
EXPANSION & RENOVATE AS NEW – PHASE 1

**CRYSTAL LAKE ELEMENTARY SCHOOL
284 SANDY BEACH ROAD
ELLINGTON, CT 06029
STATE PROJECT NO. 048-0058 EA/RR/PS**

S/P+A PROJECT NO. 12.140

DATE: January 17, 2014

The following changes to the Drawings and Project Specifications shall become a part of the Drawings and Project Specifications; superseding previously issued Drawings and Project Specifications to the extent modified by Addendum No. 8.

General Information/Clarifications:

- See attached RFIs. (7)

Changes to the Addenda:

- ADDENDUM #4, Changes to the Specifications:
 - Page 1, TABLE OF CONTENTS, Page 3, delete “095423” in its entirety.
 - Page 2, SECTION 095423, add to the end the following:

“A new SECTION 095423, LINEAR METAL CEILINGS has been added and is attached as part of this addendum. (7)
 - Page 4, SECTION 122413, ROLLER WINDOW SHADES:
 - Page 4, Article 2.2.E.1., delete revision.
 - Page 5, Article 2.3.E.1., delete revision.
 - Page 6, Article 2.4.B., revise to read as follows:

“B. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.

 1. Source: Roller-shade manufacturer.
 4. Orientation on Shadeband: Up the bolt.
 5. Style, Color, Openness, Roll Width and Composition: As indicated in Section 090000 “Schedule of Finishes”.”
 - Page 7, Article 3.2.A.1., delete revision.
- BID FORM has been deleted in its entirety. A new BID FORM has been added and is attached as part of this addendum. (3)

- ADDENDUM #5, SECTION 096623, RESINOUS MATRIX TERRAZZO FLOORING:
 - Page 3:
 - Article 2.2.A.2., revise “Match existing” to read “3/8 inch”.
 - Article 2.2.A.3., revise “Match existing” to read “As indicated on Floor Pattern Plan”.
 - Page 4:
 - Article 2.2.B., add the following:
 - “1. Flexible Reinforcing Membrane: Manufacturer's resinous membrane for substrate-crack preparation and reflective-crack reduction.
 - a. Reinforcement: Fiberglass scrim.”
 - Article 2.3.A., revise “¼ inch deep” to read “in thickness to match terrazzo”.
 - Article 2.3.A.1., delete “as a minimum but to match existing” in its entirety.
 - Article 2.3.A.2., revise “Match existing” to read “1/8 inch”.
 - Page 6:
 - Article 3.3.G., delete “in shop drawings” in its entirety.
 - Article 3.3, add the following:
 - “H. Flexible Reinforcing Membrane:
 - 1. Prepare and prefill substrate cracks with membrane material.
 - 2. Install membrane at substrate cracks in areas to receive terrazzo.
 - 3. Reinforce membrane with fiberglass scrim.
 - 4. Prepare membrane according to manufacturer's written instructions before applying substrate primer.”
- ADDENDUM #7:
 - RFI #47, Item 1, revise response to read “Crank-Operator override is not required.”
 - SECTION 087100, DOOR HARDWARE, Page 8, Article 2.4.D.2., add the following:
 - “a. Provide indicator rose with all classroom security locksets.”

Changes to the Specifications:

- TABLE OF CONTENTS, Page 5, Division 23 – Heating, Ventilating and Air Conditioning, Section 230900, Automatic Temperature Control, Pages, revise “43” to read “34”.
- SECTION 012300, ALTERNATES, Page 2, Article 3.1.D., add to the end the following:
 - ““Corridors” also refers to associated ramps as well as Vestibules B11, B132, C121 and C146.”

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- SECTION 028433, PCB REMEDIATION, Page 2, Article 1.2.1., 2nd “NOTES”, first bullet, revise to read as follows:

“Remove PCB contaminated porous paint from the metal window frames and clean thoroughly. The Town’s environmental consultant will perform wipe tests for cleanness. Metal frames to remain. Only the glass and window glazing putty shall be removed and disposed of as CT State Regulated Waste (CRW - CR01).”

- SECTION 042000, UNIT MASONRY, Page 6, Article 2.4.C.8., add the following:
 - “a. Brick of the new addition is to match that of the 1977 Addition (Area ‘B’).
 - b. All brick patching at PCB removal locations shall be toothed in using new, matching PCB free brick salvaged from other demolished locations of the existing building. Refer to Hazardous Material Abatement drawings, demolition plans and exterior elevations.”

- SECTION 077200, ROOF ACCESSORIES:

- Page 1, Article 1.2.A., add the following:

“4. Roof hatch accessories.”

- Page 3, Article 2.1, add the following:

“B. Galvanized-Steel Tube: ASTM A 500, round tube, hot-dip galvanized according to ASTM A 123.”

- Page 4, Part 2, add the following:

“2.6 ROOF HATCH ACCESSORIES

L. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches above finished roof deck.
3. Material: Hot-dip galvanized steel tube.
4. Post: 1-5/8-inch-diameter pipe.
5. Finish: Manufacturer's standard baked enamel or powder coat.

a. Color: As selected by Architect and Owner from manufacturer's full range.”

- Page 5:

- Article 3.2, add the following:

“E. Roof-Hatch Accessories Installation:

1. Attach ladder-assist post according to manufacturer's written instructions.”
 - Article 3.3, add the following:
 - “D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.”
- SECTION 083113, ACCESS DOORS AND FRAMES:
 - Page 1, Article 1.2.B.1., delete in its entirety.
 - Page 3:
 - Article 2.3.A.1., revise “**Type FR Fire Rated**” to read “**Type J-AL**”.
 - Article 2.3.D., revise “to read as follows:
 - “Watertight Aluminum Floor Door: Single-leaf opening. Extruded-aluminum gutter frame with NPS 1-1/2 drainage coupling and ¼-inch-thick, diamond-pattern, aluminum tread plate door; watertight; loading capacity to support 300-lbf/sq. ft. pedestrian live load.”
 - Page 4, Articles 2.3.F. and .G., delete in their entirety.
- SECTION 090000, SCHEDULE OF FINISHES, Page 13, Window Treatments, RS-1, revise to read as follows:

“Item:	Roller Shade
Manf:	SWFContract Shading Systems
Style:	Avila Twilight
Color:	Khaki A0015
Openness:	0%
Standard Widths:	110
Composition:	100% Polyester/Acrylic Foamed Backing/PVC Free
Note:	Apply all fascia + associated trim
Location:	<u>Motorized:</u> Media Reading C141, Window Types CW C2C, C12 and C12.1 <u>Manual:</u> All other exterior windows plus all interior doors with glazing, all interior sidelites and all interior borrowed lites <u>Exceptions:</u> Storage A105, Toilet A109 & A112, Corridor A120, Kiln A128, Storage B131, Vestibule C146 and Window Frame Type ‘S’.
Local Rep:	Ashley Brown (1-800-544-3587 ext 2585)”
- SECTION 122413, ROLLER WINDOW SHADES, Page 5, Article 2.3.A.4., delete in its entirety.
- SECTION 230900, AUTOMATIC TEMPERATURE CONTROLS has been deleted in its entirety. A new SECTION 230900, AUTOMATIC TEMPERATURE CONTROLS has been added and is attached as part of this addendum. (34)

New Drawings:

- DRAWING CSK-004, CONDUITS FOR FUTURE USE has been added and is attached as part of this addendum. This sketch revises information on Drawing C-500.~
- DRAWING SKA11, JAMB DETAIL AREA 'C' has been added and is attached as part of this addendum. This detail revises Detail 12/A601.
- DRAWING SKA12, SIGNAGE DETAIL has been added and is attached as part of this addendum. This detail revises information on Drawing A300.
- DRAWING SKA13, PARTIAL KITCHEN PLAN, 6" CMU PARTITION has been added and is attached as part of this addendum. This detail revises information on Drawing A102.
- DRAWING SKA14, GYM STORAGE ELEVATION has been added and is attached as part of this addendum. This sketch adds information to Drawing A728.
- DRAWING SKA15, REVISED COMPUTER COUNTER DETAIL has been added and is attached as part of this addendum. This sketch revises Detail 4/A803.~
- DRAWING SKA16, REVISED COMPUTER COUNTER ELEVATION has been added and is attached as part of this addendum. This sketch revises Elevation 6/A724.~
- DRAWING SKA17, SECTION DETAIL has been added and is attached as part of this addendum. This sketch adds information to Drawing A400.~
- DRAWING SKA18, ROOF DETAIL has been added and is attached as part of this addendum. This sketch adds information to Drawing A640.
- DRAWING SKP3, ADD EXTERIOR WALL HYDRANTS – AREA 'A' has been added and is attached as part of this addendum. This sketch revises information on Drawing P101.~
- DRAWING SKP4, ADD EXTERIOR WALL HYDRANTS – AREA 'C' has been added and is attached as part of this addendum. This sketch revises information on Drawing P103.~
- DRAWING SKP5, ADD EXTERIOR WALL HYDRANT – AREA 'B' – KITCHEN has been added and is attached as part of this addendum. This sketch revises information on Drawing P401.~
- DRAWING SKP6, ADD EXTERIOR WALL HYDRANT – AREA 'A' – SCIENCE STORAGE A125 has been added and is attached as part of this addendum. This sketch revises information on Drawing P401.
- DRAWING SKP7, ADD EXTERIOR WALL HYDRANT – AREA 'C' – ADMIN. has been added and is attached as part of this addendum. This sketch revises information on Drawing P402.~
- DRAWING SKE1, PENDANT LTS HEIGHTS has been added and is attached as part of this addendum. This revises information on Drawing E300.

Changes to the Drawings:

- DRAWING A006, 1ST FLOOR DEMOLITION PLAN AREA 'A', Demolition Note 3, revise to read as follows:

"Remove ceiling system consisting of, but not limited to, suspended ACT and/or gypsum board. Remove all secondary ceiling tiles, gypsum board and plaster ceilings hidden above existing ceiling back to deck. Remove all ceiling metal framing, support grids and associated hardware. Remove all existing insulation above ceilings. See also Abatement and M/E/P Drawings."
- DRAWING A007, 1ST FLOOR DEMOLITION PLAN AREA 'B' & 'C', Demolition Note 3, revise to read as follows:

"Remove ceiling system consisting of, but not limited to, suspended ACT and/or gypsum board. Remove all secondary ceiling tiles, gypsum board and plaster ceilings hidden above existing ceiling back to deck. Remove all ceiling metal framing, support grids and associated hardware. Remove all existing insulation above ceilings. See also Abatement and M/E/P Drawings."
- DRAWING A103, FIRST FLOOR PLAN AREA 'C', Construction Notes, Area 'C', Note 8, delete "hatch" in its entirety and revise "6/A722" to read "H/A162".
- DRAWING A131, ROOF PLAN AREA 'A', Roof Plan – Area 'A' 1, add Detail Tag "D/A552" to the south edge of Roof "A3", east of expansion joint.
- DRAWING A132, ROOF PLAN AREA 'B', Roof Plan – Area 'B' 1:
 - Symbol Legend, add "R.H. – Existing Roof Hatch, scrape, sand, prime and paint".
 - Construction Notes, add the following:

"At the east-west meeting of Roofs 'B1' and 'B2', provide smooth overlap transition of 'B1' tapered insulation over 'B2' rigid insulation."
 - Add Detail Tag "S/A640 (SKA18)" at north-south meeting of Roofs 'B1' and 'B2'.
- DRAWING A231, FIRST FLOOR PATTERN PLAN AREA 'B', Vestibules B111 and B132, revise Keynote symbol "3" to read "13".
- DRAWING A400, BUILDING SECTIONS, Building Section A, revise Detail Tag "1/A503" to read "1/A400 (SKA17)".
- DRAWING A622, WINDOW ELEVATIONS, Window Elevations 1:
 - Types CW C5, C6 and C13, revise detail tag "U/A630" to read "1/A913 AL-1".
 - Types CW C8, C9 and C9.1 revise detail tag "V/A630" to read "14/A601" and detail tag "T/A630" to read "C/A510".
 - Type CW C10, revise detail tag "W/A630" to "14/A601" and detail tag "X/A630" to read "12/A601" (which is SKA11).

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- DRAWING A724, CASEWORK ELEVATIONS, Computer Counter – South 6, delete note that read “Ptd Gyp Board” in its entirety.
 - DRAWING A728, INTERIOR ELEVATIONS, Gym – East 3, add note pointing to roof deck to read “Ptd Decking (P-1)”.
 - DRAWING A930, FINISH SCHEDULE:
 - General Notes, Note 12, delete in its entirety.
 - Room Finish Schedule – First Floor Area ‘A’, Storage A104 and A105, Floor:
 - Flr. Fin., revise “SCONC” to read “LSF-1”.
 - Base, add “RB-1”.
 - Room Finish Schedule – First Floor Area ‘B’, Vestibule B100, Floor, Flr. Fin., revise “LSF-1,2,4” to read “WOM-1”.

- DRAWING HAZ002, 1ST FLOOR & BASEMENT HAZARDOUS MATERIAL ABATEMENT, General Notes, PCBS Note 1, revise “Metal windows with State Regulated PCB-containing glazing shall be removed and disposed of as CT Regulated Waste (CRW-CR01)” to read as follows:

“Remove PCB-contaminated porous paint from the metal window frames and clean thoroughly. The Town’s environmental consultant will perform wipe tests for cleanness. Metal frames to remain. Only the glass and window glazing putty shall be removed and disposed of as CT State Regulated Waste (CRW-CR01).”

- DRAWINGS PD101, 1ST FLOOR PLUMBING DEMO PLAN, AREA ‘A’ and DRAWING PD102, 1ST FLOOR PLUMBING DEMO PLAN, AREA ‘B’, Numbered Demolition Notes:

- 2nd Paragraph, revise to read as follows:

“Existing underslab sanitary/waste and storm piping shown to remain per the contract drawings may remain only if TV scoping reveals that the underslab pipe is viable and does not require replacement, as judged by the project engineer. If any such piping is judged not viable by the engineer, it shall be replaced. The plumbing contractor shall, as part of his work scope, obtain and pay for the services of an independent CT-licensed company which specializes in the camera inspection of pipe interiors. The independent inspecting company shall inspect by camera all existing underslab sanitary/waste and storm piping, 2 inch and larger, intended to remain per the contract documents, and create audiovisual recordings of all such inspections. The independent inspection company shall submit an inspection report in DVD format, consisting of audiovisual recordings which include simultaneous field commentary clearly indicating camera location, pipe size and invert, and viability observations. The independent inspection company shall also provide as-built documentation, using the plumbing demolition drawings as a base, of any significant differences or additions in the verified underslab systems from the plumbing demolition drawings, and shall indicate the location/extents of test segments as recorded in the DVD report. The inspecting contractor’s report shall be submitted through standard project submittal procedures to the Engineer. The Engineer shall review and indicate which portions of the underslab sanitary/waste piping require replacement per unit pricing listed on bid form. Refer to Section 012200 “Unit Prices” and to Bid Form.”

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- Note 27, revise to read as follows:

“Non-Freeze wall hydrant – disconnect and remove”

- DRAWING PD103, BASEMENT/TUNNEL PLUMBING DEMO PLAN, add the following:

“Existing underslab sanitary/waste and storm piping shown to remain per the contract drawings may remain only if TV scoping reveals that the underslab pipe is viable and does not require replacement, as judged by the project engineer. If any such piping is judged not viable by the engineer, it shall be replaced. The plumbing contractor shall, as part of his work scope, obtain and pay for the services of an independent CT-licensed company which specializes in the camera inspection of pipe interiors. The independent inspecting company shall inspect by camera all existing underslab sanitary/waste and storm piping, 2 inch and larger, intended to remain per the contract documents, and create audiovisual recordings of all such inspections. The independent inspection company shall submit an inspection report in DVD format, consisting of audiovisual recordings which include simultaneous field commentary clearly indicating camera location, pipe size and invert, and viability observations. The independent inspection company shall also provide as-built documentation, using the plumbing demolition drawings as a base, of any significant differences or additions in the verified underslab systems from the plumbing demolition drawings, and shall indicate the location/extents of test segments as recorded in the DVD report. The inspecting contractor’s report shall be submitted through standard project submittal procedures to the Engineer. The Engineer shall review and indicate which portions of the underslab sanitary/waste piping require replacement per unit pricing listed on bid form. Refer to Section 012200 “Unit Prices” and to Bid Form.”

The bid date remains Wednesday, January 22, 2014 at 11:00am by this addendum.

The addendum consists of fifty-nine (59) pages of 8½” x 11” text, seven (7) 8½” x 11” drawings and eight (8) 11” x 17” drawings~.

End of Addendum #8

From: Rebecca Bouchard
Sent: Thursday, January 16, 2014 11:21 AM
To: abarszcz@rizzocorporation.com
Subject: RE: crystal lake elementary school, rfi

Andrew,

A revised linear metal ceilings section will be included as part of Addendum #8 as this is located at the existing and new main entrance canopies.

