devices.
 - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the NIE and the furthest connected device.
- 10. The NIE shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the Field Trunk or the SA Bus.
- 11. The NIE shall support, but not be limited to, the following applications:
 - a. Central Equipment including chillers and boilers
 - b. Lighting and electrical distribution
 - c. Built-up air handling units for special applications
 - d. Power generation and energy monitoring equipment
 - e. Interfaces to security and fire detection systems
- 12. The NIE shall be microprocessor-based with a minimum word size of 32 bits. The NIE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NIE size and capability shall be sufficient to fully meet the requirements of this Specification.
- 13. The NIE shall employ an industrial single board computer.
- 14. Each NIE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
- 15. The NIE shall include an integrated, hardware-based, real-time clock.
- 16. The NIE shall employ nonvolatile Flash memory to store all programs and data. The NIE shall employ a data protection battery to save data and power the real time clock when primary power is interrupted.
- 17. The NIE shall provide removable, color coded, screw terminal blocks for 24 VAC power, communication bus and I/O point field wiring.
- 18. The NIE shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power
 - b. Fault
 - c. SA Bus
 - d. FC Bus
 - e. Battery Fault
 - f. Ethernet
 - g. 10 LNK
 - h. 100 LNK
 - i. Run
 - j. Peer Com
- 19. Communications Ports – The NIE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator’s terminals.
 - a. USB port

- b. RS-232 serial data communication port
 - c. RS-485 port
 - d. RJ-45 Ethernet port
 - e. RJ-12 jack
20. Diagnostics – The NIE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Control Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
21. Power Failure – In the event of the loss of normal power, The NIE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
- a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
 - b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
22. Certification – The NIE shall be listed by Underwriters Laboratories (UL).File E107041, CCN PAZX, UL 916, Energy Management Equipment. FCC Compliant to CFR47, Part 15, Subpart B, Class A
23. Field Controller Bus – The NIE shall support the following communication protocols on the Field Controller Bus:
- a. The NIE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - 1) The NIE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 2) The NIE shall be tested and certified as a BACnet Building Controller (B-BC).
 - 3) A BACnet Protocol Implementation Conformance Statement shall be provided for the NIE.
 - 4) The Conformance Statements shall be submitted 10 days prior to bidding.
 - 5) The NIE shall support a minimum of 32 control devices.

2.06 NETWORK CONTROL ENGINE

- A. The Network Control Engine (NCE) shall be a fully user-programmable, supervisory controller. The NCE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
- B. The Network Control Engine (NCE) shall be a fully user-programmable, digital controller that includes a minimum of 33 I/O points.
- C. Automation Network – The NCE shall reside on the automation network and shall support a subnet of 32 Field controllers.

- D. User Interface – Each NCE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
1. The web based UI software shall be imbedded in the NCE. Systems that require a local copy of the system database on the user’s personal computer are not acceptable.
 2. The NCE shall support a minimum of two (2) concurrent users.
 3. The NCE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NCE.
 4. Systems that support UI Graphics from a central database or require the graphics to reside on the user’s personal computer are not acceptable.
 5. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
 - a. Configuration
 - b. Commissioning
 - c. Data Archiving
 - d. Monitoring
 - e. Commanding
 - f. System Diagnostics
 6. Systems that require workstation software or modified web browsers are not acceptable.
 7. The NCE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
- E. The NCE shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
- F. The NCE shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only, shall not be acceptable.
- G. The NCE shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
- H. The NCE shall support the following number and types of inputs and outputs:
1. Ten Universal Inputs - shall be configured to monitor any of the following:
 - a. Analog Input, Voltage Mode
 - b. Analog Input, Current Mode
 - c. Analog Input, Resistive Mode
 - d. Binary Input, Dry Contact Maintained Mode
 - e. Binary Input, Pulse Counter Mode
 2. Eight Binary Inputs - shall be configured to monitor either of the following:
 - a. Dry Contact Maintained Mode
 - b. Pulse Counter Mode
 3. Four Analog Outputs - shall be configured to output either of the following
 - a. Analog Output, Voltage Mode
 - b. Analog Output, Current Mode
 4. Seven Binary Outputs - shall output the following:

- a. 24 VAC Triac
 - 5. Four Configurable Outputs - shall be configured to output either of the following:
 - a. Analog Output, Voltage Mode
 - b. Binary Output, 24 VAC Triac Mode

- I. The NCE shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
 - 1. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - 2. The SA Bus shall support a minimum of 10 devices.
 - 3. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the NCE and the furthest connected device.

- J. The NCE shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the Field Trunk or the SA Bus.

- K. The NCE shall support, but not be limited to, the following applications:
 - 1. Central Equipment including chillers and boilers
 - 2. Lighting and electrical distribution
 - 3. Built-up air handling units for special applications
 - 4. Power generation and energy monitoring equipment
 - 5. Interfaces to security and fire detection systems

- L. The NCE shall support a Local Controller Display either as an integral part of the NCE or as a remote device communicating over the SA Bus.
 - 1. The Display shall use a BACnet Standard SSPC-135, clause 9 Master-Slave/Token-Passing protocol.
 - 2. The Display shall allow the user to view monitored points without logging into the system.
 - 3. The Display shall allow the user to view and change setpoints, modes of operation, and parameters.
 - 4. The Display shall provide password protection with user adjustable password timeout.
 - 5. The Display shall be menu driven with separate paths for:
 - a. Input/Output
 - b. Parameter/Setpoint
 - c. Overrides
 - 6. The Display shall use easy-to-read English text messages.
 - 7. The Display shall allow the user to select the points to be shown and in what order.
 - 8. The Display shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightens and automatic backlight brightening during user interaction.
 - 9. The display shall be a minimum of 4 lines and a minimum of 20 characters per line
 - 10. The Display shall have a keypad with no more than 6 keys.
 - 11. The Display shall be panel mountable.

- M. The NCE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard

operating systems shall be employed. NCE size and capability shall be sufficient to fully meet the requirements of this Specification.

- N. The NCE shall employ an industrial single board computer.
- O. Each NCE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
- P. The NCE shall include an integrated, hardware-based, real-time clock.
- Q. The NCE shall employ nonvolatile Flash memory to store all programs and data. The NCE shall employ a data protection battery to save data and power the real time clock when primary power is interrupted.
- R. The NCE shall provide removable, color coded, screw terminal blocks for 24 VAC power, communication bus and I/O point field wiring.
- S. The NCE shall include troubleshooting LED indicators to identify the following conditions:
 - 1. Power
 - 2. Fault
 - 3. SA Bus
 - 4. FC Bus
 - 5. Battery Fault
 - 6. Ethernet
 - 7. 10 LNK
 - 8. 100 LNK
 - 9. Run
 - 10. Peer Com
- T. Communications Ports – The NCE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator’s terminals.
 - 1. USB port
 - 2. RS-232 serial data communication port
 - 3. RS-485 port
 - 4. RJ-45 Ethernet port
 - 5. RJ-12 jack
- U. Diagnostics – The NCE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Control Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
- V. Power Failure – In the event of the loss of normal power, The NCE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
 - 1. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.

2. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
- W. Certification – The NCE shall be listed by Underwriters Laboratories (UL).File E107041, CCN PAZX, UL 916, Energy Management Equipment. FCC Compliant to CFR47, Part 15, Subpart B, Class A
- X. Field Controller Bus – The NCE shall support the following communication protocols on the Field Controller Bus:
1. The NCE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - a. The NCE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - b. The NAE shall be tested and certified as a BACnet Building Controller (B-BC).
 - c. A BACnet Protocol Implementation Conformance Statement shall be provided for the NCE.
 - d. The Conformance Statements shall be submitted 10 days prior to bidding.
 - e. The NCE shall support a minimum of 32 control devices.

2.07 DDC SYSTEM CONTROLLERS

- A. Field Equipment Controller:
1. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
 - a. The FEC shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - 1) The FEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - 2) The FEC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - 3) A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
 - 4) The Conformance Statement shall be submitted 10 days prior to bidding.
 2. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
 3. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
 4. The FEC shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power On
 - b. Power Off

- c. Download or Startup in progress, not ready for normal operation
 - d. No Faults
 - e. Device Fault
 - f. Field Controller Bus - Normal Data Transmission
 - g. Field Controller Bus - No Data Transmission
 - h. Field Controller Bus - No Communication
 - i. Sensor-Actuator Bus - Normal Data Transmission
 - j. Sensor-Actuator Bus - No Data Transmission
 - k. Sensor-Actuator Bus - No Communication
5. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
6. The FEC shall support the following types of inputs and outputs:
- a. Universal Inputs - shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode
 - 2) Analog Input, Current Mode
 - 3) Analog Input, Resistive Mode
 - 4) Binary Input, Dry Contact Maintained Mode
 - 5) Binary Input, Pulse Counter Mode
 - b. Binary Inputs - shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode
 - 2) Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following
 - 1) Analog Output, Voltage Mode
 - 2) Analog Output, current Mode
 - d. Binary Outputs - shall output the following:
 - 1) 24 VAC Triac
 - e. Configurable Outputs - shall be capable of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Binary Output Mode
7. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).
- a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The FC Bus shall support communications between the FECs and the NAE.
 - c. The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the NAE.
 - d. The FC Bus shall support a minimum of 100 IOMs and FECs in any combination.
 - e. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.
8. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
- a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.
 - b. The SA Bus shall support a minimum of 10 devices per trunk.
 - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.
9. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.

10. The FEC shall support, but not be limited to, the following applications:
 - a. Chilled water/central plant applications
 - b. Heating central plant applications
 - c. Built-up air handling units for special applications
 - d. Terminal & package units
 - e. Special programs as required for systems control
11. The FEC shall support a Local Controller Display either as an integral part of the FEC or as a remote device communicating over the SA Bus.
 - a. The Display shall use a BACnet Standard SSPC-135, clause 9 Master-Slave/Token-Passing protocol.
 - b. The Display shall allow the user to view monitored points without logging into the system.
 - c. The Display shall allow the user to view and change setpoints, modes of operation, and parameters.
 - d. The Display shall provide password protection with user adjustable password timeout.
 - e. The Display shall be menu driven with separate paths for:
 - 1) Input/Output
 - 2) Parameter/Setpoint
 - 3) Overrides
 - f. The Display shall use easy-to-read English text messages.
 - g. The Display shall allow the user to select the points to be shown and in what order.
 - h. The Display shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightens and automatic backlight brightening during user interaction.
 - i. The display shall be a minimum of 4 lines and a minimum of 20 characters per line
 - j. The Display shall have a keypad with no more than 6 keys.
 - k. The Display shall be panel mountable.