There are no acoustical metal panel ceilings in the project. Refer to RFI #33 of Addendum #4.

Thank you and have a great day.

Rebecca Bouchard, CSI, CDT
Intern Architect

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From: Andrew Barszcz [<mailto:abarszcz@rizzocorporation.com>]
Sent: Friday, January 10, 2014 10:39 AM
To: David Stein
Subject: crystal lake elementary school, rfi

The linear metal ceilings and acoustical metal pan ceilings specification sections have been deleted as per one of the addenda, yet I could not find info what materials goes in its place. Please advise.

Andrew Barszcz
Estimator
Rizzo Corporation
64 Triangle Street
Danbury, CT 06810
203-731-3132, ext 1808
203-748-8747-fax
<http://www.rizzocorporation.com>
AA/EOE Employer

From: Paul Jorgensen
Sent: Monday, January 13, 2014 1:57 PM
To: Rebecca Bouchard
Subject: Crystal Lake phasing clarification note

Please include in the next addendum:

At the 1/11/2014 pre bid walk thru a contractor asked: "When is the end wall (south wall) of the gymnasium to be removed?"
Response: Per drawing A004.2, Gymnasium renovations are to be done during the summer of 2015. And per General Phasing note #1, "...Contractor(s) shall provide detailed phasing schedules, staging diagrams and egress patterns as required by the local officials prior to starting work in each construction phase". Also note: If gymnasium work extends beyond summer 2015 and into September then the following note applies to the south end of the gym, "Provide 1 hr. rated temporary partition between construction zone and occupied areas of the building for the duration of the construction phase."

Thanks.

Paul Jorgensen, AIA
Associate/Project Architect

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January 15, 2014

Silver/Petrucci + Associates
 3190 Whitney Avenue
 Hamden, CT 06518
 Via email pjorgensen@silverpetrucci.com

Re: Crystal Lake Elementary School
 Ellington, CT
 RFI #4

Dear Paul:

Further review of the bid documents has raised additional questions. To avoid confusion, we have continued our questions in numerical order from our original RFI #2 dated 12/27/13.

DIVISION 1 – GENERAL

71. Drawing detail A/A400: Detail tag 1/A503 is mislabeled. Please provide corrected tag.
Response: Revise tag to read 1/A400 (SKA17 of forthcoming addendum).

DIVISION 3 – CONCRETE

72. Regarding 033200 Site CIP Concrete, 2.2, A.1.b: Please confirm the following is correct: Sidewalks, pedestrian and vehicle ramps, and curbing: Minimum compressive strength at 28 days shall be 4,500 psi minimum.
Response: 4,000 psi is acceptable.
73. Regarding 033200 Site CIP Concrete, 2.2, A5: Please confirm 'Natural White' is required for all Site Concrete. This requirement is not typical and very expensive.
Response: Concrete shall be standard grey.
74. Regarding 033200 Site CIP Concrete, 2.11: Please confirm which of the (3) options are required:
- a. Integral Concrete
 - b. Dry Colorants
 - c. Stains
- Response: The base concrete is integral colored concrete. Dry colorant or stains shall be used, per the manufacturer's recommendations, for stamping, texture, and joint coloring.**
75. Addendum #5, RFI #38, Item #6: Question: Is floor leveling required at new concrete slab floors? Newly placed floors will be within specified tolerance in spec 033100. Please clarify if new concrete floors require floor leveling underlayment.
Response: Floor leveling underlayment is not required at new concrete slab floors. FYI...should the specified tolerance level not be met as indicated in Section 033100 the floor will need to be removed and repoured.



DIVISION 6 – WOOD & PLASTICS

76. Room B119 – please provide elevations and detail for the assumed millwork/shelving.
Response: B119 is existing shelving to remain.
77. Room C144 – please provide elevations and detail for the assumed millwork/shelving.
Response: See Drawing 1/A805 for detail through millwork. See SKA14 Gym storage elevation included in forthcoming Addendum #8.

DIVISION 7 – THERMAL & MOISTURE PROTECTION

78. Drawing A900: Please confirm all existing top of wall partitions receive smoke seal where required by code drawing A003.
Response: Top of wall smoke seals not required, refer to partition types for all top of wall work. Corridor ceilings meet smoke barrier requirements.

DIVISION 9 – FINISHES

79. Addendum #5 Enfield Builders RFI #1 response to question 25 states “all interior gypsum board is abuse resistant.”
- Please clarify if ceiling soffit interior gypsum board is intended to be abuse resistant.
 - Please clarify if interior gypsum board concealed above ceilings is intended to be abuse resistant.
- Response: Correct. All interior gypsum board is abuse resistant.**
80. Detail 4/A803 - Please confirm steel post supports will be required at this half wall. Provide details for steel posts.
Response: Steel posts are not required, refer to sketch SK A16 Revised Computer Counter Elevation. 3/4” end panels are provided in addition to the counter support brackets. Elevation was revised to include a center support panel.
81. Detail 4/A803 notes impact resistant gypsum board. We find no spec for this. Is impact resistant gypsum board intended to be mostly concealed with painted plywood?
Response: Impact = abuse.
82. Detail 4/A803 North side – elevation 11/A724 noted painted gypsum for the upper portion of the half wall. Section 4/A803 notes painted gypsum plywood. Please clarify exposed material, plywood or gypsum.
Response: As indicated on Drawing 11/A724 North Elevation the lower portion of the wall will be painted plywood with cutouts and the upper portion of the wall should be painted impact resistant gypsum board. As indicated on Drawing 6/A724 South Elevation the lower portion of wall should be painted plywood and upper portion has a mix of two (2) tack board materials (See Schedule of Finishes for TB-3 and TB-2). Remove duplicate note from elevation “Ptd. Gyp. Board”. See revised detail 4/A803 on SKA15.
83. Spec 096623, Addendum #5: 2.2A.2: Please clarify the thickness. There is no existing Terrazzo. Standard thickness for Epoxy Terrazzo is either 1/4" or 3/8".
Response: Provide 3/8 inch thick epoxy terrazzo.



84. Spec 096623 does not mention a base. Room Finish Schedule calls for GB-1 base in corridors for base bid work. Therefore, please confirm a terrazzo base is not required for Alternate #4. Note at existing corridor walls we are leaving the existing base to remain.
Response: Confirmed. There is no terrazzo base required.
85. Spec 096623 2.2A.3: Please clarify pattern. Please provide pattern for the poured in place Terrazzo. The shop drawing stage is too late for us to establish an equitable price as previously stated in RFI #38, Items 28, 29.
Response: For pricing purposes assume the current floor pattern and up to (6) color options. Pattern is subject to change during shop drawing phase.
86. Please clarify divider strips. Typical Aluminum Divider Strips have a top width of 1/8" or 1/4" with a height to match thickness of Terrazzo.
Response: Provide 1/8 inch wide aluminum dividers.
87. Please clarify Terrazzo Aggregates. Specification calls for Marble Chips or "other aggregates". Marble Chips are typically about \$0.25/LB. Other Aggregates such as Glass and Mother of Pearl range from \$2.00 to \$4.00/LB while Silver Coated Glass is about \$15/LB. A 3/8" Terrazzo has about 3.3 LBS of aggregate per square foot so the type of aggregate plays a big part in pricing. Our suggestion would be include Marble Chips only at most areas but include maybe 20% standard glass or Mother of Pearl at various accent panels.
Response: In order to meet High Performance Building Standards for recycled content assume 50% glass aggregates and 50% marble chips for all color selections.
88. The specification should mention Crack Suppression Membrane. This Flexible Epoxy Membrane is reinforced with fiberglass scrim and either installed over cracks in the slab, typically figured as 10% of area, or over 100% of the substrate. Will it be required?
Response: Yes. For pricing, assume it will be required over 50% of the total area.
89. Spec 096543, 3.4, Type of Seaming: Is linoleum required to be a chemical or a heat welded seam type installation?
Response: No seaming is required. Manufacturer does not require it however a certified installer is required per Article 1.7.
90. Drawing A930, General Note 12 is located on Finish Schedule at 16 locations. However we do not see any wood flooring in these areas. Please confirm this note to be deleted.
Response: Confirmed.
91. Spec 099600 High Performance Coatings: We cannot locate on the drawings or Finish Schedule where this is required. Spec 099123 specifies the latex systems for both CMU and gypsum board while 099600 uses modified systems. Please clarify 099600 areas to be painted.
Response: Section 099600 is to be provided on walls and ceilings (except ACT) in all Toilets and Locker Rooms. Refer to Drawing A930 and Section 090000 for colors.
92. Spec 096466, 2.2B: If Alternate #2 is accepted, the overall height of the floor system would be 1-3/8". However, the existing slab is 3/16" +/- thick lower than the existing gym floor finish and there is not enough depth to fit the wood floor system. Door frame #'s B115C, B121C, B122A and B113A call for them to remain. Will these have to be raised up plus any special thresholds or ramping required?



Response: Existing frames are to remain, door size (undercut) at all affected gym locations shall be adjusted to coordinate with floor thickness. Ramping is required at all doors, to be provided according to manufacturer's details.

93. Room B113: Confirm paint of exposed MEPs, steel and the corrugated metal deck will be all one color.

Response: Refer to Drawing 3/A728. MEP ductwork calls for P-9 and steel calls for P-3. Add notation "PTD DECKING (P-1) to drawing 3/A728. Refer to finish schedule for paint designations.

94. Drawing A930, Room A104: Floor is scheduled to receive sealer however A230 says LSF. Please clarify.

Response: Revise A930 finish schedule to include LSF-1 and RB-1 in rooms A104 and A105.

95. Drawing A930, Room B100: Floor is scheduled to receive LSF however A231 says WOM-1. Please clarify.

Response: Revise A930 finish schedule to read WOM-1 in lieu of LSF.

DIVISION 12 – FURNISHINGS

96. Spec 122413- Roller Window Shades

- a. Motorized shades in Media. Our subcontractor/supplier insists that per SWF, shades are too high to provide crank operated override and in addition is not available by SWF and was discontinued by another. It is not recommended by MechoShade (only extremely high heavy duty motors, which we do not have here) and would be very expensive and unnecessary. Also, please confirm these are in a 3% open fabric. Confirm side and sill angles are still needed.

Response: Crank-operated override is not required. All fabric to be blackout material. Refer to forthcoming Addendum #8.

- b. Manual Shades: Confirm Interior 'borrowed lites' are not included i.e. Types G, L, L1, P etc. per addendum #3 RFI #12.

Response: To clarify, manual shades are to be included at all interior borrowed lites, both new and existing, (on the room side, not corridor) except Type S.

- c. Manual Shades: Confirm that bathrooms, all storage rooms, corridors and vestibules do not receive shades.

Response: Confirmed.

- d. Confirm that door shades are clutch operated with headboxes (existing shades are spring roller with universal brackets).

Response: Confirmed.

- e. Confirm that interior doors and sidelites are the 3% open weave fabric. Note that these do not provide privacy.

Response: All fabric to be blackout material. Refer to forthcoming Addendum #8.

Please contact me with any questions concerning the above.

Sincerely,



Richard Walsh
Estimator

Cc File

SECTION 095423 - LINEAR METAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes strip, linear metal pans and suspension systems for ceilings.

1.3 COORDINATION

- A. Coordinate layout and installation of linear metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. HPBS Submittals:
 - 1. Product Data for Section 16a-38k-6(d)(9): For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. Samples for Initial Selection: For components with factory-applied color and other decorative finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:
 - 1. Linear Metal Pan: Set of 12-inch-long Samples of each type and color and a 12-inch-long spliced section.
 - 2. Suspension System Members: 12-inch-long Sample of each type.
 - 3. Exposed Molding and Trim: Set of 12-inch-long Samples of each type, finish, and color.
 - 4. Filler Strips: Set of 12-inch-long Samples of each type, finish, and color.
 - 5. End Cap: Full size.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Linear pattern.
 - 2. Joint pattern.

3. Ceiling suspension members.
4. Method of attaching hangers to building structure.
5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
6. Ceiling perimeter and penetrations through ceiling; trim and moldings.
7. Minimum Drawing Scale: 1/8 inch = 1 foot.

B. Evaluation Reports: For linear metal ceiling and components.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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

1. Linear Metal Ceiling Components: Quantity of each pan, carrier, accessory, and exposed molding and trim equal to two percent (2%) of quantity installed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver linear metal pans, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Handle linear metal pans, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

1.9 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Exterior linear metal ceilings shall withstand exterior exposure and the effects of gravity loads and the following loads and stresses without showing permanent deformation of ceiling system components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of ceiling pans; or permanent damage to fasteners and anchors:

1. Wind Load: Uniform pressure as indicated on Drawings, acting inward or outward.
2. Seismic Criteria: Provide linear metal ceilings designed and installed to withstand the effects of earthquake motions according to the following:

- a. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580/E 580M.
 - b. ASCE/SEI 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
- 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.
- C. Recycled Content of Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than seventy percent (70%).
- D. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

2.2 LINEAR METAL CEILING PANS

- A. Acoustical Metal Pan Standard: Provide manufacturer's standard linear metal pans of configuration indicated that comply with ASTM E 1264 classifications as designated by types, acoustical ratings, and light reflectances unless otherwise indicated.
- 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15¾ inches away from test surface per ASTM E 795.
- B. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.
- 1. Aluminum Sheet: Roll-formed aluminum sheet, complying with ASTM B 209; alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated to snap on and be securely retained on carriers without separate fasteners, and finished to comply with requirements indicated.
- D. Pan Splices: Construction same as pans, in lengths 8 to 12 inches; with manufacturer's standard finish.
- E. End Caps: Metal matching pans; fabricated to fit and conceal exposed ends of pans.
- F. Filler Strips: Metal matching pans; fabricated to uninterruptedly close voids between pans.
- G. Moldings and Trim: Provide manufacturer's standard moldings and trim for exposed members, and as indicated or required, for edges and penetrations of ceiling, around fixtures, at changes in ceiling height, and for other conditions; of same metal and finish as linear metal ceiling pans.

2.3 METAL SUSPENSION SYSTEMS

- A. Metal Suspension Systems Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Suspension Systems: Provide systems complete with carriers, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, fixture adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.
- C. Attachment Devices: Size for five (5) times the design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
- D. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C 635, Table 1, Direct Hung is less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.
- E. Carriers: Factory finished with matte-black baked finish.
 - 1. Main Carriers: Aluminum, not less than 0.040-inch rolled sheet, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, complying with ASTM B 209.
 - 2. Expansion Carriers: Manufacturer's standard carriers allowing for irregularities or other unusual space conditions.
- F. Carrier Splices: Same metal, profile, and finish as for carriers.
- G. Stabilizer Channels, Tees, and Bars: Manufacturer's standard components for stabilizing main carriers at regular intervals and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated; and factory finished with matte-black baked finish.
- H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- I. Exterior Bracing: Cold-rolled steel channels and angles, hot-dip galvanized to comply with ASTM A 653, G60 coating designation; size and profile as required to withstand wind load.
- J. Hold-Down Clips: Manufacturer's standard hold-down clips spaced as standard with manufacturer.
- K. Edge Moldings and Trim: Provide exposed members as indicated or required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of penetrations through ceiling, to conceal ends of pans and carriers, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching linear metal pans or extruded plastic unless otherwise indicated.

1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.

2.4 ALUMINUM PANS AND SUSPENSION SYSTEM FOR LINEAR METAL CEILING

A. Aluminum Pans and Suspension System:

1. Basis-of-Design Product:
 - a. ATAS International, Inc.; **Linear Metal Ceilings LCB**
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Chicago Metallic Corporation
 - b. Simplex Ceilings; Armstrong World Industries, Inc.
 - c. USG Interiors, Inc.
 - d. Substitutions: Under provisions of Section 012500 "Substitution Procedures".

B. Classification: Units complying with ASTM E 1264 for Type XX, other types described as unperforated aluminum strips.

C. Pan Thickness: Not less than 0.032 inch.

D. Pan Edge Detail: Square (Box).

E. Pan Face Width: 3-3/8-inch and 7-5/8-inch face width.

F. Pan Depth: 5/8 inch deep.

G. Pan Face Finish: High-performance organic coating in color selected by Architect and Owner from manufacturer's full range.

H. End Cap, Finish of Exposed Portions: To match pan.

I. Filler Strip Design: Recessed.

J. Filler Strip, Finish of Exposed Portions: Black.

K. Suspension-System Main-Carrier Material: Aluminum.

2.5 ACCESSORIES

- A. Access Panels: For access at locations indicated, provide door hinge assembly, retainer clip, and retainer bar, assembled with ceiling panels and carrier sections into access doors of required size, permitting upward or downward opening.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than seventy percent (70%) PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which linear metal ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of linear metal ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Comply with ASTM C 636 and seismic requirement indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three (3) tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
 5. When framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

6. Do not attach hangers to roof deck. Attach hangers to structural members.
 7. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 8. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Install edge moldings and trim of type indicated at perimeter of linear metal ceiling area and where necessary to conceal edges and ends of linear metal pans.
1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system carriers so they are aligned and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Cut linear metal pans for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.
- F. Install linear metal pans in coordination with suspension system and exposed moldings and trim.
1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.
 3. Install pans with butt joints using internal pan splices and in the following joint configuration:
 - a. Random.
 4. Where metal pan ends are visible, install end caps unless trim is indicated.
 5. Install filler strips where required.
 6. Install hold-down clips where required.

3.4 CLEANING

- A. Clean exposed surfaces of linear metal ceilings, including trim and edge moldings after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION 095423

(To be submitted in triplicate)

BIDDER: _____
Name

Address

To: **The Finance Officer of the Town of Ellington, CT
55 Main Street
Ellington, CT 06029**

Project: **Crystal Lake Elementary School Expansion & Renovate As New
Phase 1 of 3
284 Sandy Beach Road
Ellington, Connecticut 06029
State Project No. 048-0058 EA/RR/PS**

In preparing this bid, we have carefully examined the Bidding Documents for this Project. We have visited the site and noted the conditions affecting the Work.

The Bidding Documents referred to include Drawings and Project Manual dated June 18, 2013 entitled Crystal Lake Elementary School Expansion & Renovate As New, Ellington, CT prepared by Silver/Petrucelli + Associates, Inc., Hamden, Connecticut.

We propose to perform the work described in the Bidding Documents, in keeping with definitions of Article 1 of the Instructions to Bidders, for the Base Bid Sum as follows:

Base Bid:

Entire Phase 1 Project for the Total Cost of:

\$ _____ Dollars (\$) .00).
written figure

We will commence work on the project _____ calendar days after receipt of "Notice to Proceed" or signing of Contract.

The undersigned acknowledges that he has examined the documents, visited and examined the site as required under "Instructions to Bidders", examined the availability of labor and materials and further agrees to comply with all the requirements as to the conditions of employment and wage rates set forth by the Department of Labor.

Bid Alternates:

The undersigned proposes to furnish all Labor, Materials, Equipment and Services necessary to construct the items listed in the Alternates described in Section 012300 for the stipulated sum of:

ADD ALTERNATE NO. 1: Cafeteria Air Conditioning:

Add to the Entire Project Base Bid a Total of: _____
_____ Dollars (\$) .00
written figure

ADD ALTERNATE NO. 2: Gymnasium B113 Flooring:

Add to the Entire Project Base Bid a Total of: _____
_____ Dollars (\$) .00
written figure

ALTERNATE NO. 3: Sanitary Pipe Tunneling:

Add to / Deduct from the Entire Project Base Bid a Total of: _____
_____ Dollars (\$) .00
written figure

ADD ALTERNATE NO. 4: Epoxy Terrazzo in Corridors Only:

Add to the Entire Project Base Bid a Total of: _____
_____ Dollars (\$) .00
written figure

Allowances: (Part of Base Bid – See Section 01019):

- Allowance No. 1: Tongue & Groove Wood Deck Replacement \$ _____
- Allowance No. 2: Metal Deck Replacement \$ _____
- Allowance No. 3: Brick Masonry Replacement \$ _____
- Allowance No. 4: Existing Brick Façade Repointing \$ _____

Unit Prices:

As required by the Base Bid, should deteriorated or damaged materials be required to be removed as determined by the Architect or Owner, the cost to remove and replace the referenced material, (or credit for specified material not provided or installed) including all labor, material, equipment and related furnishings is as follows:

- 1. Metal roof deck, sized to match existing roof deck to be removed (including deteriorated roof deck removal, credit and add) \$ _____/sf
- 2. T&G wood roof deck, sized to match existing roof deck to be removed (including deteriorated roof deck removal, credit and add) \$ _____/sf
- 3. Add pressure treated wood blocking, as specified, cut to fit around roof structure and systems and installed \$ _____/bf
- 4. Deduct pressure treated wood blocking, as specified, cut to fit around roof structure and systems and installed \$ _____/bf

- 5. Brick removal, replacement, to match existing \$ _____/sf
- 6. Mortar repointing, removal, cleaning, to match existing \$ _____/lf
- 7. Contaminated soil greater than the 50 cy identified, removal and disposal \$ _____/cy
- 8. Clean fill greater than quantity identified, provision and installation \$ _____/cy
- 9. Cut concrete slab, excavate, replace under slab drainage pipe, backfill, and repair concrete slab flush with adjacent floor surface and suitable for finished floor installation:
 - a. 2 inch pipe, replaced \$ _____/lf
 - b. 3 inch pipe, replaced \$ _____/lf
 - c. 4 inch pipe, replaced \$ _____/lf
 - d. 6 inch pipe, replaced \$ _____/lf

Addenda:

The undersigned acknowledges receipt of the following addenda to the Contract Documents, listed by number and date:

Number _____, Dated: _____	Number _____, Dated: _____
Number _____, Dated: _____	Number _____, Dated: _____
Number _____, Dated: _____	Number _____, Dated: _____
Number _____, Dated: _____	Number _____, Dated: _____

Exceptions: _____

ATTACHMENTS – Contractor is to attach the following:

- 1. Bid Bond
- 2. Contractor Prequalification Statement
- 3. Update Bid Statement

Date: _____

Signature: _____

Printed Name and Title
of Agent submitting bid: _____

Name of Company: _____

Address: _____

Telephone Number: _____ Fax Number: _____

E-mail: _____

This Bid may be withdrawn prior to the scheduled Bid Opening or any postponement thereof.

PART 1 - GENERAL

- 1.1 Description – This specification for a Building Automation System (BAS) as detailed herein shall be strictly enforced. Provide a Building Automation System (BAS) incorporating LonMark certified LONWORKS devices communicating over a Local Operating Network (LON) or BACnet Testing Laboratories (BTL) certified BACnet devices communicating over a Master-Slave Token Passing (MSTP) network at the field level and Niagara AX based network managers at the network level. The Niagara AX based network managers shall bridge the Lonworks and/or BACnet/MSTP field communications network to the owner’s Local and/or Wide Area Network, as designated by the owner, and shall communicate seamlessly with the other Niagara AX based devices on the owner’s city-wide BAS network. The BAS shall consist of Direct Digital Control (DDC) controllers, Building Controllers (BC), network management tools, programming tools, web browser based Graphical User Interface, sensors, relays, valves, actuators, and other equipment as may be necessary to provide for a complete and operational control system for the HVAC and other building related systems as described within these specifications.
- A. The system installed shall seamlessly connect devices other than HVAC throughout the building regardless of subsystem type, i.e. HVAC, lighting, and power systems devices should easily coexists on the same network channel without the need for gateways. LONWORKS or BACnet components not supplied by the primary manufacturer of the BAS shall be integrated to share common software for network communications, time scheduling, alarm handling, and history logging.
 - B. The documentation contained in this section and other contract documents pertaining to HVAC Controls is schematic in nature. The Contractor shall provide hardware and software necessary to implement the functions shown or as implied in the contract documents.
 - C. System configuration and monitoring shall be performed via a PC-type computer. Under no circumstances shall the PC be used as a control device for the network. It can be used for storage of data.
- 1.2 Open Systems Design - It is the owners expressed goal to implement an open Building Automaton System that will allow products from different manufacturers and/or suppliers to be integrated into a single unified system in order to provide flexibility for expansion, maintenance, and service of the system. The BAS provided shall maintain open interoperability in the following areas.
- A. Communications - Provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, LONWORKS technology, MODBUS, OPC, and other open communication protocols in one open, interoperable system. Where existing systems using proprietary protocols exist, a gateway or driver may be incorporated to provide for interoperability.
 - B. Network Management - Network management tools shall be based upon Niagara Framework technology as developed by the Tridium Corporation. All tools and hardware provided shall comply with the current release of the AX Niagara Framework platform.
 - C. User Access - The supplied system must incorporate the ability to access all data using standard Web browsers without requiring a proprietary operator/user interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access.

AUTOMATIC TEMPERATURE CONTROLS

- D. Databases - All controller program graphics and network databases shall be provided in a Niagara Framework AX format. The database shall be stored on the owner PC and provide on a separate CD upon final acceptance of the project. An updated database shall be provided on a CD at the end of the warranty period.
- E. Building Controllers (BC) - All BCs (devices that provide for communication between the field level controllers and the owner's wide and/or local area network, and manage facility global functions such as alarms, trends, schedules and normalization of data) shall conform to the current release of the Niagara AX Framework. All BCs shall be furnished with extended memory. No BC shall be provided with less than 128 MB of RAM. The number of BACnet or Lonworks nodes (controllers) attached to any Niagara AX based network manager shall not exceed the following limits:

COMBINED MEMORY	MAXIMUM NUMBER OF NODES
128 MB SDRAM/64 MB SERIAL FLASH	25
256 MB DDR RAM/128 MB SERIAL FLASH	50
1 GB DDR2 RAM/1 GB SERIAL FLASH	125

Regardless of the maximum number of nodes indicated above, it is ultimately the exclusive responsibility of the systems integrator/building controls contractor to ensure that the BC has adequate resources for the number of nodes (controllers) attached to it.

- F. Niagara AX Network Manager Server software shall be furnished and installed on a server grade PC for applications requiring two or more network managers.
- G. Direct Digital Controllers (DDC) - All DDC devices for HVAC and lighting control, with the exception of DDC device furnished as part of the OEM control package, shall be provided by one manufacturer and shall be certified to the current LONMARK and BTL standards appropriate to their application provided an appropriate LONMARK or BTL Certification standard exist. All points within a controller including hard I/O and software based points shall be available for viewing, management, and manipulation through the Niagara Framework tools.
- H. Product Access – All products provided shall be available for sell directly to the owner or is designated agent from multiple sources without restrictions on territory. A list of at least 3 purchasing sources shall be provided as part of the BAS submittals.
- I. Software Tools - All software tools needed for full functional use, including programming of BCs and DDC, network management and expansion, and graphical user interface development, of the BAS described within these specifications, shall be provided to the owner or his designated agent. Any licensing required by the manufacturer now and into the future, including changes to the licensee of the software tools and the addition of hardware corresponding to the licenses, to allow for a complete and operational system for both normal day to day operation and servicing shall be provided. Any such changes to the designated license holders shall be made by the manufacturer upon written request by the owner or his agent. Any cost associated with the license changes shall be identified within the BAS submittals.
- J. Programming Tools - Provide freely available Niagara AX Wizards to facilitate the programming and configuration of all of the DDC devices that are provided for the HVAC and lighting control. Wizards shall be provided free of charge and be compatible with the current published versions of the network management tool that is provided as part of this project. The wizard software shall be

available for public access from the manufacturer’s web site. These wizard programming tools shall be compatible with at least 3 other brands of the Niagara Framework network management tools. The SI shall demonstrate as part of their prequalification as to how they intend to comply with these requirements.

- K. Software License Agreement - The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights as it relates to disclosure of trade secrets contained within said software. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code, databases and documentation for all configuration and programming that is generated for a given project and/or configured for use with the BC, BAS Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner.
- L. The System Integrator shall provide as part of the submittals a copy of the Niagara Compatibility Statement (NiCS) verifying that all aspect of the Niagara Framework as provided maintain an Open System Design. The System as provided shall confirm with the following NiCS

Property	Value
STATION COMPATIBILITY IN	All
STATION COMPATIBILITY OUT	All
TOOL COMPATIBILITY IN	All
TOOL COMPATIBILITY OUT	All

- M. Training - Manufacturer provided training on the use and operation of all products provided within these specifications shall be available for purchase and attendance by the Owner or his designated agent. Such training shall be of the same curriculum as the training courses provided by the manufacturer to the System Integrator. A manufacturer advanced AX certified instructor shall give all training classes. A list of training courses and the associated cost shall be provided as part of the BAS submittals.

1.3 Quality Assurance

- A. General - The HVAC Control System shall be furnished, engineered, and installed by a licensed Controls Contractor or System Integrator (SI). All work provided under this section shall be provided by direct employees of the SI or under the direct supervision of the SI personnel.
- B. System Integrator Qualifications
 - 1. The SI must be regularly engaged in the service and installation of LONWORKS , BACnet, and Niagara AX based systems as specified herein, The SI shall have a minimum of 5 years experience in the sales, installation, engineering, programming servicing and commissioning of the Niagara^{AX} platform.
 - 2. The system integrator must be an authorized factory direct representative in good standing of the manufacturer of the proposed hardware and software components. Provide a letter dated within the last 6 months, from the manufacture certifying that the System Integrator is an authorized factory direct representative.
 - 3. The SI shall have an office within 75 miles of the Building site that is staffed with a minimum of three (3) technicians who have successfully completed the factory authorized training of the

proposed manufactures hardware and software components and have successfully completed a Niagara AX certification course. SI must provide proof of required training. The SI capabilities shall include engineering and design of control systems, programming, electrical installation of control systems, troubleshooting and service.

4. The SI shall submit a list of no less than five (5) similar projects, which have Building Automation Systems with the Niagara^{AX} Platform as specified herein installed by the SI. These projects must be on-line and functional such that the Owner's/User's representative can observe the system in full operation.

C. Hardware and Software Component Manufacturer Qualifications

1. The manufacturer of the hardware and software components must be primarily engaged in the manufacture of both LonWorks and BACnet based systems as specified herein, and must have been so for a minimum of three (3) years. The manufacturer shall demonstrate that they are the manufacturer of all DDC devices and Niagara AX products provided.
2. The manufacturer of the hardware and software components as well as its subsidiaries must be a member in good standing of the LONMARK Association, BACnet International, and the BACnet Manufacturers Association.
3. The manufacturer of the hardware and software components shall have a technical support group accessible via a toll free number that is staffed with qualified personnel, capable of providing instruction and technical support service for networked control systems.
4. Acceptable manufacturers of the hardware and software components as specified herein are as follows:
 - a. Distech Controls EC-Net^{AX}
 - b. Siemens - Talon
 - c. Honeywell – Webs Open License Version
 - d. Alerton-ASCENT
5. DDC Controls compliance checklist: The following items must be completed and will need to be approved by mechanical engineer prior to award of contract to mechanical contractor:

Proposed DDC Manufacturer & Product Name: _____

Proposed System Integrator Company Name _____

- a. System is NiagaraAX open platform.
- b. Provide documentation proving that system is capable of simultaneously communicating to equipment via BACnet, LonWorks and MODBUS as stated in specification 230900 section 1.2 paragraph A.
- c. Provide documentation that shows compliance with specification 230900 section 1.2 paragraph J.
- d. Provide documentation that shows compliance to open platform as stated in specification 230900 section 1.2 paragraph L.
- e. Provide documentation that shows minimum of 5 years of experience with NiagaraAX as stated in specification 230900 section 1.3 paragraph B.1.
- f. Provide letter as stated in specification 230900 section 1.3 paragraph B.2.
- g. Provide documentation that shows certification as stated in specification 230900 section 1.3 paragraph B.3.
- h. Provide documentation that shows previous NiagaraAX projects as stated in specification 230900 section 1.3 paragraph B.4.

1.4 Submittals

- A. General
1. Meet all applicable Submittal requirements of Division 1 and other divisions where applicable, including listed below and in the Submittal check list.
 2. Provide to the Engineer and Owner all information or data necessary to determine compliance with these specifications.
 3. Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, including specific requirements indicated.
 4. All Drawings and Diagrams shall be machine-drafted using AutoCAD 2000 or later, or Microsoft Visio. At project closeout, provide vellum plots and diskette or CD copy of control drawings and layout drawings to the Owner.
 5. Provide system device and LAN conduit routing drawing, using building plans for a background. All controllers, gateways, hubs, devices and communication cabling shall be accurately shown, except that individual sensor I/O wiring and devices need not be shown. Layout drawings shall be the same size as the Engineer's construction documents.
- B. Hardware - Include a complete list of materials of equipment to be used, including technical data, performance curves, project specification sheets and installation/ maintenance instructions.
- C. Control System Diagrams - Provide schematic diagrams for each controlled system. Illustrate the relationship between control system and controlled equipment. Show all control elements. Show all terminations and cable/tube numbers.
1. Provide equipment interface details using actual equipment termination information. Blank terminals or "field verify" is not acceptable.
 2. Provide individual diagrams for each mechanical system. If two systems are identical, then a single diagram may represent multiple mechanical systems. Notations like "this part here only applies to units xxx", etc. are not acceptable.
 3. The control diagrams and sequence of operation shall be together on the same sheet and shall be suitable for posting.
 4. The sequence of operation shall reference a schematic diagram of the controlled system. The sequence of operation shall describe in words the control strategies utilized, worded in such a way to serve as an informative reference to the maintenance and service personnel who will be responsible for unit operation.
 5. Each component and instrument on the control diagrams shall have a unique tag number such as temperature element "TE-1". The sequence of operation verbiage shall make specific reference to the individual component tag numbers, such as "Controller (C-1) compares the space temperature sensor (TE-1) to set point, and modulates hot water heating coil valve (V-1) as required". The mechanical system being controlled shall be schematically drawn and show the measurement and control points, such as "TE-1" and "V-1".
- D. Graphic Displays - Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
- E. Point List - Provide a point list for each system controller including both inputs and outputs (I/O) point, point number, the controlled device associated with the I/O point and the location of the I/O device. Use naming convention consistent with control diagrams and sequence of operation.
- F. Software manuals - Include software manuals that describe programming, testing, system overview. The manuals shall include a detailed description of each software feature including editing and writing control programs, reading or modifying printout and logs, adding, deleting and modifying user password, creating and modifying graphics. Software manuals may be

provided on CD ROM in lieu of paper copy. If submitted as a CD ROM, the vendor shall arrange to review the software manuals with the engineer at the engineer's office.