2.08 FIELD DEVICES

- A. Input/Output Module:
 1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.
 2. The IOM shall communicate with the FEC over the FC Bus or the SA Bus.
 3. The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - a. The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - b. The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - c. A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
 4. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
 5. The IOM shall have a minimum of 4 points to a maximum of 17 points.
 6. The IOM shall support the following types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode

- 2) Analog Input, Current Mode
- 3) Analog Input, Resistive Mode
- 4) Binary Input, Dry Contact Maintained Mode
- 5) Binary Input, Pulse Counter Mode
- b. Binary Inputs - shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode
 - 2) Pulse Counter Mode
- c. Analog Outputs - shall be configured to output either of the following
 - 1) Analog Output, Voltage Mode
 - 2) Analog Output, current Mode
- d. Binary Outputs - shall output the following:
 - 1) 24 VAC Triac
- e. Configurable Outputs - shall be capable of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Binary Output Mode
- 7. The IOM shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power On
 - b. Power Off
 - c. Download or Startup in progress, not ready for normal operation
 - d. No Faults
 - e. Device Fault
 - f. Normal Data Transmission
 - g. No Data Transmission
 - h. No Communication

2.09 ACTUATORS AND OPERATORS

- A. General Requirements:
 - 1. Damper and valve actuators shall be electronic.
 - 2. The manufacturer shall be ISO 9001 certified.
- B. Electronic Damper Actuators:
 - 1. Spring Return Actuators:
 - a. Regulatory Agency Listing: cULus ,CSA C22.2 No. 24-93, and CE marked
 - b. Direct-Coupled Design: Requires no crankarm or linkage for mounting to a shaft.
 - c. Coupling: toothed V-bolt clamp and nuts with toothed cradle.
 - d. Reversible Mounting: Provides either clockwise or counterclockwise operation.
 - e. Power Failure Operation: Mechanical spring return system drives load to the home position. Other forms of internal energy storage for power failure operation are not acceptable.
 - f. Motor Technology:
 - 1) Modulating Types: Microprocessor-controlled Brushless DC motor
 - 2) On/Off Types: DC brush motor.
 - g. Overload Protection: Electronic stall detection protects from overload at all angles of rotation without the use of end switches.
 - h. Enclosure Ratings:

- 1) NEMA type 2 / IP54 mounted in any orientation.
 - i. Double-Insulated construction: Eliminate the need for electrical ground wires.
 - j. Wiring: Integral cables with colored and numbered conductors.
 - k. Sized for torque required to seal damper at load conditions
 - l. Parallel Operation: Actuators shall be available that are capable of being mechanically or electrically paralleled.
 - m. Proportional actuators shall be user configurable without the use of external computer software or programming tools. Calibration, input signal range selection, and control logic reversal shall be selectable with an external mode selection switch.
 - n. Operating Temperature Range:
 - 1) 70 lb·in. Torque and Below: -40°F to 140°F
 - 2) 71 lb·in. Torque and above: -40°F to 131°F
 - o. Power Requirements:
 - 1) Modulating Types:
 - a) 27 lb·in. Torque and Below: 5VA maximum
 - b) 70 lb·in. to 19 lb·in.Torque: 8VA maximum
 - c) 89 lb·in. to 71 lb·in.Torque: 10VA maximum
 - d) 90 lb·in. to 177 lb·in.Torque: 16VA maximum
 - 2) 2-Position Types:
 - a) 27 lb·in. Torque and Below: 5VA maximum
 - b) 70 lb·in. to 19 lb·in.Torque: 7VA maximum
 - c) 71 lb·in. to 177 lb·in.Torque: 25VA maximum
- C. Non-Spring Return Actuators:
- 1. Regulatory Agency: UL Listed ,CSA Certified, and CE marked
 - 2. Direct-Coupled Design: Requires no crankarm or linkage for mounting to a shaft.
 - 3. Coupling:
 - a. Above 80 lb·in.: toothed V-bolt clamp and nuts with toothed cradled
 - b. 80 lb·in. and below: single cup-point set screw and toothed cradle.
 - 4. Overload Protection: Electronic stall detection or magnetic slip clutch protects from overload at all angles of rotation without the use of end switches.
 - 5. Minimum Enclosure Ratings:
 - a. Types with covered wiring terminals: NEMA type 2 / IP42 mounted in any orientation.
 - b. Types without covered wiring terminals: NEMA type 1 / IP30 or IP40.
 - c. Types with integrated cables: NEMA 2 / IP42 mounted in any orientation.
 - 6. Sized for torque required to seal damper at load conditions.
 - 7. Parallel Operation: Actuators shall be available that are capable of being mechanically or electrically paralleled.
 - 8. Proportional actuators shall be user configurable without the use of external computer software or programming tools.
 - a. Operating Temperature Range: -4°F to 122°F except for VAV and similar indoor applications in which case 32°F to 122°F is acceptable.
 - b. Power Requirements: 24 V with models available for both 24 VAC and 24 VDC operation, maximum
 - 1) Above 80 lb·in.: 7.5 VA at 24 VAC
 - 2) 80 lb·in.and below: 3.5 VA at 24VAC

- c. The manufacturer shall provide 5-year limited warranty from the date of sale covering defects in material or workmanship.

2.10 SENSORS AND TRANSMITTERS

A. General Requirements:

- 1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements. All sensors, transmitters and other devices are to be hard wired. Wireless devices are not acceptable.

B. Temperature Sensors:

1. General Requirements:

- a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
- b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
- c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water/Glycol, Hot Water/Glycol	$\pm .5^{\circ}\text{F}$.
Room Temp	$\pm .5^{\circ}\text{F}$.
Duct Temperature	$\pm .5^{\circ}\text{F}$.
All Others	$\pm .75^{\circ}\text{F}$.

2. Room Temperature Sensors:

- a. Room sensors shall be constructed for either surface or wall box mounting.
- b. Room sensors shall have the following options:
 - 1) Setpoint warmer/cooler dial or reset slide switch providing a ± 3 degree (adjustable) range.
 - 2) A momentary override request push button for activation of after-hours operation.

3. Thermo Wells:

- a. Thermowell manufacturer shall have models available in stainless steel, brass body, and copper bulb.
- b. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and sensor.
- c. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
- d. Thermo wells and sensors shall be mounted in a direct mount (no adapter) offering faster installation or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.
- e. Thermo wells constructed of 316 stainless steel shall comply with Canadian Registration Number (CRN) pressure vessel rating.

4. Outside Air Sensors:

- a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
 - b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
 - c. Temperature transmitters shall be of NEMA 3R (IP54) or NEMA 4 (IP65) construction and rated for ambient temperatures.
 - d. The outdoor sensor can be easily mounted on a roof, pole or side of a building utilizing its already assembled mounting bracket.
 - e. Outside Relative Humidity sensors 0-100% full range of accurate measurement. Operating temperature -4 to 140F (-20 to 60C).
 - f. Outside temperature sensors operating temperature range is -40 to 140F, +/- .55F (+/- .3C).
5. Duct Mount Sensors:
- a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
 - b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
 - c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
6. Averaging Sensors:
- a. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
 - b. For plenum applications, such as mixed air temperature measurements, a continuous averaging sensor or a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
 - c. Capillary supports at the sides of the duct shall be provided to support the sensing string.
- C. Humidity Sensors:
- 1. The sensor shall be a solid-state type, relative humidity sensor of the Thin Film Capacitance or Bulk Polymer Design. The sensor element shall resist service contamination.
 - 2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
 - 3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
 - 4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R (IP54) or NEMA 4 (IP65) enclosure with sealtite fittings.
 - 5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
 - 6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.

- D. CO2 Sensors:
1. Where shown on the drawings, CO2 sensors shall have the following features:
 - a. Jumper selectable: 0-20mA, 4-20mA & 0-10VDC output
 - b. Liquid Crystal Display
 2. The CO2 sensors shall have the ability to monitor and output the following variables as required by the systems sequence of operations:
 - a. Zone carbon-dioxide
 3. The CO2 shall transmit the information back to the controller via jumper selectable 0-20mA, 4-20mA & 0-10VDC output signals.
 - a. The CO2 sensors shall provide a maximum output current of 25mA; Maximum output voltage of 12.5V.
 - b. The CO2 sensors shall be FCC compliant to CFR47 Part 15 subpart B Class A.
 4. The CO2 Sensors shall be available with:
 - a. CO2 response time (0-63%) of 1 minute
 - b. Less than 0.083% of full scale/F° temperature dependence of CO2 output
 - c. Long term CO2 stability ±5% of full scale for 5 years
 - d. CO2 measurement accuracy of ±(40ppm + 2.0% of reading)
 - e. CO2 non-linearity of less than 1.0% of full scale
 5. The CO2 Sensors may include the following items :
 - a. Relay output module
 - b. Liquid Crystal Display module
 - c. Analog temperature module with linear 0-10VDC output for 32-122F.
- E. Differential Pressure Transmitters:
1. General Air and Water Pressure Transmitter Requirements:
 - a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
 - b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
 - c. Differential pressure transmitters shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
 - d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.

2. Low Differential Water Pressure Applications (0" - 20" w.c.):
 - a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - 1) .01-20" w.c. input differential pressure range.
 - 2) 4-20 mA output.
 - 3) Maintain accuracy up to 20 to 1 ratio turndown.
 - 4) Reference Accuracy: +0.2% of full span.

F. Power Monitoring Devices:

1. Current Measurement (Amps):
 - a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.
 - b. Current Transformer -A split core current transformer shall be provided to monitor motor amps.
 - 1) Operating frequency -50 - 400 Hz.
 - 2) Insulation -0.6 Kv class 10Kv BIL.
 - 3) UL recognized.
 - 4) Five amp secondary.
 - 5) Select current ration as appropriate for application.
 - c. Current Transducer - A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
 - 1) 6X input over amp rating for AC inrushes of up to 120 amps.
 - 2) Manufactured to UL 1244.
 - 3) Accuracy: +.5%, Ripple +1%.
 - 4) Minimum load resistance 30kOhm.
 - 5) Input 0-20 Amps.
 - 6) Output 4-20 mA.
 - 7) Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).

G. Refrigerant Leak Detectors:

1. The refrigerant leak detector shall be a standalone device and shall provide a SPDT output to directly energize the refrigeration room exhaust ventilation fans. The detector shall include a sensor or sensors connected to a control panel. Two relay contacts at the control panel shall provide trouble and alarm indication to the Facility Management System. The alarm relay contact shall also directly energize the exhaust fans.
2. The refrigerant leak detector shall sense the type of refrigerant used in the specified chillers. Provide proper sensing coverage for the area of the Equipment Room in which refrigeration equipment is located.

- H. Status and Safety Switches:
1. General Requirements:
 - a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
 2. Current Sensing Switches:
 - a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
 - b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
 - c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
 3. Air Filter Status Switches:
 - a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
 - b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
 - c. Provide appropriate scale range and differential adjustment for intended service.
 4. Air Flow Switches:
 - a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
 5. Air Pressure Safety Switches:
 - a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
 - b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
 6. Low Temperature Limit Switches:
 - a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
 - b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
 - c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

- I. Control Relays:
 - 1. Control Pilot Relays:
 - a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
 - b. Mounting Bases shall be snap-mount.
 - c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
 - d. Contacts shall be rated for 10 amps at 120VAC.
 - e. Relays shall have an integral indicator light and check button.

- J. Electronic Signal Isolation Transducers:
 - 1. A signal isolation transducer shall be provided whenever an analog output signal from the BMS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.
 - 2. The signal isolation transducer shall provide ground plane isolation between systems.
 - 3. Signals shall provide optical isolation between systems.

- K. Energy Measurement System:
 - 1. The entire Energy Measurement System shall be built and calibrated by a single manufacturer and shall consist of a flow meter, two temperature sensors, a BTU meter, temperature thermowells, and all required mechanical installation hardware. A certificate of NIST* traceable calibration shall be provided with each system.
 - a. BTU Meter: The BTU meter shall provide the following points both at the integral LCD and as outputs to the building control system: Energy Total, Energy Rate, Flow Rate, Supply Temperature and Return Temperature. Output signals shall be BACnet[®] MS/TP or BACnet/IP protocol. Each BTU meter shall be factory programmed for its specific application, and shall be re-programmable using the front panel keypad (no special interface device or computer required).
 - b. Temperature sensors: Temperature sensors shall be loop-powered current based (mA) sensors and shall be bath-calibrated and matched (NIST* traceable) for the specific temperature range for each application. The calculated differential temperature used in the energy calculation shall be accurate to within ± 0.15 deg. F (including the error from individual temperature sensors, sensor matching, input offsets, and calculations).
 - c. Flow Meter: The flow meter shall be installed either in the supply or return pipe of the system to be measured following the manufacturer's instructions with particular attention paid to upstream and downstream straight pipe runs. Insertion type flow meters shall be provided with all installation hardware necessary to enable insertion and removal of the meter without system shutdown and shall be hand insertable up to 400 psi.
 - 1) Insertion Electromagnetic Type: Materials of construction for wetted metal components shall be 316 SS. For installations in non-metallic pipe, install grounding rings or probes. The flow meter shall average velocity readings from two sets of diametrically opposed electrodes. Each flow meter shall be individually wet-calibrated against a primary volumetric

standard that is accurate to within 0.1% and traceable to NIST*. A certificate of calibration shall be provided with each flow meter. Accuracy shall be within $\pm 1\%$ of rate from 2-20 ft/s. Overall turndown shall exceed 100:1. Output signals shall be completely isolated and shall consist of the following: (1) high resolution frequency output for use with peripheral devices such as a display module or BTU meter, (1) analog output; 4-20mA, 0-10V, or 0-5V jumper selectable and (1) scalable dry contact output for totalization.

2.11 CONTROL VALVES

- A. Ball Valves, 1/2 through 2 in.:
1. Ball Valves shall have forged brass bodies.
 2. Valves shall have available either Chrome Plated Brass Balls or 300 Series Stainless Steel Balls in all sizes.
 3. Valves shall have available either Nickel Plated Brass Stems or 300 Series Stainless Steel Stems with a blow-out proof stem design in all sizes.
 4. Valves shall have Graphite reinforced Polytetrafluoroethylene (PTFE) seats with Ethylene Propylene Diene Monomer (EPDM) O-ring backing.
 5. Stem seals shall be double EPDM O-rings.
 6. Flow Characterization Disk shall be manufactured from Amodel AS-1145HS Polyphthalamide Resin and rated for 50 psid maximum differential pressure and shall be inserted against the casting of the valve.
 7. All ball valves with internal pipe thread end connections shall be rated to 580 psi maximum static pressure at 203°F (95°C) fluid temperature.
 8. All ball valves with sweat end connections or press end connection shall be rated to 300 psig maximum static pressure at 203°F (95°C) fluid temperature
 9. All valves shall be rated for service with hot water, chilled water and 50% glycol solutions.
 10. Ball Valves with stainless steel balls and stems shall be rated for use with 15 psig saturated steam.
 11. Flow Characteristics shall be equal percentage on the control port. Bypass port on three-way valves shall have linear flow characteristics.
 12. Valves shall have a maximum leakage specification of 0.01% of maximum flow for the control port, ANSI/FCI 70-2, Class 4 and 1% of maximum flow, bypass port.
 13. Valves shall be maintenance free
 14. Valves shall be provided with a 5 year warranty.
 15. Valves shall be rated for 200 psid closeoff pressure.
 16. Valve actuators shall be UL-recognized or CSA-certified.
- B. Ball Valves, 2-1/2 through 4 in. Flanged:
1. Ball Valves shall have forged brass bodies with ASME Class 150 ductile iron flanges.
 2. Valves shall have 300 Series Stainless Steel Balls.
 3. Valves shall have 300 Series Stainless Steel Stems with a blow-out proof stem design.
 4. Valves shall have Graphite reinforced Polytetrafluoroethylene (PTFE) seats with Ethylene Propylene Diene Monomer (EPDM) O-ring backing.
 5. Stem seals shall be double EPDM O-rings.

6. Flow Characterization Disk shall be manufactured from Amodel AS-1145HS Polyphthalamide Resin and rated for 50 psid maximum differential pressure.
 7. Flow Characteristics shall be equal percentage on the control port. Bypass port on three-way valves shall have linear flow characteristics.
 8. Valves shall have a maximum leakage specification of 0.01% of maximum flow for the control port, ANSI/FCI 70-2, Class 4 and 1% of maximum flow, bypass port.
 9. All valves shall be rated for service with hot water, chilled water, 50% glycol solutions and rated for use with 25 psig saturated steam.
 10. Two-Way Valves shall be rated for 100 psid closeoff pressure and Three-Way Valves shall be rated for 50 psid closeoff pressure.
 11. Valves shall be maintenance free.
 12. Valves shall be provided with a 5 year warranty.
 13. Valve actuators shall be UL-recognized or CSA-certified.
- C. Butterfly Valves, 2 through 20 in. resilient seat ASME Class 125/150 Flanged:
1. Butterfly Valves shall have cast iron bodies meeting ASTM A126 Class B requirements and meet ASME class 125/150 flange requirements and shall be fully lugged.
 2. Butterfly Valves seat shall be Ethylene Propylene Diene Monomer (EPDM).
 3. Butterfly Valve disk shall be Ductile Iron with Nylon 11 coating.
 4. Butterfly Valve stems shall be Stainless Steel.
 5. Flow Characteristics shall be equal percentage up to 70° of disk rotation.
 6. All valves shall be rated for service with hot water, chilled water and 50% glycol solutions.
 7. Valves shall be maintenance free.
 8. Valve shall be provided with a 3 year warranty.
 9. Valve electric actuators shall be UL-recognized or CSA-certified.
- D. Globe Valves, Brass, 1/2 through 2 in.:
1. Valves shall have bodies manufactured from a RoHS compliant brass.
 2. Valves shall meet the pressure and temperature requirements of ANSI B16.15, Class 250
 3. Valve stems shall be a 300 Series Stainless Steel.
 4. Valves with brass plug and seat shall have stem seals with Self-Adjusting Ethylene Propylene Rubber (EPR) Ring Pack U-Cups
 5. Valves with Stainless Steel plug and seat shall valve stem seals with Spring Loaded Polytetrafluoroethylene (PTFE) and Elastomer V-Rings
- E. Electric Zone Valves, 1/2 through 1-1/4 in.
1. Valves shall have bodies manufactured from Forged Brass.
 2. Valves stems shall be brass (Hard Chrome Plated)
 3. Valve Actuator shall be UL, cUL listed or CSA certified.
 4. Valves shall be rated for service with hot water, chilled water and 50% glycol solutions.
 5. Two Position valves shall have models available rated for use with 15 psig saturated steam.
 6. Valve Actuator shall be replaceable without removing valve from the pipe.
 7. Modulating Valves flow characteristics shall be equal percentage
 8. Valves shall be provided with a 2 year warranty.

9. Valve actuators shall be UL-recognized or CSA-certified.

2.12 CONTROL DAMPERS

- A. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the Drawings.
- B. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
- C. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
- D. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.
- E. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g.
- F. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below.
- G. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

2.13 MISCELLANEOUS DEVICES

- A. Local Control Panels:
 - 1. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.

2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices - such as relays, transducers, and so forth - that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
 3. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
 4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
 5. All wiring shall be neatly installed in plastic trays or tie-wrapped.
 6. A 120 volt convenience outlet, fused on/off power switch, and required transformers shall be provided in each enclosure.
- B. Power Supplies:
1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
 2. Input: 120 VAC +10%, 60Hz.
 3. Output: 24 VDC.
 4. Line Regulation: +0.05% for 10% line change.
 5. Load Regulation: +0.05% for 50% load change.
 6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
 7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
 8. A power disconnect switch shall be provided next to the power supply.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Testing Existing Sub-Systems:
1. Prior to installing the new system, test the existing sub-systems (boiler controls) to ascertain their operating condition.
 2. Conduct tests that are disruptive to facility personnel after normal working hours as directed.
 3. Prepare a written report for the Director's Representative indicating the repairs required, if any, to make the existing sub-systems function properly.
 4. Repairs to the existing sub-systems are not included in the Work unless requested by Order on Contract.
- B. Interruptions to Existing Sub-Systems:
1. Maintain the existing sub-systems in their present condition to the extent possible while installing new Work.
 2. Prior to making changes or removals relative to the existing sub-systems, notify the Director's Representative and have procedures approved.

3.02 BMS SPECIFIC REQUIREMENTS

- A. Graphic Displays:
 - 1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
 - 2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.
 - 2. Provide a color graphic system flow diagram display for each HVAC system with all points as indicated on the point list.
 - 4. Provide a text sequence of operation for each system launched from the graphic.
 - 5. Provide a color graphic display for each floor in the facility. Indicate each HVAC zone, color coded to indicate zone values and status.

- B. Custom Reports:
 - 1. Provide custom reports as required for this project.

- C. Actuation / Control Type:
 - 1. Primary Equipment:
 - a. Controls shall be provided by BMS manufacturer as specified herein.
 - b. All damper and valve actuation shall be electric.
 - 2. Air Handling Equipment:
 - a. All air handlers shall be controlled with a HVAC-DDC Controller
 - b. All damper and valve actuation shall be electric.
 - 3. Terminal Equipment:
 - a. Terminal Units (fan coil units, etc.) shall have electric damper and valve actuation.