- G. Other Items Requiring Submittals
 - 1. Point to point and basic function commissioning forms to be used on site for the start, test and check of network components and systems.
 - 2. List of specific personnel who will be involved in the system installation and commissioning.
 - 3. Functional performance test documentation and procedures to be used in commissioning control sequences.
- H. Operation and Maintenance Manuals shall be submitted indicating the correct procedures and processes to operate and maintain the system. O&M's shall be delivered either hard copy or on a CD-ROM developed specifically for the project. Contractor shall submit (3) copies of the Operation and Maintenance Manuals.
- I. Parts List shall be submitted listing: manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair necessary to ensure continued operation with minimal delay.
- J. Submittal Check List - The following Submittal Check list is intended to provide the SI, Consulting Engineer and Owner with a working document upon which to verify compliance with the major portions of the specification that can more easily be verified through printed documentation. It in no way excludes the SI from compliance or for verification of compliance of any portion of this specification.
- 1.5 Training - Meet all applicable Training requirements of Division 1, Division 15, and the following.
 - A. Instruct the operators how to accomplish control of the system. Include basic troubleshooting and override of equipment and controls in the event of system failure.
 - B. Training Allowance: Provide not less than (24) hours formal training to the Owner's designated operations personnel.
 - C. Trainers - Persons conducting the training shall hold an advanced Niagara AX certification, be knowledgeable in the workings of the system, and shall be regularly engaged in training exercises, so as to provide effective training. Acceptability of the trainers shall be at the discretion of the Owner.
 - D. Training Manuals - Include the following in training manuals.
 - 1. Manufacturer's training brochures.
 - 2. Operation and maintenance manuals.
 - 3. Completed Field Acceptance Test Procedure.
 - 4. "As-installed" Drawings.
 - 5. Manufacturer's Operation Manuals.
 - 6. Software interaction sheets to be used in instructing students how to use the control system, on a command-by-command basis.
 - E. Training Classes - Prior to conducting training, prepare and submit for approval the proposed training literature and topics. Submit this information at least two weeks prior to the first class.
 - F. Provide approved training manuals to the Owner at least one week prior to the first class.
 - G. Provide Audio Visual Tutorials both in a CD format and on the manufactures website instructing on the operation of the programming software tools as provided under this specification.

1.6 Warranty

- A. The HVAC Control System shall be free from defects in workmanship and material under normal use and service. If within twelve (12) months from the date of substantial completion, the installed equipment is found to be defective in operation, workmanship or materials, the building systems contractor shall replace, repair or adjust the defect at no cost. Service shall be provided within 4 hours upon notice from Owner's designated Representative.
- B. The warranty shall extend to material that is supplied and installed by the Contractor. Material supplied but not installed by the Contractor shall be covered per the above to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation.
- C. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.

PART 2 – NETWORK ARCHITECTURES AND DEVICES

- 2.1 Networks – All Niagara AX based network managers supplied under this section shall bridge the Lonworks, BACnet or ModBus field bus to the owner's Local Area Network (LAN) and/or Wide Area Network (WAN) as designated by the owner. The network managers shall communicate at no less than 100 Megabits/sec over the Ethernet network and shall support BACnet over IP, Java, XML, HTTP, Fox and SOAP for maximum flexibility as it relates to the integration of building data with enterprise information systems. The system shall provide support for multiple network managers, Building Controllers (BC), user workstations and, if specified, a local server. The WAN and/or LAN will be provided by others. The SI shall coordinate with the General Contractor for the access to the WAN and/or LAN.
 - A. Network minimum physical and media access requirements:
 - 1. Ethernet; IEEE standard 802.3
 - 2. Cable; 100 Base-T, UTP-8 wire, category 5 Minimum throughput; 100 Mbps
 - B. Network Access - Remote Access - For Local Area Network installations; provide access to the WAN and/or LAN from a remote location, via the Internet. The Owner shall provide a connection to the Internet to enable access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). The Owner agrees to pay monthly access charges for connection and ISP.
- 2.2 Network - Field Level Controllers – The communication network between the field level controllers shall be Lonworks TP/FT 10 bus topology, BACnet MSTP, BACnet/IP, Modbus RS-485 or Modbus/IP. All wiring shall be provided in accordance with the standards for the appropriate protocol. The number of devices on any one network shall not exceed 90% of capacity.
- 2.3 Network Management Devices – These various devices will service multiple functions on the network depending on network design, communication medium and needed task. These functions can include: management of traffic on the network, reconfiguring and strengthening of signals, the conversion of protocols, normalizing of data, global management of alarms, trends and schedules, control logic, protocol conversion and web page hosting for use as a Graphical User Interface.

AUTOMATIC TEMPERATURE CONTROLS

- A. Building Controller (BC) – This Niagara Framework based device shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the BC.
 1. It shall be provided with these features
 - a) Web page hosting
 - b) Extended memory
 - c) Network management tools resident within the BC (optional)
 - d) Appropriate hardware and driver(s) associated with the protocol it manages
 - e) Din rail mounted power supply
 2. Provide multiple Building Controllers as necessary. In order to maintain peak performance of the network, limit the maximum consumed resources to 80 percent as indicated by the resource meter resident in the network management tools.
 3. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc. Manage alarms as defined in the points list.
 4. Provide timed (schedule) routing of alarms by class, object, group, or node.
 5. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control. Control equipment and network failures shall be treated as alarms and annunciated.
 6. Alarms shall be annunciated in any of the following manners as defined by the user:
 7. Screen message text
 8. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 9. Day of week
 10. Time of day
 11. Recipient
 12. Pagers via paging services that initiate a page on receipt of email message
 13. Graphic with flashing alarm object(s)
 14. Printed message, routed directly to a dedicated alarm printer
 15. The following shall be recorded by the BC for each alarm (at a minimum):
 16. Time and date
 17. Location (building, floor, zone, office number, etc.)

18. Equipment (air handler #, access way, etc.)
19. Acknowledge time, date, and user who issued acknowledgement.
20. Number of occurrences since last acknowledgement.
21. Alarm actions may be initiated by user defined programmable objects created for that purpose.
22. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
23. A log of all alarms shall be maintained by the BC and/or a server (if configured in the system) and shall be available for review by the user.
24. Provide a “query” feature to allow review of specific alarms by user defined parameters.
25. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
26. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.
27. Data Collection and Storage - The BC shall collect data for any property of any object and store this data as defined in the points list.
28. The data collection shall be performed by log objects, resident in the BC that shall have, at a minimum, the following configurable properties:
29. Designating the log as interval or deviation.
30. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
31. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
32. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
33. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
34. Audit Log - Provide and maintain an Audit Log that tracks all activities performed on the BC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the BC), to another BC on the network, or to a server. For each log entry, provide the following data:
35. Time and date
36. User ID

37. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
- B. LON to LON and Bacnet Routers and Repeaters – A router or repeater may be used on a LON segment between controllers and a BC as a means to manage traffic and reconfigure and strengthen a transmission signal. Routers shall be fully programmable and permit a systems integrator to define message traffic, destination, and other network management functions utilizing LONWORKS. A repeater or signal booster may only be used to increase the signal strength of the communications. Under no circumstances may it be used in the place of a router.
- C. Server Functions and Hardware – Provide a Personal Computer server along with the Niagara Framework Network management tools and server software, unlimited connectivity version. The server shall support all BCs connected to the customer’s network whether local or remote. It shall be possible to provide access to all BC via a single connection to the server. In this configuration, each BC can be accessed from a remote Graphical User Interface (GUI) or from a standard Web Browser Interface (WBI) by connecting to the server. The server shall provide the following functions, at a minimum:
1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
 2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any BC in the network, local or remote.
 3. The server shall include a master clock service for its subsystems and provide time synchronization for all BCs.
 4. The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.
 5. The server shall provide demand limiting that operates across all BCs. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
 6. Provide for browser based graphical home screen with links to each connected BC. See graphic section for additional details.
 7. The server shall provide central alarm management for all BC supported by the server. Alarm management shall include:
 - A Routing of alarms to display, printer, email and pagers
 - B View and acknowledge alarms
 - C Query alarm logs based on user-defined parameters
 8. The server shall provide central management of log data for all BCs supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
 - A Viewing and printing log data
 - B Exporting log data to other software applications
 - C Query log data based on user-defined parameters
- D. Server Hardware Requirements: The server hardware platform shall have the following requirements: NOTE: Update to Owner standards or latest industry standard performance levels for a PC server
1. The server shall have an 500-gigabyte minimum hard drive, a 64 bit dual-core processor with 2.66 minimum processing speed, and 8 GB of RAM. It shall include a DVD-ROM/CD-RW Combination Drive, 2-parallel ports, 2-asynchronous serial ports, 2 Ethernet ports, and 2-USB ports.
 2. The server operating system shall be provided with latest Microsoft Windows Operating Systems server based software that corresponds to the currently support version of the Niagara

Framework and browsers as well as the latest version of Symantec Antivirus Software including a 1 year upgrade subscription service to the Symantec software.

3. Connection to the FMCS network shall be via high a high speed Ethernet network interface card, minimum 100 Mbps.
4. A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 60-PPM print speed minimum.

PART 3- BUILDING AUTOMATION SYSTEM CONTROLLERS

- 3.1 All controllers shall be designed for easy installation and servicing including removable enclosures, removable terminals, and factory applied labels for all I/O. All internal points within the Programmable Controllers shall be fully supported by the Graphical User Interface (GUI), allowing the user to easily modify them and monitor them. All of the internal programming points (e.g. variables, constants, PID's, timers, inputs and outputs) shall be exposed to the network on dedicated network variable outputs. All controllers programs and schedules shall contain non-volatile flash memory. Upon a loss of power all controllers shall perform a self restart.
- 3.2 Programmable Controllers (PC) – a controller designed for more complex sequences of operations such as built up AHU, central plant operations, electrical monitoring, and control and management for chillers, boilers and generators. The PCs are to allow for the flexibility of custom control programming to meet the needed sequences of operation.
 - A. Performance – Each PC shall have a minimum of 64K of Non-volatile Flash memory for control applications and 128K non-volatile flash memory for storage with a minimum 32 bit processor. The PC shall have a minimum ambient operating temperature range of -0°C to 70°C or 32°F to 158°F.
 - B. Inputs – Analog inputs shall have the following minimum level of performance: 16-bit A to D resolution; allow monitoring of platinum 100 ohms, platinum 1000 ohm, nickel 1000 ohms, thermistor 10K type II, thermistor 10K type III, voltage input 0-10VDC, current input 4-20mA, digital input, pulsed input minimum 2 Hz.
 - C. Outputs – Outputs shall be either software configurable to be either analog or digital or dedicated digital only - Analog outputs shall be selectable as voltage of 0-10 VDC (linear) or 4-20mA or Digital outputs shall be 0-12 VDC (off/on), floating or PWM. Outputs shall have an adjustable range of 2 seconds to 15 minutes. Output Resolution shall be a minimum 10 bit digital / analog converter. All individual outputs and power supply shall be protected by an auto reset fuse. There shall be an LED status indicator on each of the outputs.
 - D. Programmable Controller Features
 1. Provide an onboard network communication jack
 2. The PC shall be provided with two on-board RJ45 Connections. One of the RJ45 connections shall serve as a single point connection for connecting a wireless receiver that will enable the PC to accept up to 12 wireless inputs utilizing the EnOcean communications protocol. The wireless receiver shall have an integrated antenna. The supplier/provider shall provide documentation verifying the strength and reliability of the wireless signal with the submittal package. The second RJ 45 connection shall serve as a single point connection for an integrated room sensor (IRS) with an LCD display. The sensor shall have a fully customizable LCD display. It shall measure occupancy, relative humidity, carbon dioxide and temperature in a single integrated device. Using separate devices for the sensing of occupancy, relative humidity, carbon dioxide and/or

- temperature is not acceptable. Up to 4 integrated room sensors shall reside on a single daisy-chained communication bus.
3. The LCU shall come standard with a color operator interface that provides real-time access to monitored inputs, setpoints, modes, values, statuses, and outputs.
 - A. The operator interface shall consist of :
 - B. An icon-based, interactive backlit color display.
 - C. A turn and select navigation jog dial to access, edit, and modify internal controller functions. The jog dial shall be used to navigate through menus, select options and icons, and change parameters. Scroll buttons (up, down, left and right) shall not be acceptable.
 - D. Navigable menus to display, select, edit, and modify values and other controller information.
 - E. List-based menus with a minimum of eight (8) lines of text.
 - F. Icon-based menus.
 - G. A display with the following minimum characteristics: a resolution of 400 W x 240 H pixels (WQVGA) with an effective viewing area of 2.4” L x 1.4” H (61.2mm x 36.7 mm), and 2.8” (71mm) diagonal viewing area.
 - H. The operator interface shall use color-codes with icons and text lists to indicate values and controller statuses.
 - I. The operator interface shall, at a minimum, have the following functions:
 - J. Points. The operator interface shall provide points list menus to view the inputs, setpoints, and output values such as hardware inputs/outputs, analog values, binary values, multistate values, Intelligent Space Sensor (ISS) inputs, and wireless inputs.
 - K. The points list menus shall allow the operator to monitor, set, and override controller points and values.
 - L. A color-code shall be used to indicate the conditions and statuses of points displayed in the points list menus.
 - M. Alarms. The operator interface shall provide a controller’s alarms menu to view details of an alarm, to acknowledge the alarm, and to view the alarm history.
 - N. The alarm menu shall allow the operator to view the following type of alarms: active not acknowledged, active acknowledged, and inactive not acknowledged.
 - O. The combination of an icon and its color state shall notify the operator of an alarm condition.
 - P. The operator shall be able to select a single point in alarm to view further details such as the alarm to/from status, current status, event date and time, alarm event threshold, and alarm event value.
 - Q. Overrides. The operator interface shall provide an overrides menu to view a list of the controller’s overridden points such as hardware input, hardware output, value, constant, or variable. The menu shall allow the operator to select an overridden point and to modify or release the override on the selected point.
 - R. PID loops. The operator interface shall provide a PID Loops menu to view, configure, and adjust the PID parameters. The interface shall also provide visual PID tuning with live system response graphing (live-trend).
 - S. The operator interface shall support Latin-based languages and allow the interface user to select from three (3) defined languages.
 - T. The operator interface shall allow personalization of a contact information screen with a minimum of eight (8) lines of user configurable text as well as the option to add a color graphic such as a company logo. The tool shall support, but not be limited to, image file formats such as GIF, PNG, JPG, etc.
 - U. Favorites. The operator interface shall allow access to a list of bookmarked points.
 - V. Weather. The operator interface shall provide a weather menu to view the current weather conditions with a weather status icon. The units shall be configured to be displayed in either metric or US units.

- W. Password protected. The controller operator interface shall provide multi-level password protection, with user-defined, alphanumeric, name/password combinations. The operator interface shall return to lock mode after a user-defined log-off delay. A password icon shall indicate the lock mode state.
- X. Settings. The operator interface shall provide a settings menu to view and configure date and time parameters such as the current time, time zone, and daylight savings time.
- 4. Enclosures – Provide for a plastic enclosure with a separate back plate with terminals such that the electronic portion of the controller can be easily removed for ease of installation and servicing.
- 3.3 Configurable Controllers (CC) - A controller designed through its I/O configuration and configurable control logic to be used for a specific type mechanical equipment. Typical applications are VAV boxes, Fan Coil Units, Roof Top Units, Unit Ventilators, Split DX Systems, Heat Pumps etc.
 - A. Performance: Inputs Provide software selectable universal inputs. Analog inputs - shall have the following minimum level of performance: 16 bit A to D resolution for all terminal box applications, 12 bit A to D resolution for all other configurable applications, manage thermistors with an accuracy of: $\pm 0.5^{\circ}\text{C}$; $\pm 0.9^{\circ}\text{F}$, and a Potentiometer. For VAV Applications provide a differential pressure input sensor built in to the controller with a 16 bit A to D resolution an adjustable range of 0" to 1" H₂O (0-248.8 Pa) static pressure with a minimum accuracy of $\pm 3\%$. Minimum response time shall be 0.5 seconds from input to output time.
 - B. Output – Analog outputs shall have the following minimum level of performance: Tri-mode Voltage of 0-10 VDC (linear), digital 0-12 VDC (off/on) or PWM. All analog outputs shall be equipped with an auto reset fuse. Output Resolution shall be a minimum 8 bits digital / analog converter. Digital outputs shall be provided with a minimum of a triac output rated at 24VAC and 1 amp. All analog outputs shall be fuse protected
 - C. CC Features:
 - 1. The CC except for the VAV shall be provided with an optimum start program internal to its control logic. The optimum start shall be activated by a event signal from its associated scheduler on the network.
 - 2. The CC shall be provided with two on-board RJ45 Connections. One of the RJ45 connections shall serve as a single point connection for connecting a wireless receiver that will enable the PC to accept up to 12 wireless inputs utilizing the EnOcean communications protocol. The wireless receiver shall have an integrated antenna. The supplier/provider shall provide documentation verifying the strength and reliability of the wireless signal with the submittal package. The second RJ 45 connection shall serve as a single point connection for an integrated room sensor (IRS) with an LCD display. The sensor shall have a fully customizable LCD display. It shall measure occupancy, relative humidity, carbon dioxide and temperature in a single integrated device. It shall be a fully functional device suitable for air balance as both a wall-mounted device and a handheld tool. Using separate devices for the sensing of occupancy, relative humidity, carbon dioxide and/or temperature is not acceptable. Up to 4 integrated room sensors shall reside on a single daisy-chained communication bus.
 - 3. The CC shall allow the use of its spare I/O as dumb I/O to be shared over the network to other controllers such as PC or the Building Controller (BC), where a sequence of operation can be applied to the I/O. Such applications shall include but not be limited to exhaust fan control, heaters, light control, etc.

4. Enclosures – Provide for all CC except for the VAV, a plastic enclosure with a separate back plate with terminals such that the electronic portion of the controller can be easily removed for ease of installation and servicing.
- D. VAV Specific functions. In addition to the features for the CC VAV controller shall provide the following functions
 1. The CC VAV shall be a single integrated package consisting of a microprocessor, power supply, damper actuator, differential pressure transducer, field terminations, and application software. An alternate model shall be offered that allows for direct connectivity to an external actuator for those applications that employ a non-butterfly style damper configuration. All input/output signals shall be directly hardwired to the CC VAV controller with the exception of wireless sensors. The internal actuator shall employ a manual override that allows for powered or non-powered adjustment of the damper position. In all cases, the controller shall automatically resume proper operation following the return of power to, or control by the CC VAV. Programming, configuring and/or troubleshooting of input/output signals shall be easily executed through the CC VAV sensor at the wall sensor location through the requisite LON connection.
 2. The CC VAV control algorithms shall be designed to limit the frequency of damper repositioning, to extend the life of the components. The CC VAV shall provide an internal differential pressure transducer. Flow-through transducers requiring filter maintenance are not acceptable. The CC VAV shall provide zone control accuracy equal to or better than +/- 1 degree Fahrenheit. The supplier/provider shall provide performance data that verifies control accuracy of the CC VAV with the documented in the submittal package.
 3. Accept platinum 1k ohm and thermistor 10k ohms type II sensors
 4. Provide for CO2 sensing and control from control logic within the CC VAV as per the sequence of operation
 5. Configuration of all I/O points shall be accomplished without physical hardware jumpers, switches or settings.
 6. The built in actuator shall be a brushless constant speed actuator with direct feed back of the actuator position
- E. CC VAV - Air Balancing
 1. Pre-calibration: Provide as part of the configuration wizard for the CC VAV an automatic calibration tool that will calibrate the box air balance position based upon the K factor of the box and the cross section of the input duct to the VAV box. The pre-calibration procedure shall be implemented for all boxes within 5 working days of delivery of conditioned air to the boxes.
 2. Certified Air Balance: The following Air Balancing tools shall be provided:
 - A LCD sensor calibration tool. Provide for a LCD based sensor that operates as a user interface for temperature adjustment, override and display of values along with the ability to perform Air Balance task. The LCD sensor shall provide for access to all of the VAV input and output variables to allow for complete Air balance task. Upon completion of Air Balance the application shall deliver a code that documents the air balance calibration for each individual VAV box. In addition the LCD sensor shall operate as a standalone Air Balance tool that communicates directly to the VAV through a wall mounted sensor with communication port to the VAV.
 - B The CC VAV shall utilize a Niagara Framework wizard to be used as a web browser based balancing tool. This tool shall allow the air balancer to manually control the action of the actuator (e.g. full open, full close, open slowly, close slowly, etc...). Automatic calibration as well as two-point calibration shall be available through this web page. The air balance sequence shall step the balancing supplier/provider through the checkout and calibration of the CC VAV. Upon completion of the balancing sequence, the flow values presented by the CC VAV shall match those observed by the balancing supplier/provider's measurement equipment. Additionally, upon completion of the air balance, the CC VAV shall automatically archive the balance settings for

- future use including a calibration code that documents the air balance calibration for each individual VAV box.
- C Systems not able to provide a web based air balance tool and a LCD Sensor based balancing tool as part of their the CC VAV shall provide an individual full time technician during the Air-balancing process to assure full balance compliance.
- 3.4 Special Purpose Configurable Controllers (SPCC) – A controller designed with unique functions and features particular to a specific type of mechanical equipment or applications that may be less common and/or standardized in its use and application.
- A. SPCC – Thermostat (SPCCT) – A self contained controller with a built-in user interface that is intended for installation in the occupied space of the building. The SPCCT shall have the following features:
1. The SPCCT shall be a microprocessor based controller with all of its control logic, sensors, inputs and outputs, network communication and user interface provided within a manufacture provided enclosure specific to the application. The enclosure shall be aesthetically appealing with a modern design that will fit in with the architecture of the building. A sample of the SPCCT shall be provided as part of the submittal process.
 2. The SPCCT shall be programmed through the user interface contained within the device, through the Niagara AX Wizard, and/or th LNS Plug-In.
 3. The User interface display shall be provided with 3 levels of password protection: Level 1 – Lockout with view only and time adjustment; Level 2 - schedule override and mode settings; Level 3 – full access to all parameters. The display shall be back lighted for easy viewing.
 4. The SPCCT shall utilize a PI (proportional and integral) control algorithm. Upon power failure, all programmed schedules and parameters must be retained in non volatile flash memory. Progressive temperature recovery shall be a standard feature. Two configurable digital/binary inputs will be available as well as two remote temperature sensor inputs for outdoor air and remote room/return air monitoring. Built-in frost protection, which can be disabled, will energize the heating as soon as the ambient temperature falls below 45°F (5°C). An auxiliary digital/binary output, which can be configured for normally open or normally closed operation, will also be available.
- B. Lighting Control (SPCC-LC) – A standalone microprocessor based control panel that contains line and or low voltage relays for control of the lighting circuits along with the appropriate schedules and local user interface.
1. The SPCC-LC shall provide as a minimum the following functionality;
 - A Occupant-Sensitive Operating Scenarios
 - B Schedule With Flick Warn
 - C Time-delay Overrides With Flick Warn
 - D Common Area Interlock With Egress Timer
 - E Master Switch Control With Flick Option
 - F Cleaning Lights
 - G Automatic Daylight Switching With Occupant Interlock/Override
 - H Status and Runtime Data
 2. It shall manage input switches and sensors, output relays as well as lighting sequences and groups, enabling the user to configure and monitor a very large number of different lighting schemes and schedules.
 3. Provide for a manual override of each circuit.
 4. The SPCC-LC shall provide, as a minimum, the ability to interface with the hardware of the associated relay panels to allow for minimal disruption to the existing high voltage panel wiring.

- The SPCC-LC shall be capable of providing all logic, control, runtime data, status information, and communications functions.
5. If specified, provide a built-in LCD operator interface with the ability to read the status of the lighting relays and switches and implement temporary override command .
 6. The SPCC-LC shall be able to control the General Electric® three-wire relay or a two wire Aromat relay.

PART 4 - BAS SOFTWARE TOOLS

- 4.1 Provide ____ copies of all tools necessary for the development, maintenance, expansion and use of the BAS described within these specifications. All software tools shall part of the Niagara Framework tools or be provided as Wizards that operates within the Niagara Framework environment. For the purpose of this specification software tools shall be divided into the following categories and meet these specified requirements.
 - A. Controller Programming Software
 1. Provide Wizards or objects that facilitate the programming and configuration of the Configurable Controllers (CC), Programmable Controller (PC) and or the Special Purpose Configurable Controllers (SPCC) sequence of operation through menu driven wizard. The programming tools shall perform the following functions:
 - A. PC programming shall be accomplished by graphical programming language (GPL) where objects are used to define different portions of the control sequence. All control sequences programmed into the PC shall be stored in non-volatile memory. Systems that only allow selection of sequences from a library or table are not acceptable. All code must be exportable to a library for future use.
 - B. CC and SPCC – Provide for the programming of the required sequence of operation through an intuitive configuration menu driven selection process. The configuration tools menu shall define items such as I/O configurations, set point, delays, PID loops, optimum start stops, and network variables settings. The configuration tool must indicate the device status and allows system override. Graphical programming language as described for the PC is acceptable.
 - B. Network Management – (Disregard if software already in place) Provide one copy of the latest version of the Niagara Framework network management tool (unlimited connectivity version). Provide for the installation of the tools on a the customer provided Personal Computer or server.
- 4.2 The Graphical User Interface (GUI) shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
 - A. Provide a visual graphical representation of each piece of mechanical equipment and/or mechanical system that duplicates the represented system, where applicable. Graphics shall include at a minimum the value of each input, each output, each setpoint, alarms and graphical representation of trend logs. The graphic shall provide for the ability to command each point, including both timed and permanent overrides. In addition, provide for all information

represented in the graphics in an associated graphical table with links to the equipment graphics and commandable points. All graphics shall commiserate with latest industries standards and practices. Sample graphics shall be provide as part of the submittals for approval by owner.

- B. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
1. Graphic screens shall be developed using any drawing package capable of generating or assembling objects from a GIF, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
 2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
 3. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
 - a) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - b) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 4. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 5. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.
- C. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
1. Create, delete or modify control strategies.
 2. Add/delete objects to the system.
 3. Tune control loops through the adjustment of control loop parameters.
 4. Enable or disable control strategies.
 5. Generate hard copy records or control strategies on a printer.
 6. Select points to be alarm-able and define the alarm state.
 7. Select points to be trended over a period of time and initiate the recording of values automatically.
- D. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide

the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

- E. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- F. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
- G. Alarm Console
 - 1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
 - 2. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.
- H. End User Dashboard Clients
 - 1. Provide a browser-based dashboard application that provides rapid identification of real-time and historical trends, including energy use, operational efficiencies and critical metrics.
 - 2. Provide a user configurable dashboard software license on a Niagara AX Supervisor station (or multiple AX supervisors) located at . Provide connectivity to building energy meters and HVAC controls via BACnet, LonWorks, Modbus or Fox communication drivers. Server hardware (is existing or to be furnished by .)
 - 3. The Dashboard service shall run as a module on a Niagara station and shall utilize the existing Niagara licensing and security model. All user profiles defined in the station shall be available for dashboard access and conform to the defined security levels and categories.
 - 4. The Dashboard contractor shall utilize the appropriate communication drivers to discover the appropriate BAS, electrical, and metering point data from the various systems. Build the appropriate historical trends for long term visualization. Add local weather data trends (temperature, %RH, cooling, heating and total degree days data) if not currently available.
 - 5. The Integrator shall enable the oBix service on the central server and the Dashboard shall utilize a built-in Discovery and Mapping Wizard to extract only the necessary point and trend data required.

6. Provide for front end virtual trend formations without having to adjust the underlying trend database. The virtual trends that are created are in equivalent units of an existing trend, such as a BTU trend built from a kWh trend. They can also be mathematical derivatives of the native trend using any formula desired by the user. Once created, the virtual trends can be used like any other AX trend and are continually updated as additional native data is added to the original trend.
7. The Dashboard interface shall be designed to complement the Niagara network by providing multiple, concurrent, user-centric "Viewer Applets" or "Viewlets" that can be easily configured and frequently modified by non-technical end-users.
 - a) The Owner shall be able to add multiple viewlets to a single webpage. The dashboard shall allow viewlets to be minimized, expanded, or moved dynamically. Multiple instances of each viewlet shall be allowed within the same dashboard.
 - b) The Owner shall be able to group Viewlets into multiple Tabs for convenience.
 - c) The Owner shall configure the viewlet by intuitively selecting the appropriate point(s) or trend(s) and adding them to the viewlet. This data shall be available via a pull down menu and shall not require any knowledge of the IDE tools.
 - d) The owner shall be able to rename Viewlets, move viewlets among tabs, save viewlets as an image or export to pdf.
 - e) The user shall be able to rename each imported point and trend with a unique dashboard name, independent of the Niagara provided name.
 - f) The owner shall be able to save configured Viewlets and tabs to a library and make saved Viewlets/tabs available to others in the organization.
 - g) The owner shall be able to configure properties such as graph colors, units, function (min, max, sum, avg), viewlet name, etc, on each viewlet independently.
 - h) Viewlets shall provide visual indication of data changes. Real time or live data shall update at a minimum of every 10 seconds. Historical data trends shall 'flash' when user selectable time periods change.
 - i) The owner shall be able to export viewlets as an image file, or as an image within a PDF file. Certain viewlets shall allow historical tabular data to be exported in CSV format for instant use in reports and technical documents.
8. The Dashboard shall save the User's custom configuration so that returning users are greeted with previously saved views. The Dashboard shall allow for "guest" passwords to share read only versions of the Dashboard.
9. The Dashboard shall also provide a "kiosk mode" for publication of Dashboard views to a local Monitor or kiosk. Provide the ability for user to build custom Screen Tip or Informational "pop-up" window to give additional insight on a kiosk slide for the general public. The kiosk shall have the ability to pause when user interaction is detected for a user selectable period of time.
10. A basic set of Viewlets shall be provided as part of the project. At a minimum, the following viewlet functionality shall be provided for the Owner's use:

- a) Resource Utilization - this viewlet is used to illustrate the comparative consumption of a resource (like energy) over a flexible time period. The information is ordered by location and multiple locations may be plotted on the same columnar chart for clear analysis and comparison. In addition to enabling a plot of a specific resource, this applet includes selectable options to view the resource in equivalent quantities of other materials. For example, when viewing the energy consumption of one or more locations in kWh, the user can select the "Coal Icon" to view the same consumption in terms of carbon equivalents. Similarly, a conversion is available to view the consumption in equivalent barrels of oil. When properly configured, this viewlet can also trend the cost of the resource in dollars (or local currency).
- b) Location Ranking – This viewlet is used to visually show the relationship of various properties of a location, relative to similar data on other locations. For example, a building's energy consumption or average temperature can be compared to that of other buildings for the same time period.
- c) Utility Performance Index - This viewlet enables the creation and visualization of one or more Key Performance Index (KPI) charts for comparisons of resource utilization efficiencies for multiple locations. A typical use of this viewlet is in displaying a "scatter plot" of consumption (y-axis) versus consumption per unit area (x-axis). For example, an "Energy" KPI can be displayed by selecting the locations of interest (e.g. all Dormitories on Campus), selecting the vertical axis variable as Electric Consumption (kWh) and the horizontal axis as a "normalized" metric, such as "kWh per Sft".
- d) Network Health – This viewlet is used to visually show the relationship of the physical devices on the Niagara Network including Server, NAC, and IBC or ILC. The devices conform to the Niagara color coding for offline, alarm, etc and shall change colors to indicate issues in the physical device. Additional statistics from certain devices are made available such as memory and CPU usage.
- e) Real time Gauges – Gauge viewlets allow the Owner to track analog values such as temperature, pressure, humidity and level in real time.
- f) Live Point Table – This viewlet provides the Owner a tabular summary of real time data. Data can be grouped by system or simply be the most important data points that day. The data points conform to Niagara's color coding and the table row changes color on data point alarm, etc.
- g) Critical Alarm Viewlet - Displays AX alarms in a single viewlet. A wide range of functionality is provided including ability manage and acknowledge alarms, chart alarm occurrence over time, filter based on alarm properties, and color alarms based on priority. The Alarm viewlet serves as an alternative to the Niagara AX Alarm Console for querying the alarm database. The Alarm viewlet enables users to create and save "filters" as well as trend the number of alarms over time.
- h) Drill Down Viewlets (Pie Chart or Column Chart versions) – These viewlets give the user a standard column or pie chart display, with the added benefit and functionality of multiple levels of data. Double-clicking on the individual columns will "drill down" to a separate column chart nested within the larger section above it. This viewlet makes multi-tiered comparisons of energy usage simple and concise.
- i) Virtual Electric Meter Viewlet – This viewlet displays energy usage in a meter-style display. The meter has the ability to show kWh, kW, power factor, and kVAR.