- D. Schedule of Operator Workstations (OWS):

ID	TYPE	LOCATION	FUNCTION
ADS-1	Server	Bldg. 37	Application & Data Server Server
PTR-1	Printer	Bldg. 37	Report Printer
POT-1	Laptop PC	Portable	User Interface
LTS-1	LCD Graphic Touch Screen	Bldg. 29 Pump Rm.	User Interface
LTS-2	LCD Graphic Touch Screen	Bldg. 66 Mech. Rm.	User Interface

- E. Field Equipment Controllers:
 - 1. Provide at least one Field Equipment Controller (FEC) for each air handling system and for each mechanical equipment room. Separate discreet FECs shall be provided to support each major HVAC system. In all cases where primary and back-up systems are specified, a single FEC shall not be used to control both primary and secondary systems. In addition, a single FEC shall not be used to control two or more major HVAC systems (i.e., chillers and heat exchanger controlled by one single panel).

3.03 INSTALLATION PRACTICES

- A. BMS Wiring:
1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, including power wiring for controllers, actuators, sensors, etc. shall be provided by the BMS Supplier/Installer. All wiring shall comply with the requirements of Specification Section 260502 - Basic Electrical Materials and Methods for Direct Digital Building Control System and all local and national electric codes, unless specified otherwise in this section.
- B. BMS Identification Standards:
1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
 2. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.
- C. BMS Panel Installation:
1. The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
 2. The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.
- D. Input Devices:
1. All Input devices shall be installed per the manufacturer recommendation
 2. Locate components of the BMS in accessible local control panels wherever possible.
- E. HVAC Input Devices – General:
1. All Input devices shall be installed per the manufacturer recommendation
 2. Locate components of the BMS in accessible local control panels wherever possible.
 3. The HVAC contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
 4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
 5. Outside Air Sensors
 - a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
 - b. Sensors shall be installed with a rain proof, perforated cover.
 6. Water Differential Pressure Sensors
 - a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
 - b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
 - c. The transmitters shall be installed in an accessible location wherever possible.

7. Building Differential Air Pressure Applications (-1" to +1" w.c.):
 - a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - b. The interior tip shall be inconspicuous and located as shown on the drawings.
8. Duct Temperature Sensors:
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
 - b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
 - d. The sensor shall be mounted to suitable supports using factory approved element holders.
9. Space Sensors:
 - a. Shall be mounted per ADA requirements.
 - b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
10. Low Temperature Limit Switches:
 - a. Install on the discharge side of the first water or steam coil in the air stream.
 - b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
 - c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
11. Air Differential Pressure Status Switches:
 - a. Install with static pressure tips, tubing, fittings, and air filter.
12. Water Differential Pressure Status Switches:
 - a. Install with shut off valves for isolation.
13. HVAC Output Devices:
 - a. All output devices shall be installed per the manufacturers recommendation. The HVAC contractor shall install all in-line devices such as control valves, dampers, pressure wells, etc.
 - b. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke.
 - c. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
 - d. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.
 - e. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal

isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems.

- F. Provide all control wiring and conduit required to interconnect chiller condensing unit (located outdoors) with its remote evaporator (located indoors) including, but not limited to, wiring to chilled water temperature sensors and flow switch.
- G. Provide interface modules as required to allow DDC system to communicate with, control and obtain operating condition information from boiler and chiller factory mounted control panels.

3.04 FIELD QUALITY CONTROL

- A. Preliminary System Test:
 - 1. Preparation: Have the Company Field Advisor adjust the completed system and then operate it long enough to assure that it is performing properly.
 - 2. Run a preliminary test for the purpose of:
 - a. Determining whether the system is in a suitable condition to conduct an acceptance test.
 - b. Checking and adjusting equipment.
 - c. Training facility personnel.
 - 3. Also perform a witnessed validation demonstration consisting of:
 - a. Running each specified report.
 - b. Display and demonstrate each data entry template to show site specific customizing capability. Demonstrate parameter changes.
 - c. Execute menu tree.
 - d. Display graphics, demo update.
 - e. Execute digital and analog commands in English and graphic mode.
 - f. Demonstrate freeform address assignments and commands.
 - g. Demonstrate all specified diagnostics.
 - h. Demonstrate DDC loop precision and stability via trend logs of inputs and outputs (6 loops minimum).
 - i. Demonstrate scan, update, and alarm responsiveness.
- B. System Acceptance Test:
 - 1. Preparation: Notify the Director's Representative at least 3 working days prior to the test so arrangements can be made to have a Facility Representative witness the test.
 - 2. Make the following tests:
 - a. Test system operational functions step by step as summarized in the detailed description of system operation.
 - b. Test monitor and control devices.
 - c. Test all remote devices such as valve and damper actuators to demonstrate full range of motion in the "controllable range".
 - 3. Supply all equipment necessary for system adjustment and testing.
 - 4. Submit written report of test results signed by Company Field Advisor and the Director's Representative. Mount a copy of the written report and in a Plexiglas enclosed frame assembly adjacent to the POS.

- C. Post System Acceptance Test: Deliver Portable Operator’s Terminal, and appurtenances to the Director’s Representative as specified under Paragraph 1.02 A.

3.05 POINT DESCRIPTION, PROGRAM LIST, AND SEQUENCES

- A. General:
1. Points listed on drawings are the minimum number of points to be provided. Provide additional points as required to satisfy the sequence and operational requirements as described on drawings.
 2. Provide spare points. After the system has been completed and tested, the following minimum quantity of spare points shall be available for future connection at each DCP:
 - a. Binary inputs: 2.
 - b. Binary outputs: 2.
 - c. Analog inputs: 1.
 - d. Analog outputs: 1.
 3. Provide proportional-integral-derivative algorithms for all control programs.
 4. Determine, through operation of the system, proportional bands, interval time, integral periods, adjustment rates, and any other input information required to provide stable operation of the control programs.
 5. Where primary and standby pumps are provided, programming shall provide for alternating operation of pumps each time the system starts, and once per month during periods of continuous operation, unless otherwise indicated on Sequences. Provide automatic start-up of standby pump on failure of the pump which has been selected for operation. Failure is the inability to maintain the specified minimum differential pressure for a period of 60 seconds.
 6. Provide proof of flow for fans. Fan proof-of-flow switches shall be adjustable set point and differential pressure type. Switches shall be piped to fan discharge except where fans operate at less than one inch W.C., they shall be piped across the fan. For fractional horsepower and non-ducted fans, relays or auxiliary contacts may be used. Maximum pressure rating shall be at least 10 inches W.C.
 7. Provide proof of flow for pumps. Pump proof-of-flow switches shall be adjustable set point and differential pressure type. For fractional horsepower pumps, relays or auxiliary contacts may be used.
 8. The system-wide outdoor air temperature and outdoor air humidity signals shall each consist of the average of 3 sensors. The sensors shall be located in the fresh air intake serving HRU-1.
 9. The following definitions apply to the letter descriptors used in the point lists on the drawings:
 - a. RT - Run time of a piece of equipment. This shall be the total operating time since initial start-up of a piece of equipment.
 - b. T - Indicates the point shall be trendable.
 - c. A - Indicates the system shall alarm when the point is outside its range, or upon contact closure or opening.
 10. All alarms shall be trendable. All equipment start/stops shall be trendable.
 11. At a minimum, each sequence and accompanying point list shall be represented by an individual graphic. Each point listed shall appear on the graphic. Where appropriate and approved, multiple sequences and point lists may be combined into a single graphic.

- a. For analog outputs, display on the graphic the percent of full signal (percent open for valves and dampers, percent of speed for variable speed drives, percent open for vortex dampers, etc.).
 - b. For analog outputs controlled by analog inputs, provide a probe at the graphic to redefine the proportional, integral, and derivative gains.
 - c. Alarm set points and ranges shall be resettable from the graphic. Control set points and ranges shall be resettable from the graphic.
 - d. Where average point values are called for in the sequence, the average value shall be displayed on the graphic. In response to a probe on the graphic, the individual sensor values and sensor locations shall be displayed.
12. Where dampers operate in conjunction with fan operation, the damper open signal shall precede the fan start signal by 10-15 seconds. The damper close signal shall be delayed 10-15 seconds after the fan stop signal.

END OF SECTION

GENERAL NOTES

1. ALL CONSTRUCTION SHALL CONFORM WITH THE CURRENT PROVISIONS OF THE BUILDING CODE OF NEW YORK STATE.
2. A. DESIGN LOADS:
 - 1.) DESIGN ROOF SNOW LOADS:
GROUND SNOW LOAD (Pg) = 50 psf
SNOW EXPOSURE FACTOR (Ce) = 1.0
SNOW LOAD IMPORTANCE FACTOR (Is) = 1.1
THERMAL FACTOR (Ct): 1.2
 - 2.) MINIMUM ROOF DESIGN LIVE LOAD = 20 psf
 - 3.) WIND DESIGN LOADS:
BASIC WIND SPEED = 90 mph
WIND LOAD IMPORTANCE FACTOR (Is) = 1.15
WIND EXPOSURE CATEGORY = B
INTERNAL PRESSURE COEFF. (Gcpi) = +0.18/-0.18
 - 4.) SEISMIC DESIGN DATA:
SEISMIC IMPORTANCE FACTOR = 1.25
SPECTRAL RESPONSE COEFFICIENTS:
SDS = 0.228
SD1 = 0.093
SITE CLASS: D
BASIC SEISMIC-RESISTING SYSTEMS:
-ORDINARY STEEL CONCENTRICALLY BRACED FRAMES
DESIGN BASE SHEAR (V=CW): 0.766k
SEISMIC DESIGN CATEGORY: B
ANALYSIS PROCEDURE: EQUIVALENT LATERAL FORCE
- B. THE STRUCTURE HAS BEEN DESIGNED FOR THE DEAD AND LIVE LOADS INDICATED ABOVE. ANY INCREASE OF LOADS DUE TO CHANGE IN USAGE OR CONSTRUCTION MATERIALS, ETC. SHALL HAVE THE WRITTEN APPROVAL OF THE ENGINEER.
3. A. IT IS THE CONTRACTOR'S RESPONSIBILITY TO SATISFY HIMSELF AS TO THE LOCATION OF ANY UTILITIES IN THE IMMEDIATE VICINITY OF CONSTRUCTION SO AS TO PREVENT DAMAGE TO THEM. SHOULD ANY DAMAGE TO SUCH UTILITIES OCCUR, THE CONTRACTOR SHALL BE REQUIRED TO REPAIR SUCH DAMAGE AT HIS OWN EXPENSE AND TO THE SATISFACTION OF THE OWNER.
- B. COORDINATE WITH ARCHITECTURAL, MECHANICAL AND ELECTRICAL DRAWINGS FOR LOCATION AND DIMENSION OF CHASES, INSERTS, OPENINGS, SLEEVES, WASHERS, DRIPS, REVEALS, DEPRESSIONS AND OTHER PROJECT REQUIREMENTS.
- C. THE CONTRACTOR SHALL CHECK AND VERIFY ALL DIMENSIONS BEFORE PROCEEDING WITH CONSTRUCTION. ALL DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ARCHITECT.
- D. THE STRUCTURAL CONTRACT DOCUMENTS SHALL NOT BE REPRODUCED FOR USE AS SHOP DRAWINGS.
- E. ANY REVIEW OF STRUCTURAL ITEM SHOP DRAWINGS BY THE STRUCTURAL ENGINEER IS FOR THE GENERAL CONFORMANCE WITH THE DESIGN CONCEPT AS PRESENTED BY THE CONTRACT DOCUMENTS. NO DETAILED CHECK OF QUANTITIES OR DIMENSIONS WILL BE MADE.
- F. ALL CHANGES AND ADDITIONS MADE ON RE-SUBMITTALS MUST BE CLEARLY FLAGGED AND NOTED. THE PURPOSE OF THE RE-SUBMITTALS MUST BE CLEARLY NOTED ON THE LETTER OF TRANSMITTAL. THE REVIEW OF THE RE-SUBMITTALS WILL BE LIMITED TO THOSE ITEMS CAUSING THE RESUBMISSION.