- j) Utility Accounting Viewlet - This viewlet allows the user to import their utility bills and display monthly electricity, gas, and water usage statistics. The numbers are shown in a chart which gives total resource consumption numbers for each utility, the cost per month, as well as the cost per unit of consumption. The viewlet also presents the figures in interactive pie and column charts to help the user visualize their respective energy usage over time. This viewlet requires some customization for each Utility.
- k) Baseline Comparison Viewlet – This viewlet enables comparison of any trended variable, such as energy consumption, production, resource usage, etc. for the “Current” time period vs. a “Baseline” period. The comparison may be visualized either in direct units, or through a “Delta Mode” showing the net of “Current” minus “Baseline” values.
- l) The History Color Grid - This viewlet is used to analyze complex arrays of data using color visualization of variations in the values of the data being analyzed. This feature is useful in rapidly detecting instances of cyclical data variations over user selectable time periods.
- m) Green Tips Viewlet – This viewlet provides “tips” for reducing energy and resource consumption and can be customized for end users to highlight existing success stories.
- n) Event History Timeline – This viewlet provides a powerful stacked chart view for consuming large amounts of information. This viewlet also has capability to drill down into smaller time periods and display user configurable events.
- o) Optional Sustainability Viewlets (*provided that the end user has such sustainable features available and connectivity to the resulting data via the BAS) - “focus” viewlets targeting sustainable energy applications that include: Solar, EV Charging Stations, and Wind Turbines.
- 11. An initial Dashboard Configuration and training session shall be provided by the Integrator for the Owner’s staff. The initial configuration shall include:
 - a) Setup of the desired Locations including Location name, address, square footage, and any utility resource costs.
 - b) Discovery of Point and trend data. Integrator shall assist Owner in understanding the Niagara point names and importing the desired point and trend values.
 - c) Setup of customizable dashboard views for the Owner. The Integrator shall demonstrate how the Owner can add Viewlets and Tabs to create a preferred daily view. Initial dashboards to be configured include:
 - 1) Executive View
 - 2) Utility View
 - 3) Demand Management View
 - 4) Chiller/Boiler Views
 - 5) Preferred Guest View
 - 6) Sustainability View.

12. Import a two (2) history of utility bill data (gas, water and electricity), degree days and any real-time meter data that the owner has on hand.
13. Additional viewlets shall be made available to Owner for purchase as developed. Owner shall be able to receive notification from the manufacturer on new viewlets and software updates.

PART 5 - USER INTERFACES

- 5.1 Web Browser Clients – Provide for a series of browser accessible graphical screens that are resident on the BC and Server that represent the systems controllers and managed by that BC and its associated controllers. What do we add here to define the actual graphic pages provided

The Web browser client shall support at a minimum, the following functions:

14. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
15. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
16. HTML programming shall not be required to display system graphics or data on a Web page
17. Storage of the graphical screens shall be in the Building Controller (BC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
18. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
19. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - a) Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 - 1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - b) Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 - c) View logs and charts
 - d) View and acknowledge alarms
20. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home

- page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
21. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.
 - 5.2 LCD Display – Provide a wall mounted and or controller mounted easy to operate User Interface that provides direct read / write access to any point on the network. The LCD Display shall provide the following:
 1. The Display User access shall be through a simple to use directional and entry buttons or a full keyboards.
 2. Ability change temperature values. Implement temporary overrides and command equipment on and off.
 3. Two levels of user access protected by a password. Level one: View only. Level two: read and write
 - 5.3 Intelligent Space Sensors (ISS) shall communicate on a daisy-chained network connected to any Local Control Unit (LCU) or Terminal Control Unit (TCU) and shall provide ambient space condition sensing without the use of hardware I/O at the LCU or TCU.
 - 5.4 Each ISS shall provide a white Liquid Crystal Display (LCD), where indicated on the drawings, with the following minimum features:
 1. 1.4” x 1.18” (36mm x 30mm) display area
 2. Backlit
 - 5.5 The ISS shall be capable of displaying is LCD the measured space temperature from 50 degF to 104 degF (10 degC to 40 degC) and/or humidity from 0 % RH to 100 % RH with one decimal.
 - 5.6 The ISS shall be capable of displaying the following element:
 1. Space temperature
 2. Cooling space temperature set point
 3. Heating space temperature set point
 4. Current heating or cooling mode
 5. Current occupancy mode
 6. Fan speed
 7. Light status
 8. Blind position
 9. Alarm condition
 10. Current time
 11. Energy consumption indicator

- 5.7 Each ISS shall provide a local keypad for local user interface to perform navigation and adjustment of points configured as adjustable.
- 5.8 The ISS shall be configured for the LCU or TCU intended application requirements.
- 5.9 Provide an ISS where indicated on the drawings each ISS shall provide at a minimum the following on-board integral I/O without the consumption of any inputs and/or outputs at the host LCU or TCU:
 1. Temperature Sensor
 2. Sensing Element: 10k Thermistor
 3. Accuracy: ± 0.9 degF (0.5 degC)
 4. Resolution: ± 1.8 deg F (± 1 deg C)
 5. Range: 41 degF to 104 degF (5 degC to 40 degC)
 6. Relative Humidity Sensor
 7. Accuracy: ± 3 % RH
 8. Resolution: 1 % RH
 9. Range: 10 % RH to 90 % RH
- 5.10 The ISS shall provide function to fully balance the air flow of a Variable Air Volume (VAV) Terminal Control Unit (TCU). The ISS shall allow the air balancer to control the action of the VAV TCU including the following function: open VAV damper, close VAV damper, go to flow setpoint. The ISS shall allow the air balancer to enter flow related parameters including minimum air flow, maximum air flow and K factor. The ISS shall be capable of operating as a handheld tool for air balancing functions in situations where the ISS is not required as an installed sensor.
- 5.11 The ISS menus provide function to configure the Terminal Control Unit (TCU) shall define items such as I/O configurations, set point and delays.
- 5.12 The configuration tool or through an Intelligent Space Sensor (ISS) menus shall allow to commission the TCU application and perform action such as inputs calibration, outputs override.
- 5.13 The ISS shall provide password protected menus or any other mechanism to prevent a local user to access advanced configuration menus including air flow balancing menu and network addressing.
- 5.14 Programmable to display up to ten (10) data points in any combination of local and/or networked values from any device on the internetwork.
- 5.15 Each ISS shall provide a point of access for a B-OWS, Service Tool, etc. to the internetwork via the ISS communication port.
- 5.16 The ISS shall be capable of promoting good energy usage practices to the room occupant by displaying an Energy Consumption Indicator (ECI). The ECI shall be modified in real-time when the room occupant modifies a parameter of the Local Control Unit (LCU) or Terminal Controller Unit (TCU) such as the room temperature setpoint or the fan speed. The ECI shall indicate to the room occupant the energy impact of the parameter changes.

PART 6 - SEQUENCE OF OPERATIONS

6.1 GENERAL

- A. All HVAC Systems shall be controlled with Direct Digital Control (DDC) according to the sequence of operation contained in this section of the specifications. Additional points or software programming not listed but which are required to meet the following sequences of operation shall be provided.
- B. Mechanical Contractor shall coordinate with Equipment Manufacturers and Temperature Controls Contractor to provide all necessary components required for communication between Mechanical Equipment and Temperature Control System.

6.2 DEDICATED OUTDOOR AIR SYSTEM, (no cooling) – AHU-1, 2

- A. Occupied Mode: The DOAS unit shall be indexed to run during occupied hours or by a special event schedule for the respective area. The supply and exhaust fans shall run continuously and the outside and exhaust dampers shall be open. A differential pressure switch across the filter banks shall indicate an alarm if the filters become dirty and create a differential pressure of > 1.0inwc (adjustable). The supply and exhaust fans shall be monitored by a current sensing switch and generate an alarm if either fan fails. Discharge air setpoint shall be reset by the average space temperature of the space it is serving.
- B. Occupied Heating: The enthalpy wheel speed shall be modulated to maintain the enthalpy wheel discharge setpoint as determined by the discharge air setpoint. If further heating is required the hot water valve shall modulate to maintain discharge air setpoint.
- C. Unoccupied Mode: The air handling unit shall be indexed to off during unoccupied hours by the DDC controller. The supply fan shall be off and the outside and exhaust dampers shall be closed.
- D. Defrost Sequences are to be supplied by the manufacturer for BMS system implementation.
- E. Smoke Detector Shutdown: Duct smoke detectors shall be provided on the supply side of the ductwork and shall shut the unit down upon detection of smoke in the system.
- F. Filter Alarms: A differential pressure switch across the unit's filters and wired to the BAS control panel shall when the filters become dirty initiated an alarm through the BAS.
- G. Freeze Protection: The Freeze Protection thermostat mounted on the leaving side of the heating coil shall shutdown the supply fan and associated exhaust fan if the temperature drops below 38°F. During this condition the heating coil valve shall go to full open and the outside air damper shall move to full closed position. An alarm shall be initiated through the BAS.

6.3 DEDICATED OUTDOOR AIR SYSTEM, (no cooling) – AHU-7, 9

- A. Occupied Mode: The DOAS unit shall be indexed to run during occupied hours or by a special event schedule for the respective area. A differential pressure switch across the filter banks shall indicate an alarm if the filters become dirty and create a differential pressure of > 1.0inwc (adjustable). The supply and exhaust fans shall be monitored by a current sensing switch and generate an alarm if either fan fails.

- B. Occupied Heating: The supply fan shall run continuously at a minimum airflow (adjustable) to maintain the occupied mode heating setpoint. The hot water valve on the supply shall modulate to maintain the space temperature setpoint. The exhaust fan, bypass damper and energy wheel shall remain off subject to input from the CO2 sensor. The supply fan, return fan and bypass damper shall modulate based on input from a CO2 sensor. As the amount of people in the space increases, as sensed by the CO2 sensor, the fan speeds shall increase and the bypass damper shall modulate accordingly.
- C. Occupied Cooling (AHU-7, alternate): The supply fan, exhaust fan, bypass damper and energy wheel shall follow a similar sequence to that of occupied heating. The compressors shall stage individually, upon a call for cooling to maintain the occupied mode cooling setpoint. Cooling shall be disabled in the unoccupied mode.
- D. Unoccupied Mode: The DOAS unit shall be indexed to off during unoccupied hours by the DDC controller. The supply fan shall be off and the outside and exhaust dampers shall be closed. Upon a call for heating the supply fan shall activate and the hot water valve shall modulate to maintain the unoccupied mode space temperature. The bypass damper shall modulate to 100% recirculation.
- E. Defrost Sequences are to be supplied by the manufacturer for BMS system implementation.
- F. Smoke Detector Shutdown: Duct smoke detectors shall be provided on the supply side of the ductwork and shall shut the unit down upon detection of smoke in the system.
- G. Filter Alarms: A differential pressure switch across the unit's filters and wired to the BAS control panel shall when the filters become dirty initiated an alarm through the BAS.
- H. Freeze Protection: The Freeze Protection thermostat mounted on the leaving side of the heating coil shall shutdown the supply fan and associated exhaust fan if the temperature drops below 38°F. During this condition the heating coil valve shall go to full open and the outside air damper shall move to full closed position. An alarm shall be initiated through the BAS.

6.4 RADIATION AND CONVECTORS

- A. Occupied: Each space temperature sensor shall open/close the associated radiation valve to maintain the adjustable occupied set point.
- B. Unoccupied set point shall be 57°F (adjustable).

6.5 Air Handling Units with Hot Water Coils and D/X Cooling – AHU-4, 5, 6, 8

- A. Freeze Protection: The Freeze Protection thermostat mounted on the leaving side of the heating coil shall shutdown the supply fan and associated exhaust fan if the temperature drops below 38°F. During this condition the heating coil valve shall go to full open and the outside air damper shall move to full closed position. An alarm shall be initiated through the BAS.
- C. Filter Alarms: A differential pressure switch across the unit's filters and wired to the BAS control panel shall when the filters become dirty initiated an alarm through the BAS.

- D. Supply Fan Alarm: If the supply fan does not start as determined by the current sensing relay an alarm shall be initiated to the BAS.
- E. Optimum Start: Each RTU shall have an optimum start program that will index the unit into warm-up or cool down mode based on the time needed to bring the indoor conditions to their specified set points by its scheduled start time.
- F. Occupied Cooling: The supply fan shall remain running. The outside air, return air and exhaust air dampers shall be in the closed position. If the return air enthalpy is greater than the outside air enthalpy, the outside air and return air dampers shall modulate to provide free cooling. If additional cooling is required the DX cooling stages shall begin to modulate to maintain the discharge air setpoint as reset by the average space temperature. As the discharge air temperature setpoint is met, the DX cooling stages shall modulate off before the outside air and return air dampers begin to close. If outside air enthalpy is greater than return air enthalpy then the outside air and return air dampers shall remain at minimum ventilation position and DX cooling shall be staged to provide cooling.
- G. Occupied Heating: The supply and return fans shall remain running. The outside air damper shall remain closed subject to modulation by the CO2 controls. The hot water valve shall modulate to maintain the discharge air set point as reset by the average space temperature.
- H. Energy Wheel (as specified): The energy wheel shall run anytime the outside air dampers are open at minimum or greater except when in economizer mode.
- I. CO2 Control: The return air CO2 sensor shall monitor the CO2 concentration and modulate the economizer dampers to maintain CO2 setpoint (adjustable). Damper shall modulate between fully closed and max outside air cfm as listed on the drawings (position to be set by the balancing contractor).
- J. Shutdown Periods: Unoccupied Cooling & Unoccupied Heating: When the supply fans are shut down, outside air dampers shall be closed, return air dampers shall be opened, the DX cooling shall be off and the heating coil valve shall be opened. In heating, if any space temperature drops below 55°F (adjustable) the respective unit shall be indexed to warm-up and shall operate per the warm-up sequence described within. When the space temperature rises 5°F the unit shall return to the unoccupied sequence and shutdown.

6.6 Heating and Ventilating Units

- A. Freeze Protection: The Freeze Protection thermostat mounted on the leaving side of the heating coil shall shutdown the supply fan and associated exhaust fan if the temperature drops below 38°F. During this condition the heating coil valve shall go to full open and the outside air damper shall move to full closed position. An alarm shall be initiated through the BAS.
- B. Filter Alarms: A differential pressure switch across the unit's filters and wired to the BAS control panel shall when the filters become dirty initiated an alarm through the BAS.
- C. Supply Fan Alarm: If the supply fan does not start as determined by the current sensing relay an alarm shall be initiated to the BAS.

- D. Occupied Heating: The supply fan shall remain running. The outside air damper remains open. The hot water valve shall modulate to maintain the discharge air setpoint as reset by the average space temperature.
- E. Unoccupied Heating: When the supply fans are shut down, the outside air dampers shall be closed, the heating coil valve shall be open. Upon a call for heating the supply fan shall start and the hot water valve shall modulate to maintain the unoccupied mode space temperature schedule.

6.7 EXHAUST FANS; (EF-1, 2, 3, 4, 4A, 5, 6, 7, 10, 11, 12, 13, 16, 17)

- A. Shall run based on the respective area occupied schedule.
- B. The fans shall have proof of running via a current sensing relay; if any fan fails an alarm shall be generated to the BMS upon any failure.

6.8 Science Storage Exhaust Fan; (EF-22)

- A. Shall run continuously.
- B. The fans shall have proof of running via a current sensing relay; if any fan fails an alarm shall be generated to the BMS upon any failure.

6.9 EXHAUST FANS; (EF-9, 14, 15, 18, 19, 20)

- A. Shall be activated by a local switch. Local switch by Electrical Contractor.

6.10 EXHAUST FAN EF-23

- A. Fan shall activate on high temperature limit as sensed by temperature sensor in well house.
- B. The fans shall have proof of running via a current sensing relay; if any fan fails an alarm shall be generated to the BMS upon any failure.

6.11 Boiler Room Operation

- A. If outside air is less than 65° F(adjustable) then the boiler system shall be indexed to heating. Once in the heating mode the lead hot water pump shall start and shall begin to speed up to maintain system differential pressure setpoint which is to be determined by the balancing contractor. If the lead hot water pump fails as determined by the current reading, faults and alarms from the VFD then the lag hot water pump shall start and run as the lead. An alarm shall be initiated through the BMS.

On a call for heating the combustion air fan shall start and once running as determined by a current sensor, the lead boiler shall be enabled to run. The BMS shall calculate outside air reset based upon the table below and send the reset setpoint to this boiler. All communications to this boiler shall be via the lonWorks network connection. Through this connection the BMS shall also monitor all available temperatures, status', alarms and report this information to the graphical pages.