FOUNDATIONS

1. THE BOTTOM OF ALL EXTERIOR FOOTINGS SHALL BEAR ON UNDISTURBED SOIL OR STRUCTURAL FILL A MINIMUM OF 4 FEET BELOW ADJACENT FINISHED GRADE.
2. FOOTINGS ARE DESIGNED FOR A NET ALLOWABLE BEARING CAPACITY OF 2000 PSF.
3. ALL FILL UNDER SLABS ON GROUND SHALL BE SELECT COARSE GRANULAR FILL COMPACTED TO 95% MAXIMUM DENSITY AS DETERMINED BY ASTM D1558 (MODIFIED PROCTOR).

CAST-IN-PLACE CONCRETE

1. ALL CONCRETE WORK SHALL CONFORM TO THE LATEST APPROVED (BY LOCAL GOVERNMENT) EDITIONS OF THE FOLLOWING ACI AND ASTM DOCUMENTS:

ACI-211	PROPORTIONS OF CONCRETE
ACI-214	COMPRESSION TESTS
ACI-301	SPECIFICATIONS FOR STRUCTURAL CONCRETE FOR BUILDINGS
ACI-302,1R	FLOOR AND SLAB CONSTRUCTION
ACI-304	PLACING CONCRETE
ACI-305	HOT WEATHER
ACI-306	COLD WEATHER
ACI-315	DETAILING
ACI-318	BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE
ACI-347	FORMWORK
ASTM C94	READY-MIX CONCRETE
2. ALL FIELD AND LAB TESTING OF CONCRETE SHALL CONFORM TO THE LATEST APPROVED (BY LOCAL GOVERNMENT) EDITIONS OF ASTM:

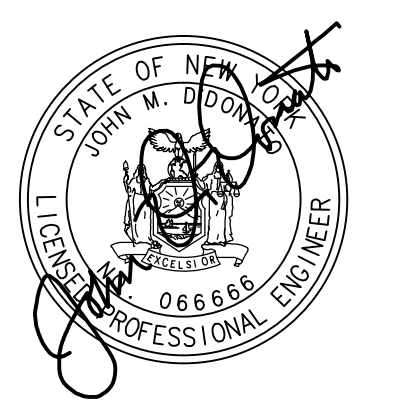
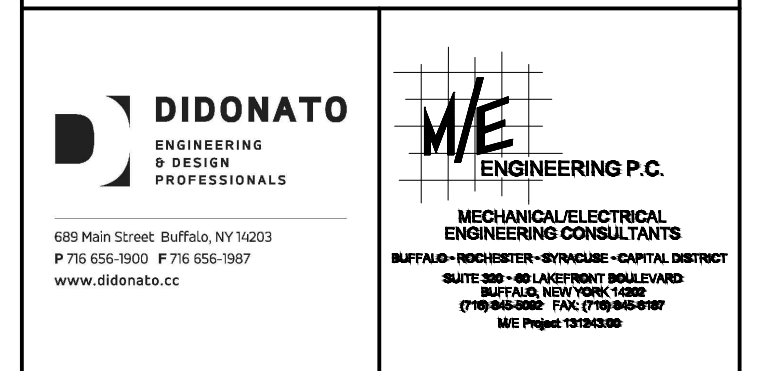
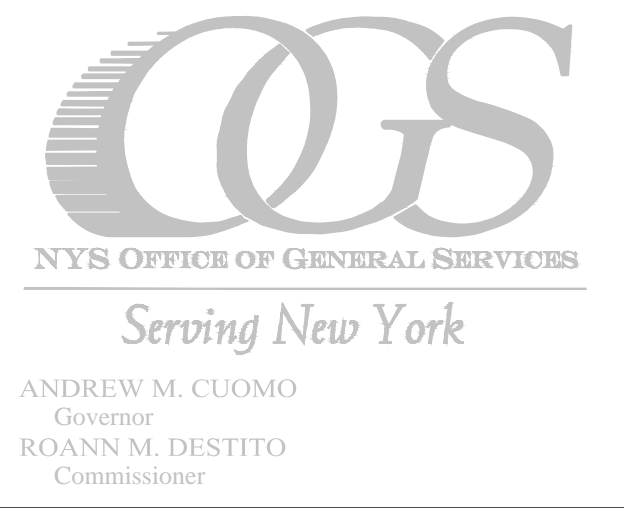
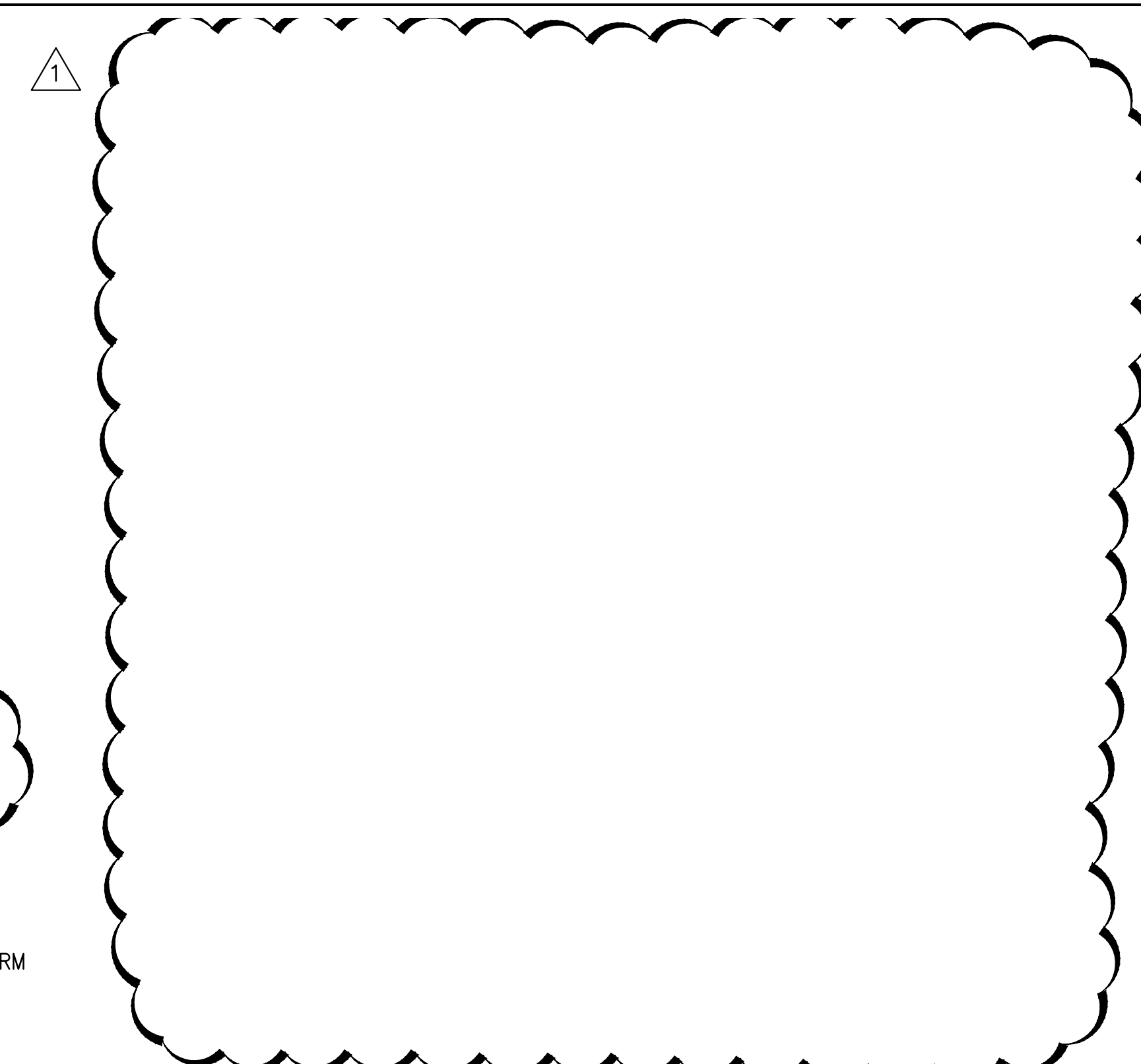
ASTM C31	FIELD CYLINDER SPECIMENS
ASTM C39	LAB TESTING CYLINDERS
ASTM C42	HARDENED CORES (WHEN REQUIRED)
ASTM C143	SLUMP TEST
ASTM C172	SAMPLING FRESH CONCRETE
ASTM C231	AIR CONTENT (WHEN REQUIRED)
3. ALL CONCRETE, UNLESS NOTED OTHERWISE, SHALL BE STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI WITH A MINIMUM OF 611 POUNDS OF CEMENT PER CUBIC YARD.. ALL CONCRETE EXPOSED TO WEATHER SHALL HAVE AN AIR ENTRAINMENT OF 6±1.5%. NO ADMIXTURES CONTAINING CALCIUM CHLORIDE SHALL BE PERMITTED, AND MAXIMUM SLUMP SHALL BE 3". ALL CONCRETE SHALL CONTAIN A WATER REDUCING ADMIXTURE.
4. ALL CONCRETE MIX DESIGNS AND ADMIXTURES SHALL BE APPROVED BY THE ARCHITECT/ENGINEER PRIOR TO PLACING CONCRETE. CONTRACTOR SHALL INDICATE INTENDED LOCATIONS OF USE FOR EACH PROPOSED MIX ALONG WITH THE MIX DESIGNS.
5. ALL REINFORCING BARS SHALL CONFORM TO ASTM A-615 GRADE 60. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A-185 GRADE 65. ALL WELDED WIRE FABRIC SHALL BE IN SHEETS AND SUPPORTED ON CHAIRS.
6. ALL CONCRETE SHALL BE SAMPLED AND TESTED BY AN AGENCY RETAINED BY THE CONTRACTOR. THE CONTRACTOR SHALL NOTIFY THE TESTING AGENCY 48 HOURS PRIOR TO THE PLACEMENT OF ANY CONCRETE.
7. MINIMUM BAR LAPS SHALL BE 48 DIAMETERS WITH A MINIMUM LAP OF 24" UNLESS NOTED OTHERWISE.
8. REINFORCEMENT COVER, UNLESS NOTED OTHERWISE:
 - A. FOOTINGS - BOTTOM 3", TOP 2"
 - B. WALLS - 2"