If the lead boiler fails or if it is unable to maintain the hot water setpoint, then the secondary boiler shall be enabled to run. If the secondary boiler is unable to maintain the hot water setpoint

the third boiler shall be enabled to run. All boilers shall be modulated through the BMS to maintain the hot water reset setpoint as described earlier in this sequence. All alarms shall be monitored and reported through the BMS.

Boilers and pumps shall cycle on a lead/lag basis subject to run time.

All above sequences are with propane as the fuel source.

When boiler is running the delta temperature between the boiler supply and boiler return shall be monitored. If the delta T exceeds 40°F, the respective blend pump shall start and circulate supply water to the return to prevent thermal shock. When the building return water temp increases so the delta T is less than 40°F, then the respective blend pump will shutdown.

- C. Outside Air Reset Schedule as Follows:
- | Outside Air Temp | Boiler set point |
|------------------|------------------|
| 65°F | 140°F |
| 20°F | 180°F |
- E. All alarms shall be sent to designated personnel.

6.12 Kitchen Equipment

- A. Makeup air unit: System shall be activated subject to activation of any kitchen exhaust fan. Supply fan shall activate and outside air damper shall open. Burner shall activate to maintain space neutral (75F, adjustable, discharge air temperature.)
- B. Kitchen exhaust fans (KEF-1, KEF-2, CEF-1): Fans shall activate subject to local control. The fans shall have proof of running via a current sensing relay; if any fan fails an alarm shall be generated to the BMS upon any failure.
- C. Smoke detector shutdown: Smoke detector shall be supplied in supply air ductwork and shall shut down unit and kitchen exhaust fans upon detection of smoke.

6.13 Ductless Split Systems

- A. Systems shall be provided with manufacturer's controls.
- B. Controls contractor shall provide space temperature sensor and monitor via BMS system.

6.14 Unit Heaters and Cabinet Unit Heaters

- A. The fan shall cycle on/off to maintain space temperature setpoint subject to hot water being available as determined by the aqua-stat located on unit heater piping. If outside air is above 60° F. the unit heaters shall be locked out.

6.15 Radon Exhaust Fans

- A. Radon exhaust fans shall run continuously. Fan status shall be monitored on BMS.
- B. Fan pressure sensors shall signal alarm to BMS on drop in pressure to indicate fan failure.

6.16 Sump Pump SEP1

A. Sump Pump SEP1 shall operate On/Off through its level monitoring/control system.

6.17 Floor Water Alert System – Basement Electrical Equipment Area

A. Floor water sensing system shall monitor for liquid on floor in vicinity of major electrical equipment in Basement. (Refer to Sketch SKP2)

B. Upon sensing water on floor in vicinity of major electrical equipment in Basement, water sensing system shall signal alarm to BMS.

PART 7 - EXECUTION- Use CE standard language

SCHEDULE OF RESPONSIBILITIES

A. The following schedule identifies the responsible Division for the installation of the building automation system. This schedule should be used as a general guide. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Architect.

Item		Furnish By	Insta ll By	Powe r By	Contr ol Wirin g By	
1.	Equipment Motors	M	M	E	<input type="checkbox"/>	
2.	Magnetic Motor Starters:					
	a.	Automaticall y controlled, with or without HOA switches.	E	E	E	
	b.	Manually controlled.	E	E	E	<input type="checkbox"/>
	c.	Manually controlled, and which are furnished as part of factory wired	M	M	E	E

AUTOMATIC TEMPERATURE CONTROLS

Item		Furnish By	Install By	Power By	Control Wiring By	
		equipment.				
	d.	Special duty type (part winding, multi-speed, etc.)	M	See Note 1.	E	See Note 1.
	e.	Variable frequency drives with manual bypass.	SI	M	E	SI See Note 2.
	f.	Domestic booster pump. Motor Controls	M	M	E	SI
5.	General equipment disconnect switches, thermal overload switches, manual operating switches.		E	E	E	<input type="checkbox"/>
6.	Sprinkler system water flow and tamper switches.		M	M	E	<input type="checkbox"/>
7.	Outside fire alarm horn and light (at Siamese connection).		M	M	E	<input type="checkbox"/>
8.	Line voltage contactors.		E	E	E	E
9.	Control relay transformers (other than starters).		SI	SI	E	SI
10.	Main fuel oil tank alarms (high and low level) and remote indicating lights.		M	M	SI	SI
11.	Day tank fuel oil alarms (high and low level) and remote indicating lights.		E	E	E	SI
12.	Line voltage control items such as line voltage thermostats not connected to control panel systems.		M	SI	SI	SI

AUTOMATIC TEMPERATURE CONTROLS

	Item	Furnish By	Insta ll By	Powe r By	Contr ol Wirin g By
1 3.	Loose controls and instruments furnished as part of the packaged mechanical equipment or required for operation such as valves, float controls, relays, sensors, etc.	M	M	E	—
1 4.	Control and Instrumentation panels	SI	SI	E	SI
1 5.	Automatic control valves, automatic dampers and damper operators, solenoid valves, insertion temperature and pressure sensors.	SI	M	SI	SI
1 7.	Duct type fire and smoke detectors, including relays for fan shut down.	E	E	E	SI
1 8.	Contactors for cooling tower basin heaters.	M	M	E	E
1 9.	Mechanical piping heat tracing (including relays, contactors, thermostats, etc.)	M	M	E	E
2 0.	Emergency power off (EPO) shut down pushbutton(s) (break glass station) and controls.	SI	SI	SI	SI
2 1.	Control interlock wiring or software bindings between chillers, pumps and cooling towers, fans and air handling units and other miscellaneous mechanical equipment.	SI	SI	SI	SI
2 2.	Electric radiant heating panels unducted electric unit heaters and cabinet heaters, and electric	E	E	E	E

AUTOMATIC TEMPERATURE CONTROLS

	Item	Furnish By	Insta ll By	Powe r By	Contr ol Wirin g By
	baseboard radiation.				
2 3.	Airflow control devices with transmitter.	SI	M	SI	SI
2 4.	Air terminal devices (i.e., VAV and fan powered boxes).	M	M	E	SI
2 5.	Intelligent Devices and Control Units provided with packaged mechanical equipment such as:	M	M	E	SI
	Valve and damper operators. Heat pumps, AC units. Fan Coil Units. Air Terminal Units. Boilers, chillers.				
2 6.	Intelligent Devices and Control Units provided with electrical systems such as:	E	E	E	SI
	Occupancy/motion sensors. Lighting Control Panels. Switches and Dimmers. Switch Multiplexing Control Units. Door Entry Control Units.				
2 7.	Gateways or interfaces for protocol conversion with a non-LONWORKS based system.	M	E	E	SI
2 8.	Routers, Bridges and Repeaters.	SI	SI	SI	SI
<u>Abbreviations</u>					
Furnish.		Furnished by			
Install.		Installed by			

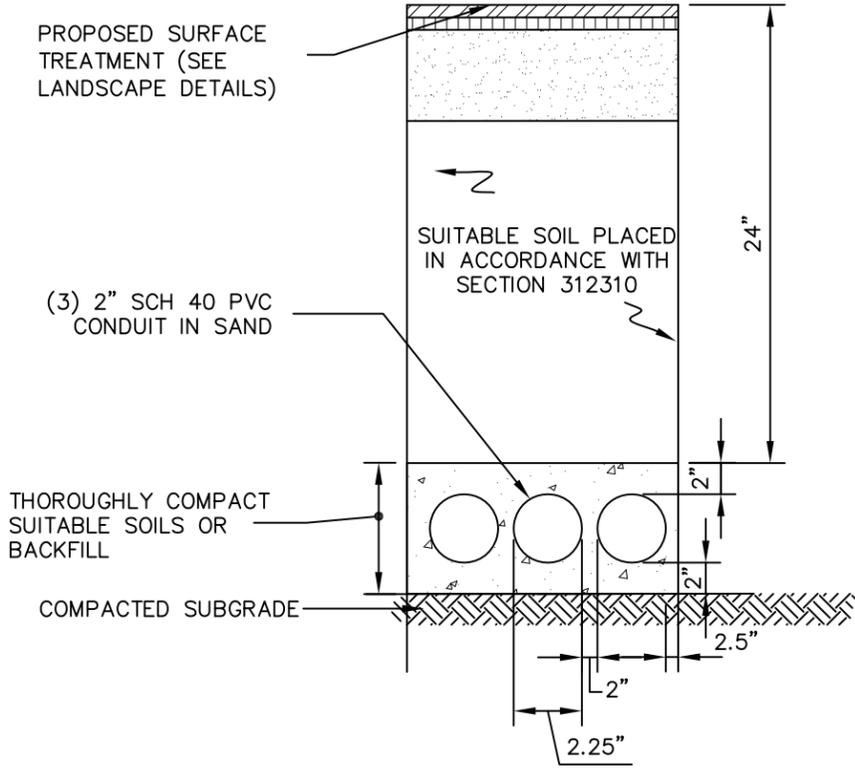
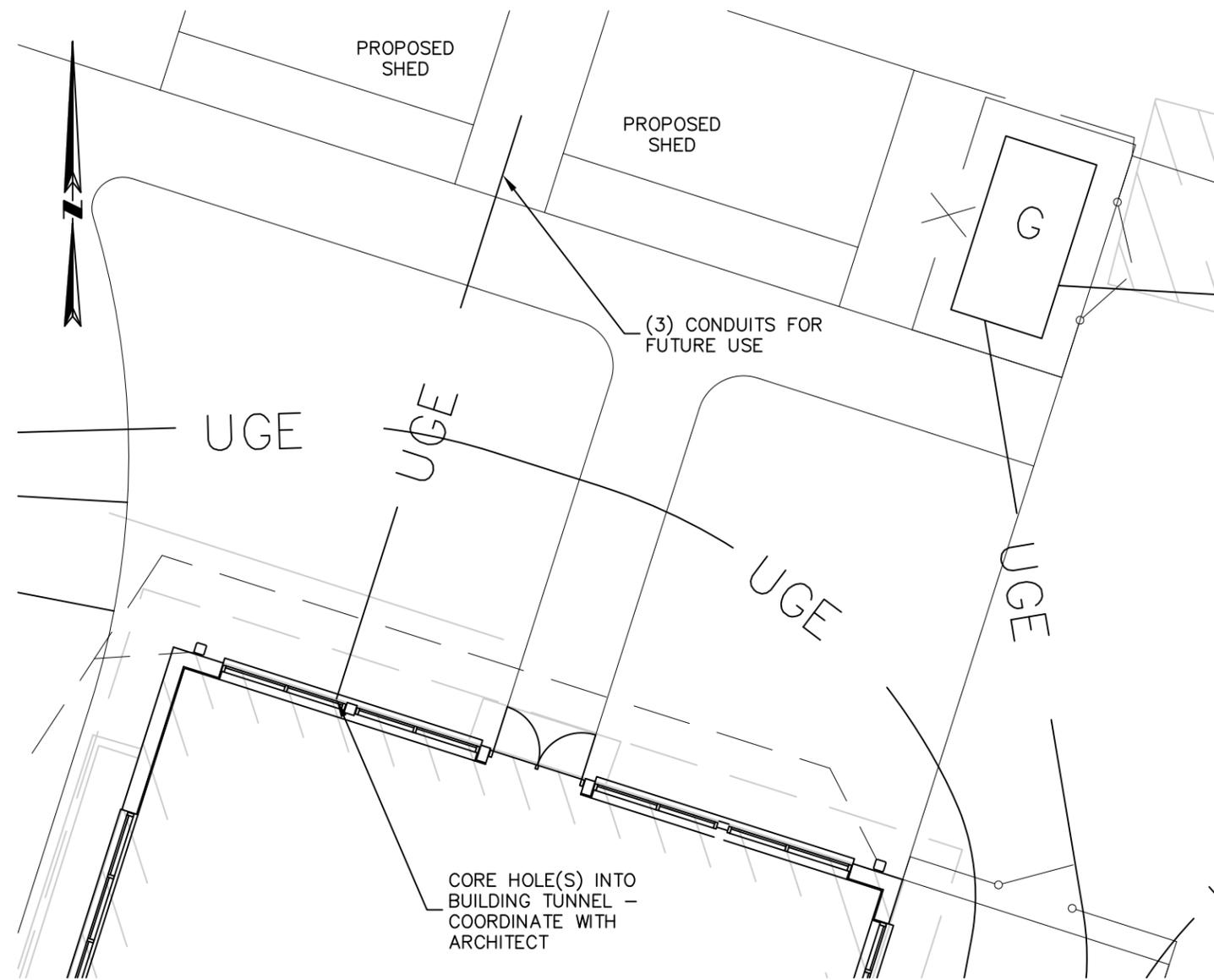
AUTOMATIC TEMPERATURE CONTROLS

Item	Furnish By	Install By	Power By	Control Wiring By
Power	Power Wiring Connection, Low and Medium Voltage			
SI	Systems Integrator			
M	Mechanical Contractor			
E	Electrical Contractor			

Notes to Schedule of Responsibilities:

1. Magnetic motor starters (special duty type) shall be set in place under electrical division except when part of factory wired equipment, in which case set in place under mechanical division.
2. Where a remote motor disconnect is required in addition to the one provided integral to an Variable Frequency Drive (VFD), the NI Contractor shall provide the necessary control interlock between the disconnects.
3. The System Integrator shall inform the Mechanical Contractor and the Electrical Contractor of the additional capacity required of control power transformers.
4. The Mechanical Contractor shall refer to the electrical specifications and plans for all power and control wiring and shall advise the Architect of any discrepancies prior to bidding. The System Integrator shall be responsible for all control wiring as outlined, whether called for by the mechanical or electrical drawings and specifications.

END OF SECTION 230900

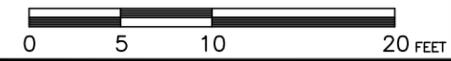


CONFIGURATION

GENERAL NOTES:

1. CAP CONDUITS UNDER GROUND ADJACENT THE SHED.
2. DUCT BANK TO BE BACKFILLED WITH SUITABLE SOILS.
3. ALL DUCTS TO COMPLY WITH CUDS NE-1.
3. MINIMUM 210# TENSILE STRENGTH PULL LINES TO BE INSTALLED IN ALL DUCTS BY THE CONTRACTOR. PULL LINES SHALL BE GREENLEE CATALOG #430, PART #5021481.0 OR EQUAL.

SCALE: 1" = 10'



**CRYSTAL LAKE
ELEMENTARY SCHOOL**

284 SANDY BEACH ROAD

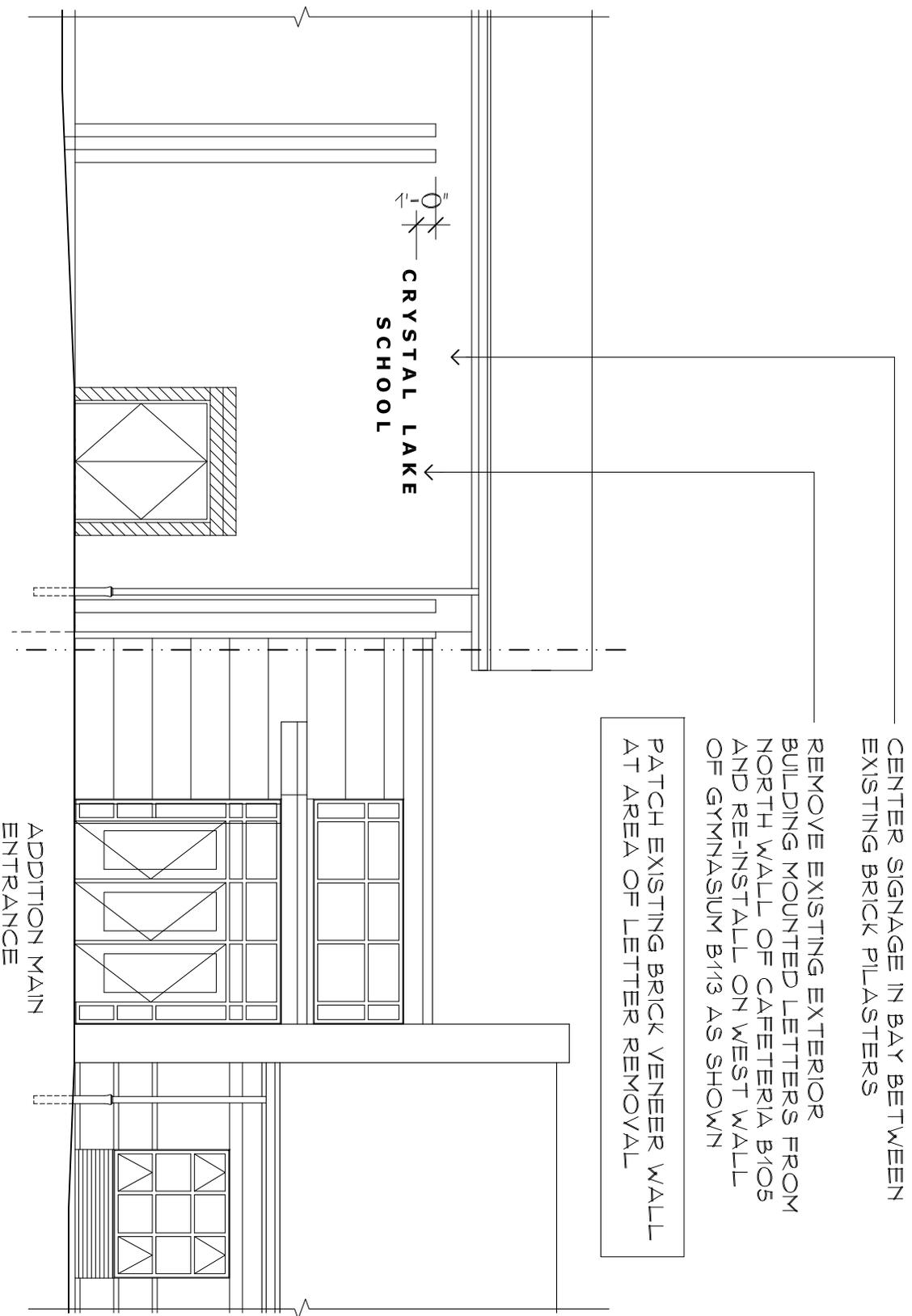
IN
**ELLINGTON
CONNECTICUT**

**CONDUITS FOR
FUTURE USE**

PREPARED FOR:
SILVER PETRUCELLI + ASSOCIATES
3190 WHITNEY AVENUE
HAMDEN, CT 06518

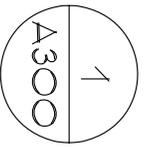
BSC GROUP
180 Glastonbury Boulevard
Suite 103
Glastonbury, Connecticut 06033
860 652 8227