STRUCTURAL AND MISCELLANEOUS STEEL

1. ALL STRUCTURAL AND MISCELLANEOUS STEEL SHALL CONFORM TO THE AISC "SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS", MARCH 9, 2005.
2. ALL STRUCTURAL STEEL SHALL BE AS FOLLOWS:
WIDE FLANGE SHAPES _____ ASTM A-992, FY = 50,000 PSI.
ANGLES, CHANNELS, BARS AND PLATES _____ ASTM A-36, FY = 36,000 PSI.
3. STEEL TUBE AND HSS SECTIONS SHALL CONFORM TO ASTM A500 GRADE B, FY = 46,000 PSI.
4. ALL STEEL PIPE AND ROUND HSS SECTIONS SHALL CONFORM TO ASTM A-501, FY = 36,000 PSI, OR ASTM A-53 TYPE "E" OR "S" GRADE B, FY = 35,000 PSI.
5. ALL WELDED CONNECTIONS SHALL BE MADE WITH E70XX ELECTRODES (MINIMUM 3/16" THICKNESS UNLESS NOTED OTHERWISE). ALL BOLTED CONNECTIONS SHALL USE 3/4" DIAMETER ASTM A325 HIGH STRENGTH BOLTS UNLESS NOTED OTHERWISE. ALL BEAM CONNECTIONS SHALL DEVELOP THE FULL UNIFORM LOAD CAPACITY THE MEMBER CAN CARRY WITH DUE CONSIDERATION TO CONCENTRATED LOADS AT THE ENDS OF THE MEMBER UNLESS SPECIFICALLY DETAILED OTHERWISE ON THE DRAWINGS. NO CONNECTION SHALL BE MADE USING LESS THAN TWO BOLTS. ALL THREADED ANCHOR ROD MATERIAL SHALL BE ASTM F1554 GR 36.
6. SHOP AND FIELD WELDS SHALL BE MADE BY APPROVED CERTIFIED WELDERS AND SHALL CONFORM TO THE AMERICAN WELDING SOCIETY CODE FOR BUILDING AWS D1.1. WELDS SHALL DEVELOP THE FULL STRENGTH OF MATERIALS BEING WELDED, UNLESS OTHERWISE NOTED.
7. ALL EPOXY ANCHORS SHALL BE 1/2"Ø HIT-RE 500 EPOXY ANCHORS, 2 1/2" MINIMUM ANCHOR LENGTH IN CONCRETE AND MASONRY AS MANUFACTURED BY HILTI FASTENING SYSTEMS OR APPROVED EQUIVALENT, U.N.O. ALL EPOXY ANCHORS SHALL BE SET IN CONCRETE OR 100% SOLID FILLED MASONRY.
8. THE USE OF A GAS-CUTTING TORCH IN THE FIELD FOR CUTTING HOLES OR FOR CORRECTING FABRICATION ERRORS WILL NOT BE PERMITTED ON NEW STRUCTURAL FRAMING MEMBERS EXCEPT WITH THE WRITTEN APPROVAL OF THE ENGINEER FOR EACH SPECIFIC CONDITION.
9. ALL STRUCTURAL STEEL SHALL BE SHOP PAINTED WITH AN APPROVED HIGH-RATIO WATER BASED ZINC SILICATE PRIMER.

STEEL ROOF DECK

1. STEEL ROOF DECK SHALL CONFORM TO AISI SPECIFICATION FOR THE DESIGN OF LIGHT GAGE COLD-FORMED STRUCTURAL STEEL MEMBERS AND THE STEEL DECK INSTITUTE'S DESIGN REQUIREMENTS. STEEL ROOF DECK SHALL CONFORM TO ASTM A-611, GRADE C, D OR E, OR FROM A-653-94 STRUCTURAL QUALITY GRADE 33 OR HIGHER.
2. STEEL ROOF DECK, UNLESS SPECIFIED OTHERWISE, SHALL BE 1 1/2" DEEP, 22 GAGE MINIMUM, TYPE "B" BY VULCRAFT, OR APPROVED EQUAL. STEEL DECK SHALL BE PAINTED. FIELD WELDS SHALL RECEIVE TOUCH UP PAINT PRIOR TO ROOFING INSTALLATION.
3. STEEL ROOF DECK SHALL BE CONTINUOUS, AND SHALL BE FASTENED TO THE SUPPORTS AT UNIT ENDS AND AT INTERMEDIATE SUPPORTS AS INDICATED.



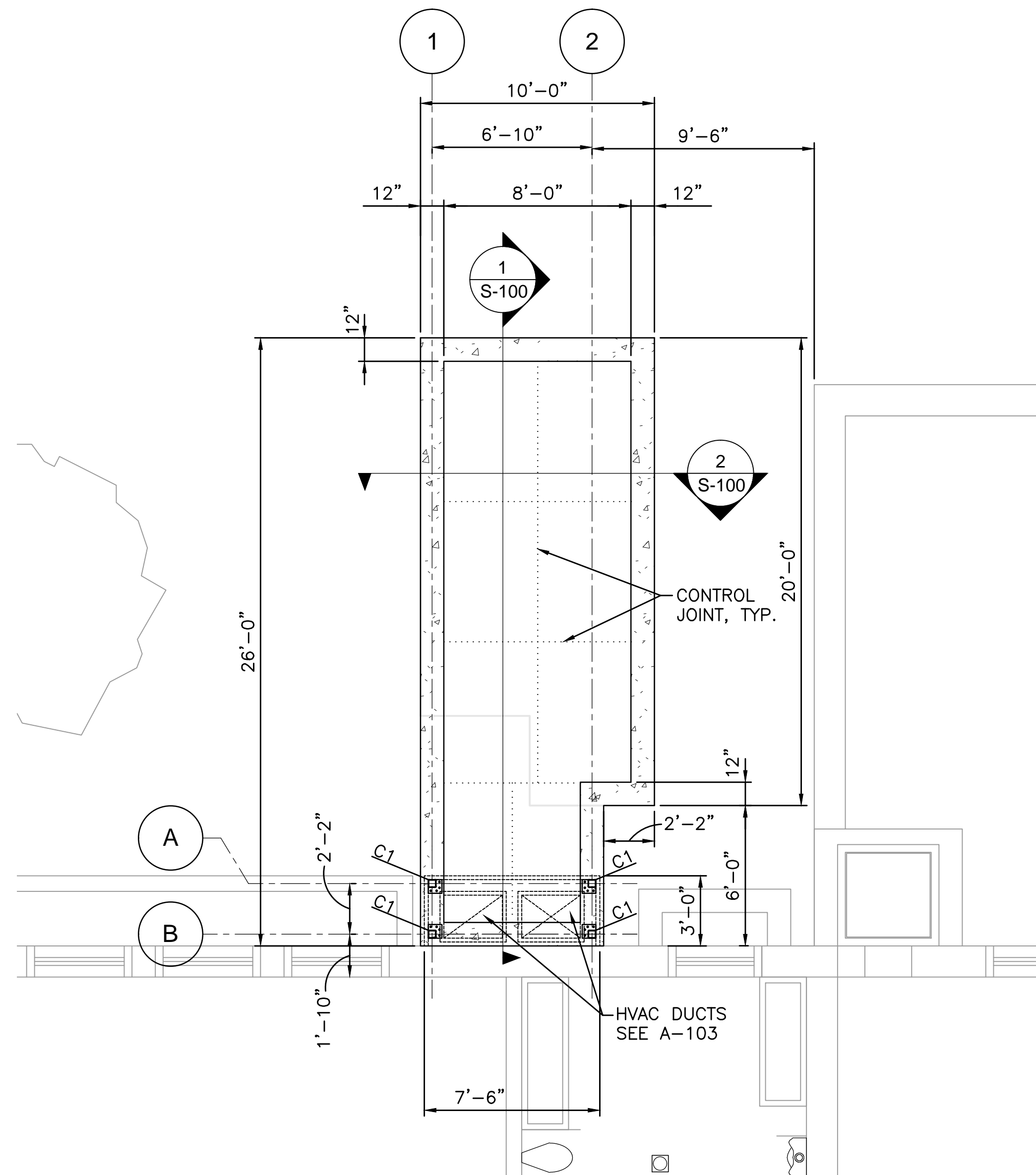
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CONTRACT:	
CONSTRUCTION	
TITLE:	REPLACE HVAC SYSTEMS BUILDINGS 29 AND 66
LOCATION:	INDUSTRY LIMITED SECURE CENTER 375 RUSH-SCOTTVILLE ROAD RUSH, NEW YORK 14543
CLIENT:	OFFICE OF CHILDREN AND FAMILY SERVICES

MARK	DATE	DESCRIPTION
1	2/13/2015	ADDENDUM 1
	1/16/2015	BID DOCUMENTS
	1/9/2015	100% SUBMISSION
	11/14/2014	60% SUBMISSION
PROJECT NUMBER:	44811 - C	
DESIGNED BY:	JAF	
DRAWN BY:	MBS	
FIELD CHECK:	X	
APPROVED:	X	

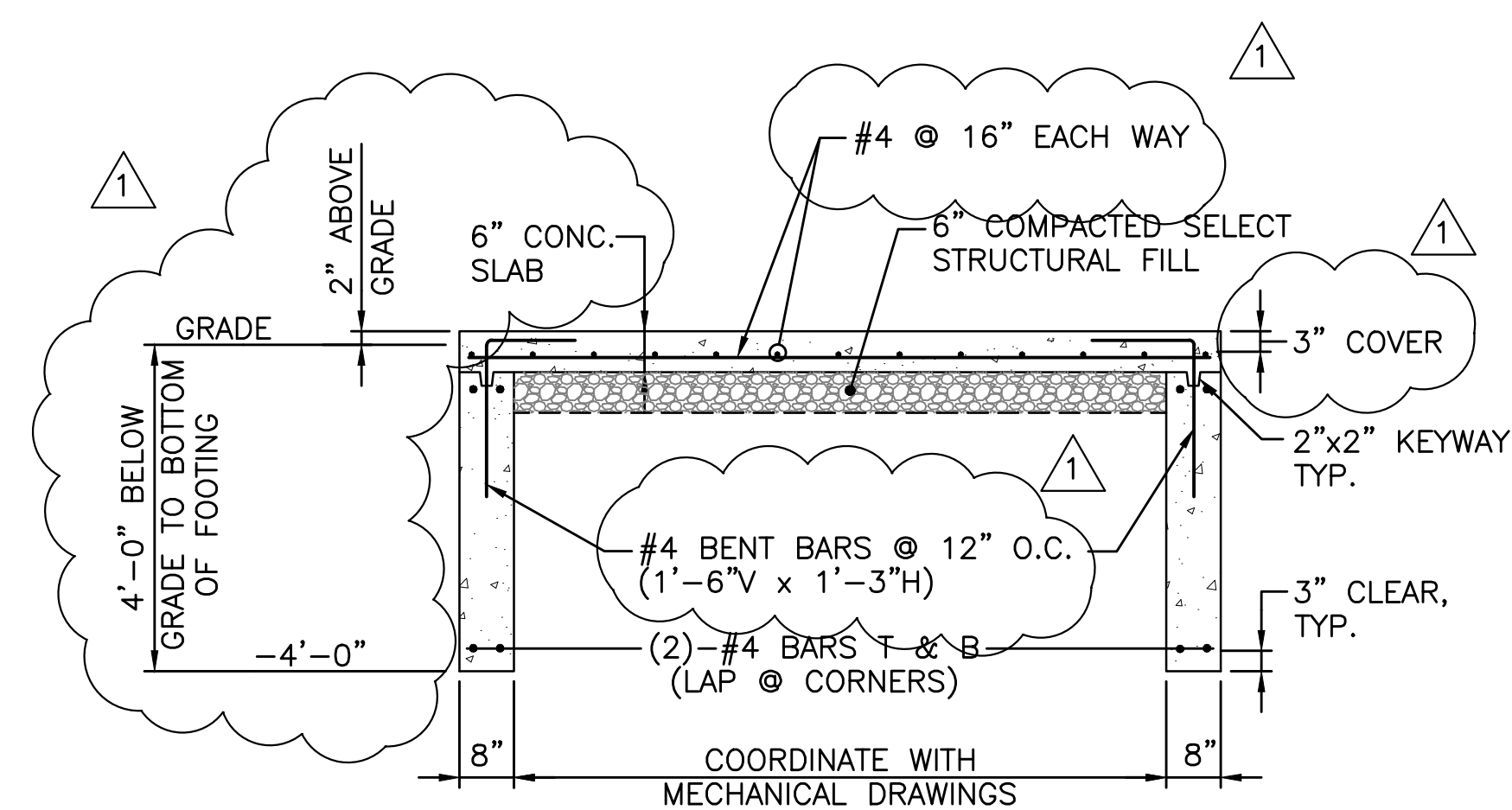
SHEET TITLE:
STRUCTURAL NOTES

DRAWING NUMBER:
S-001

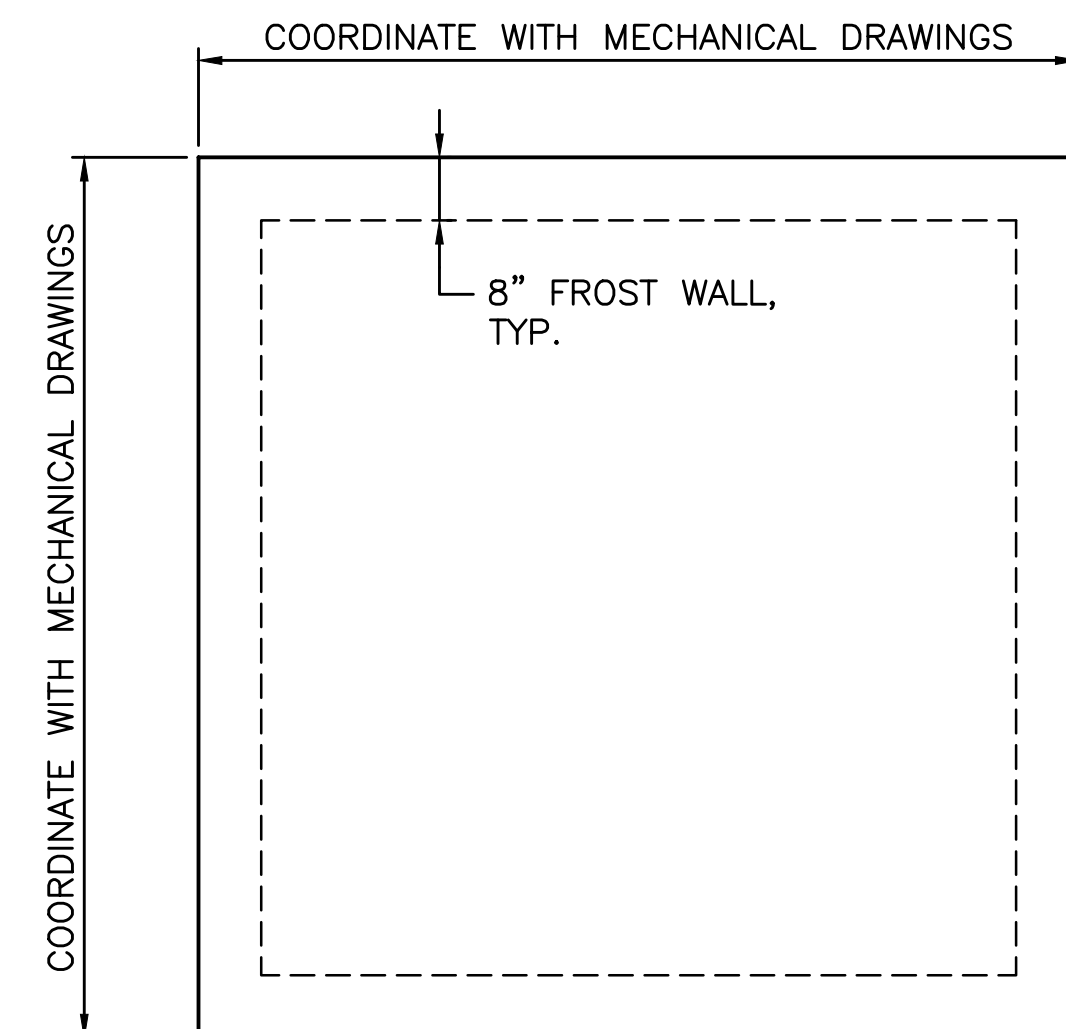


PARTIAL FOUNDATION PLAN
SCALE: 1/4" = 1'-0"

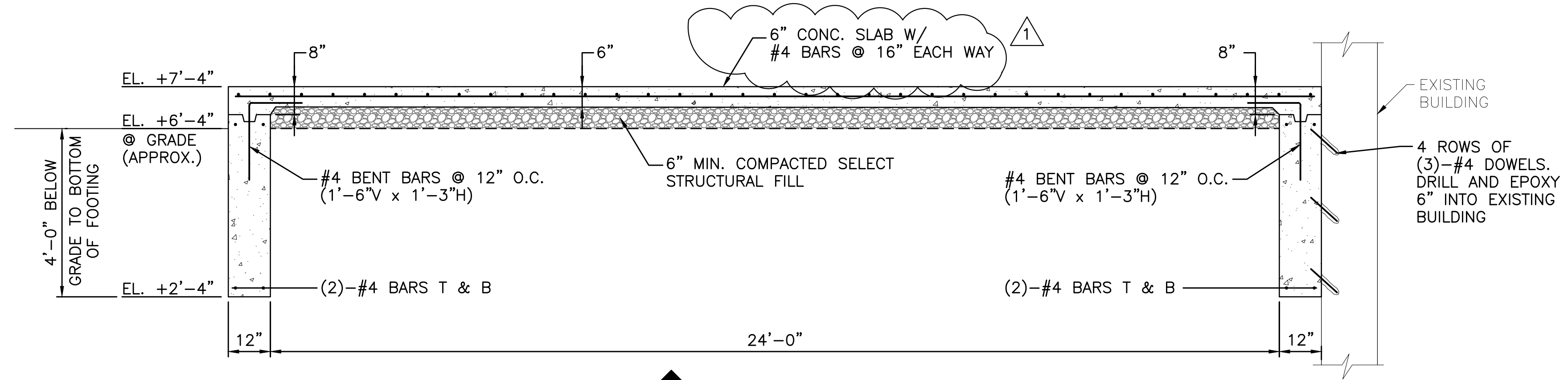
COLUMN SCHEDULE			
MARK	COLUMN SIZE	BASE PL	ANCHORS
C1	HSS 4x4x4	PL 3/8"x7"x0'-7"	(4)-5/8"Ø RODS



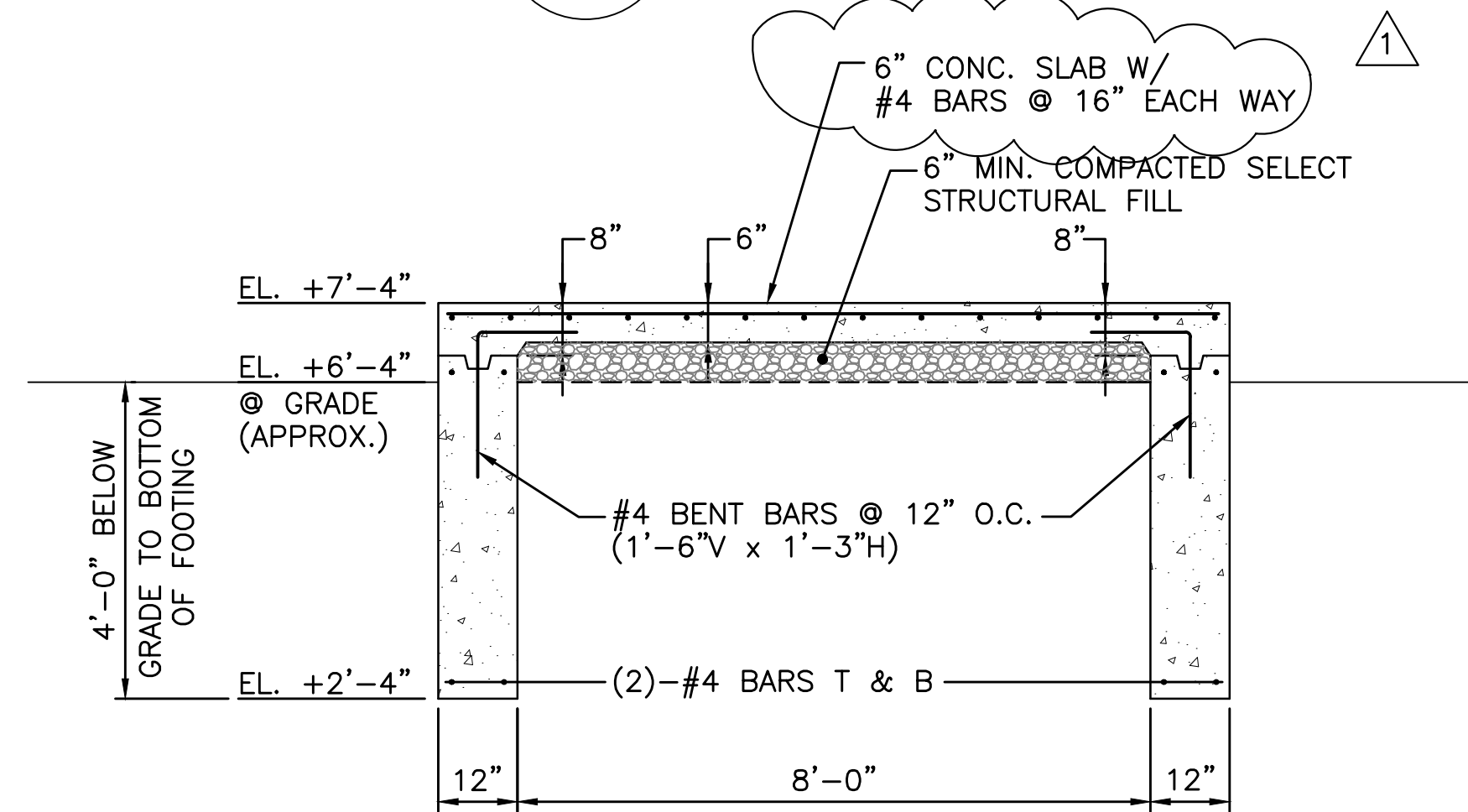
3 TYPICAL MECHANICAL UNIT CONCRETE PAD SECTION
S-101 SCALE: 1/2" = 1'-0"



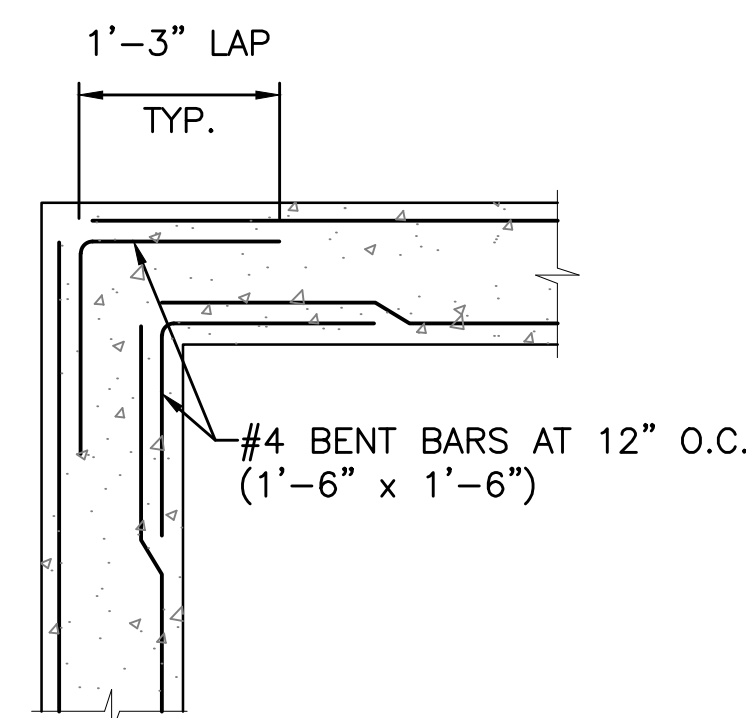
4 TYPICAL MECHANICAL UNIT CONCRETE PAD PLAN
S-101 SCALE: 1/2" = 1'-0"



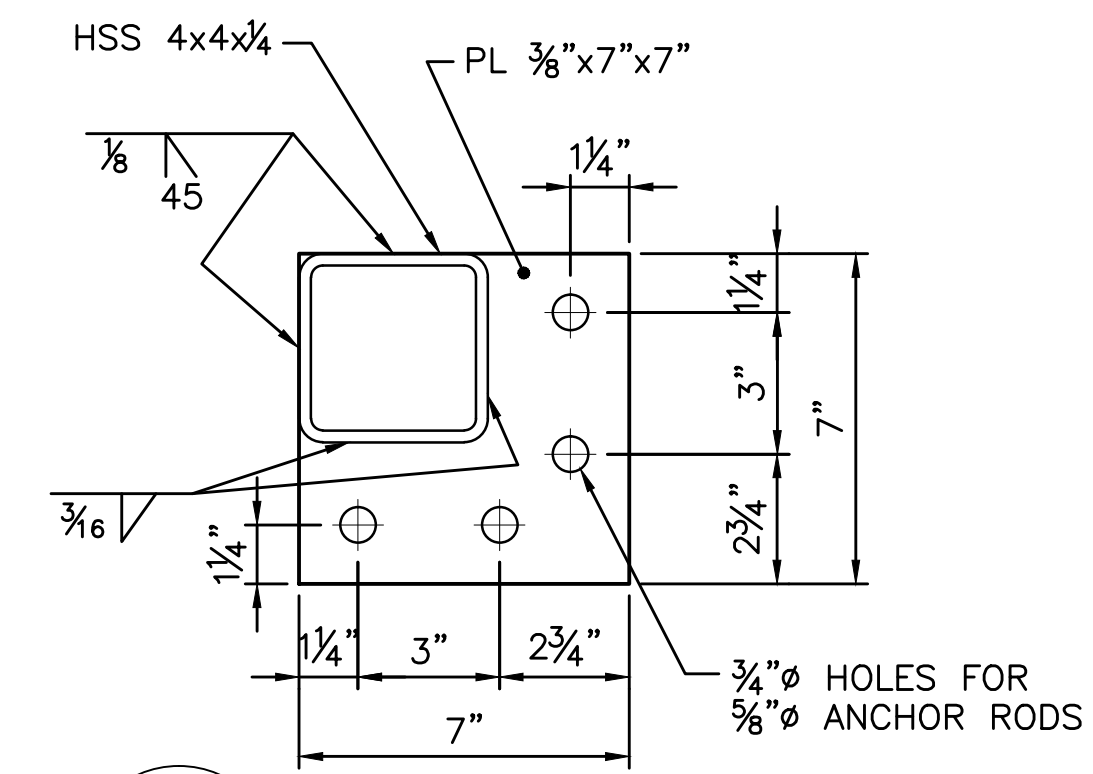
1 SECTION S-100
SCALE: 1/2" = 1'-0"



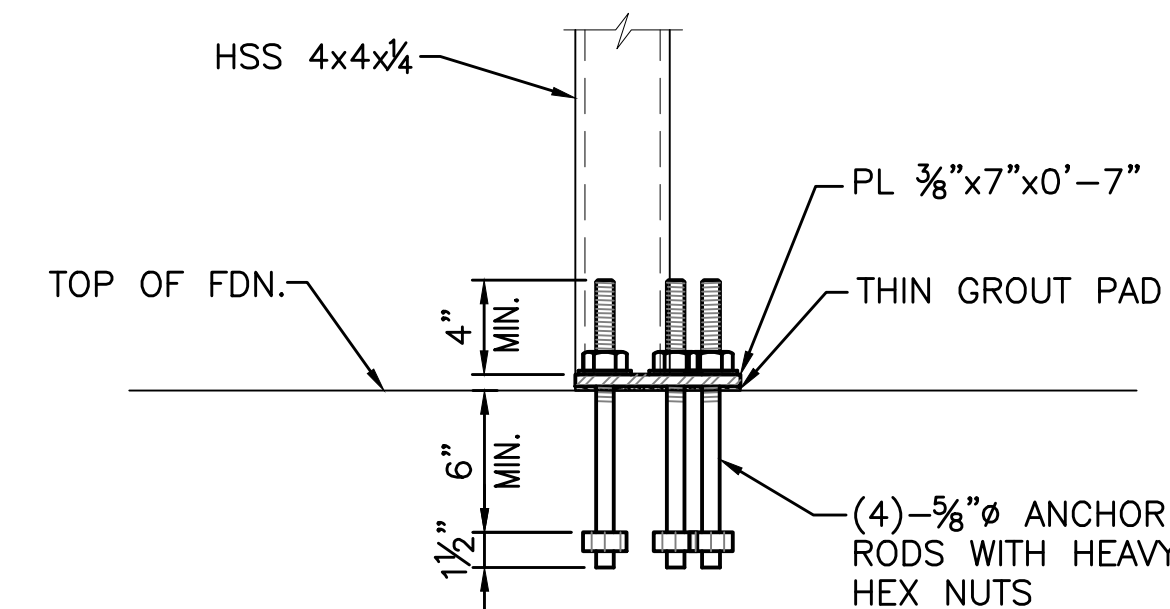
2 SECTION S-100
SCALE: 1/2" = 1'-0"



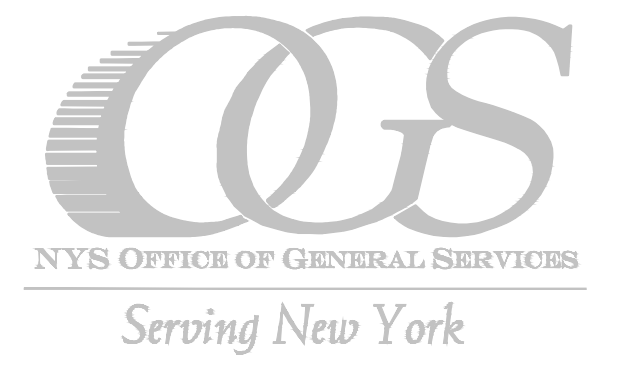
1 FOUNDATION WALL CORNER DETAIL
S-101 SCALE: 3/4" = 1'-0"



2 COLUMN BASE PLATE DETAIL
S-101 SCALE: 3" = 1'-0"



5 TYPICAL COLUMN BASE PLATE ELEVATION DETAIL
S-101 SCALE: 1 1/2" = 1'-0"

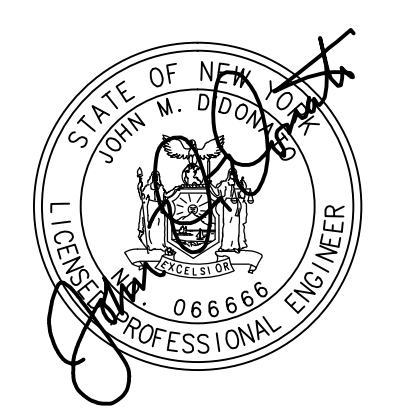


ANDREW M. CUOMO
Governor
ROANN M. DESTITO
Commissioner

CONSULTANT

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CONSTRUCTION

TITLE:
REPLACE HVAC SYSTEMS
BUILDINGS 29 AND 66

LOCATION:
INDUSTRY LIMITED SECURE CENTER
375 RUSH-SCOTTVILLE ROAD
RUSH, NEW YORK 14543

CLIENT:
OFFICE OF CHILDREN AND
FAMILY SERVICES

MARK	DATE	DESCRIPTION
1	2/13/2015	ADDENDUM 1
	1/16/2015	BID DOCUMENTS
	1/9/2015	100% SUBMISSION
	11/14/2014	60% SUBMISSION

PARTIAL FOUNDATION PLAN AND SECTIONS

DRAWING NUMBER:
S-101