Job No.: 83520.00 Date: 01-15-2014
Scale: 1"=10' Revised: _____
Dwg No: CSK-004
Ref: C-500



SIGNAGE DETAIL, PARTIAL WEST ELEVATION

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



Project Title:
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 Crystal Lake Elementary School**
 284 Sandy Beach Road
 Ellington, Connecticut 06029

 **SILVER/PETRUCELLI + ASSOCIATES**
Architects / Engineers / Interior Designers
 3190 Whitney Avenue, Hamden, CT 06518-2340
 Tel. 203 230 9007 Fax. 203 230 8247
 silverpetrucci.com

Drawing Title:
Signage Detail

Date:
 1/14/2014

Scale:
 AS NOTED

Drawn By:
 PEJ

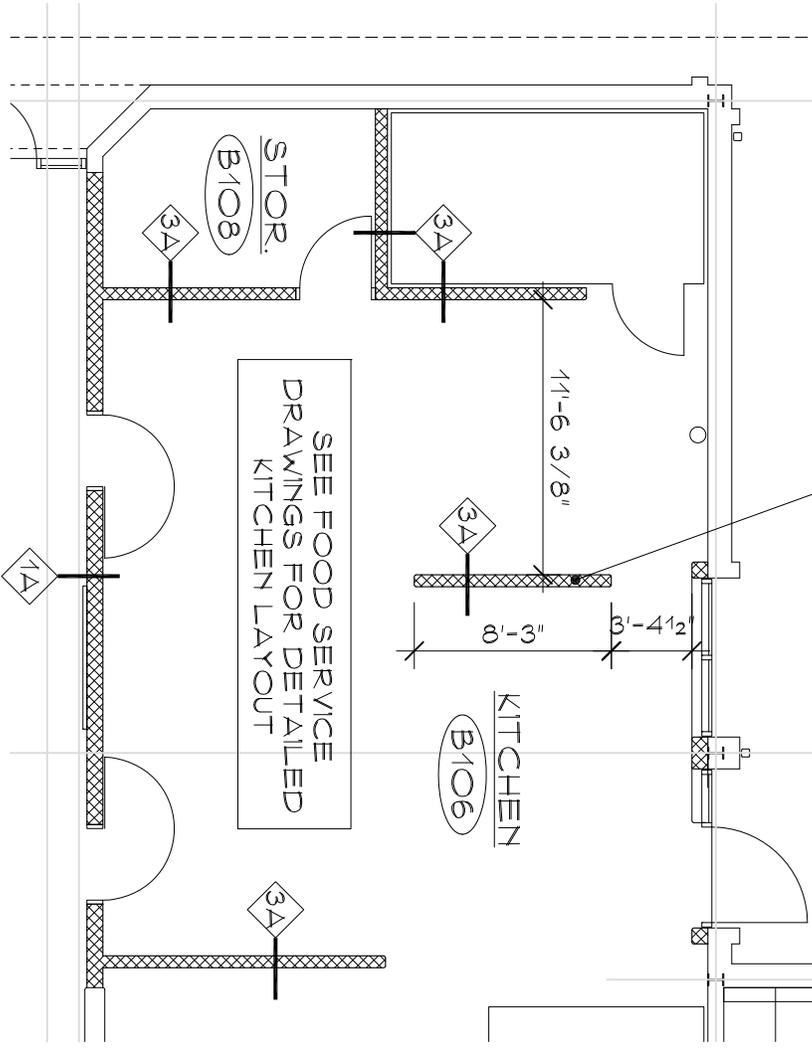
Project Number:
 12.140

Drawing Number:
 BID PHASE

SKA12

6" CMU PARTITION, SEE STRUCT. DWGS FOR REINF. AND FOOD SERVICE DWGS FOR FINISHES. PROVIDE RADIUS EDGES AT ENDS OF WALL AND QUARRY TILE WALL BASE.

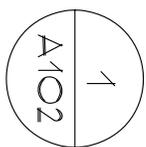
COORDINATE PARTITION LAYOUT WITH KITCHEN EQUIPMENT, SEE FOOD SERVICE DRAWINGS.
REFER TO DRAWING A900 FOR PARTITION TYPES.



SEE FOOD SERVICE DRAWINGS FOR DETAILED KITCHEN LAYOUT

PARTIAL KITCHEN PLAN, AREA "B"

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



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Drawing Title:
Partial Kitchen
Plan, 6" CMU
partition

Date:
1/15/2014

Scale:
AS NOTED

Drawn By:
PEJ

Project Number:
12.140

Drawing Number:
BID PHASE

SKA13

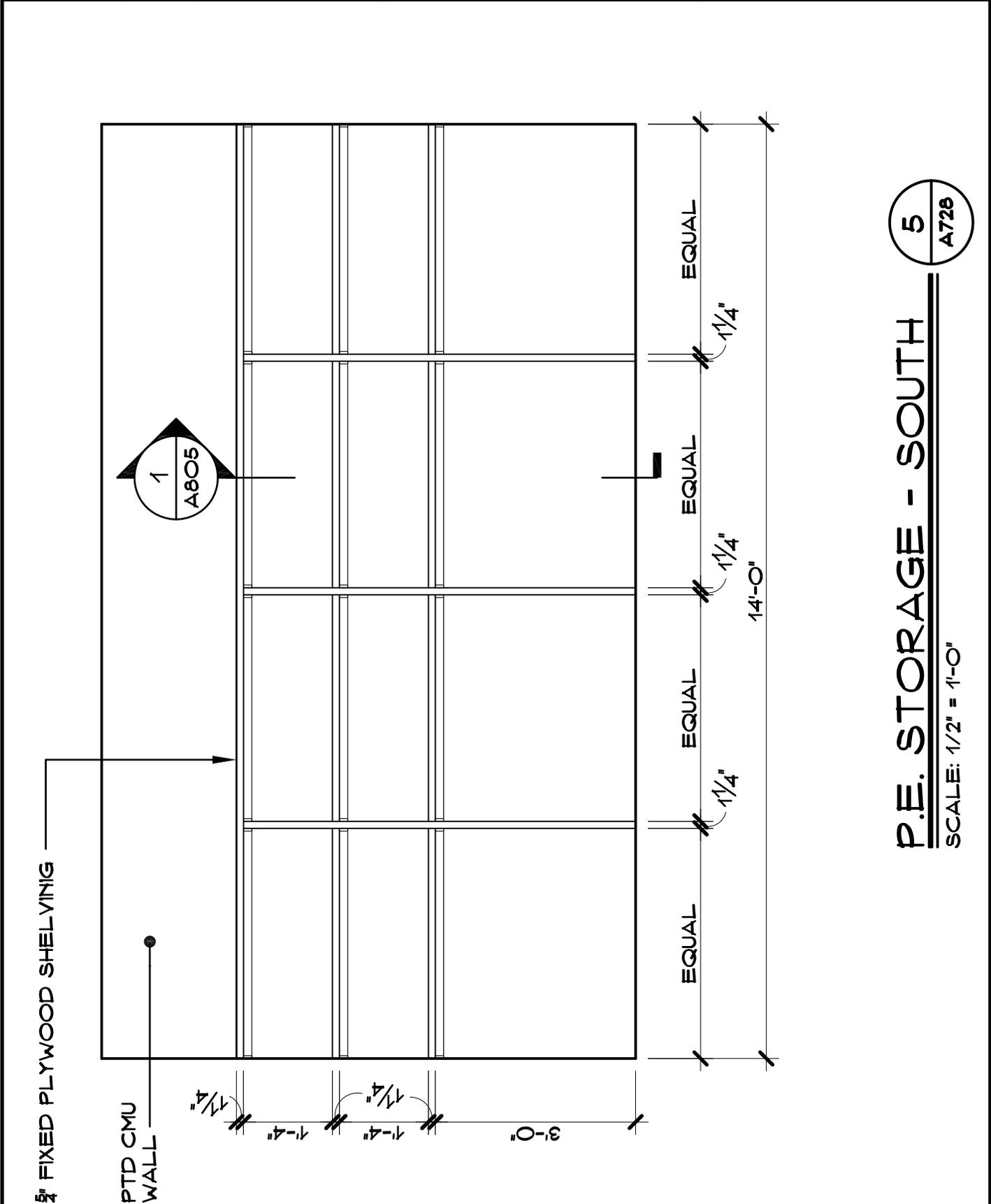
SKA14
BD PHASE
Drawing Number:

01/16/14
AS NOTED
AMC
Project Number:

Gym Storage
ELEVATION
Drawing Title:

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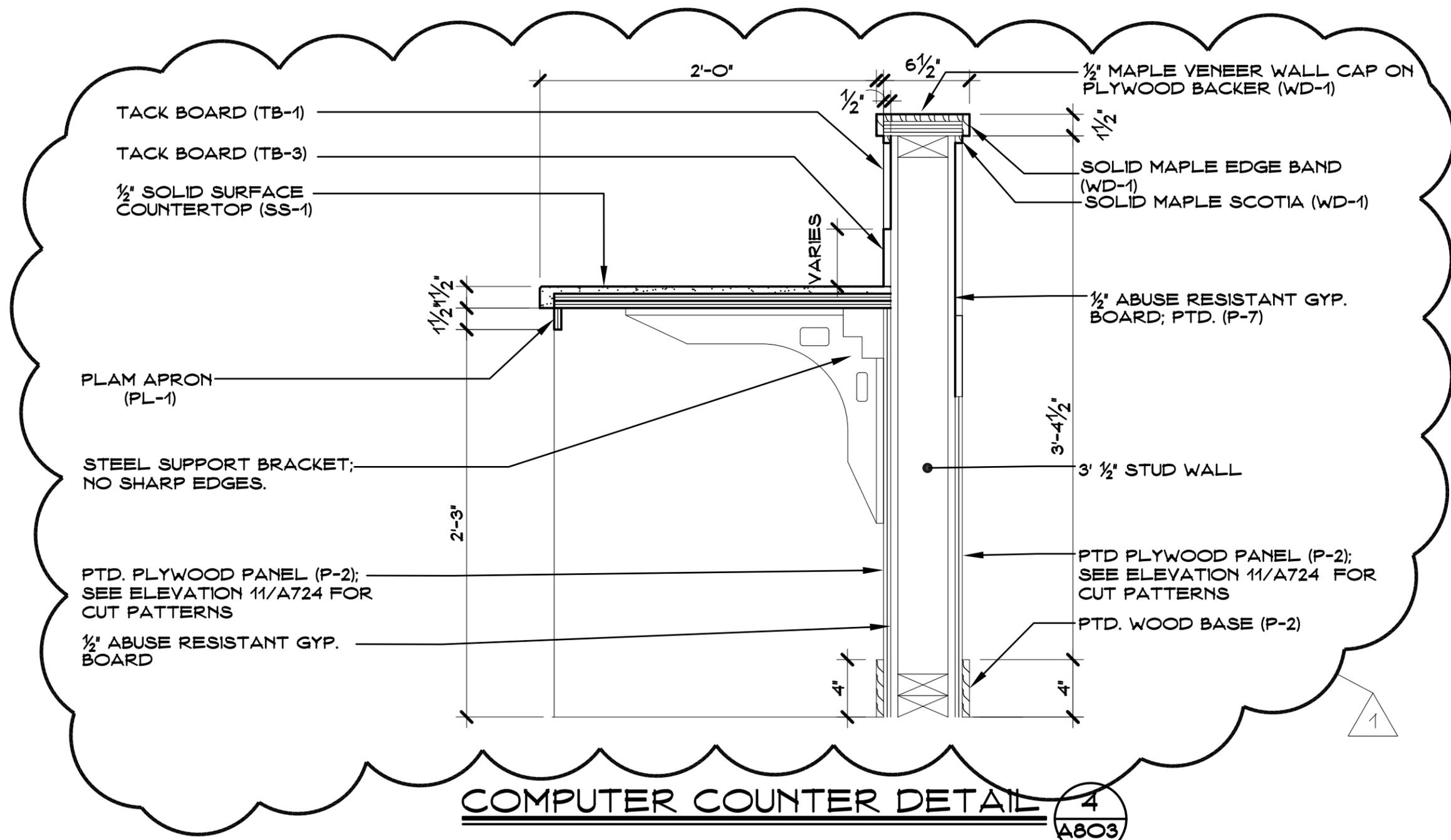
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284 Sandy Beach Road
Ellington, Connecticut 06029



5
A728

P.E. STORAGE - SOUTH

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



COMPUTER COUNTER DETAIL 4
A803

Drawing Number:
BID PHASE
SKA15

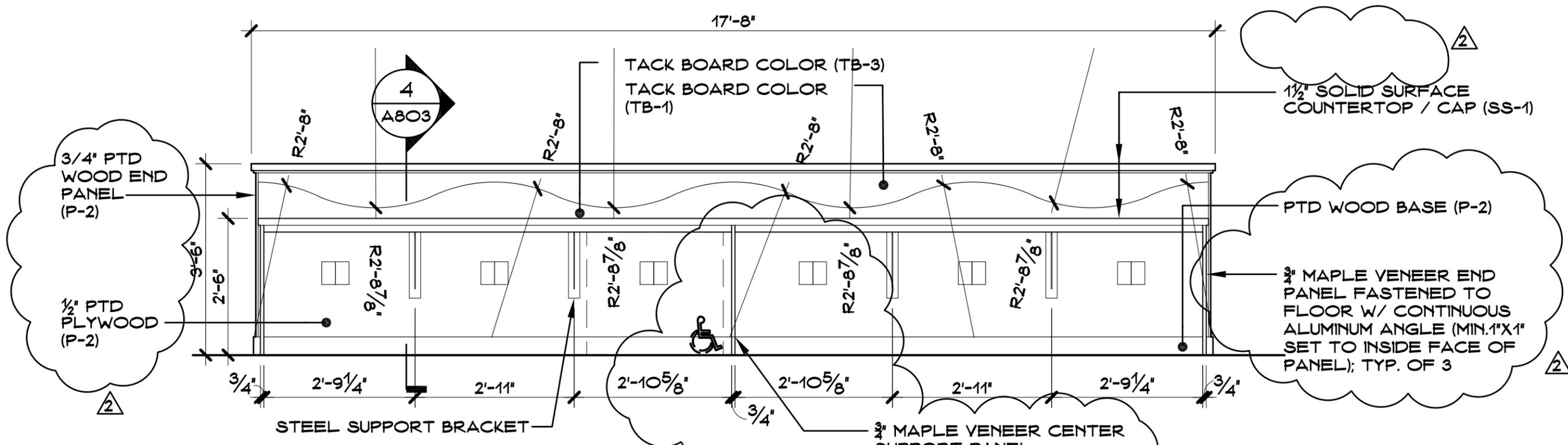
Date: **01/16/14**
 Scale: **AS NOTED**
 Drawn By: **AMC**
 Project Number: **12-140**

Drawing Title:
Revised Computer Counter Detail

SILVER/PETRUCELLI + ASSOCIATES
 Architects / Engineers / Interior Designers
 3100 Whitney Avenue, Hamden, CT 06518-2340
 Tel. 203.230.9007 Fax. 203.230.8247
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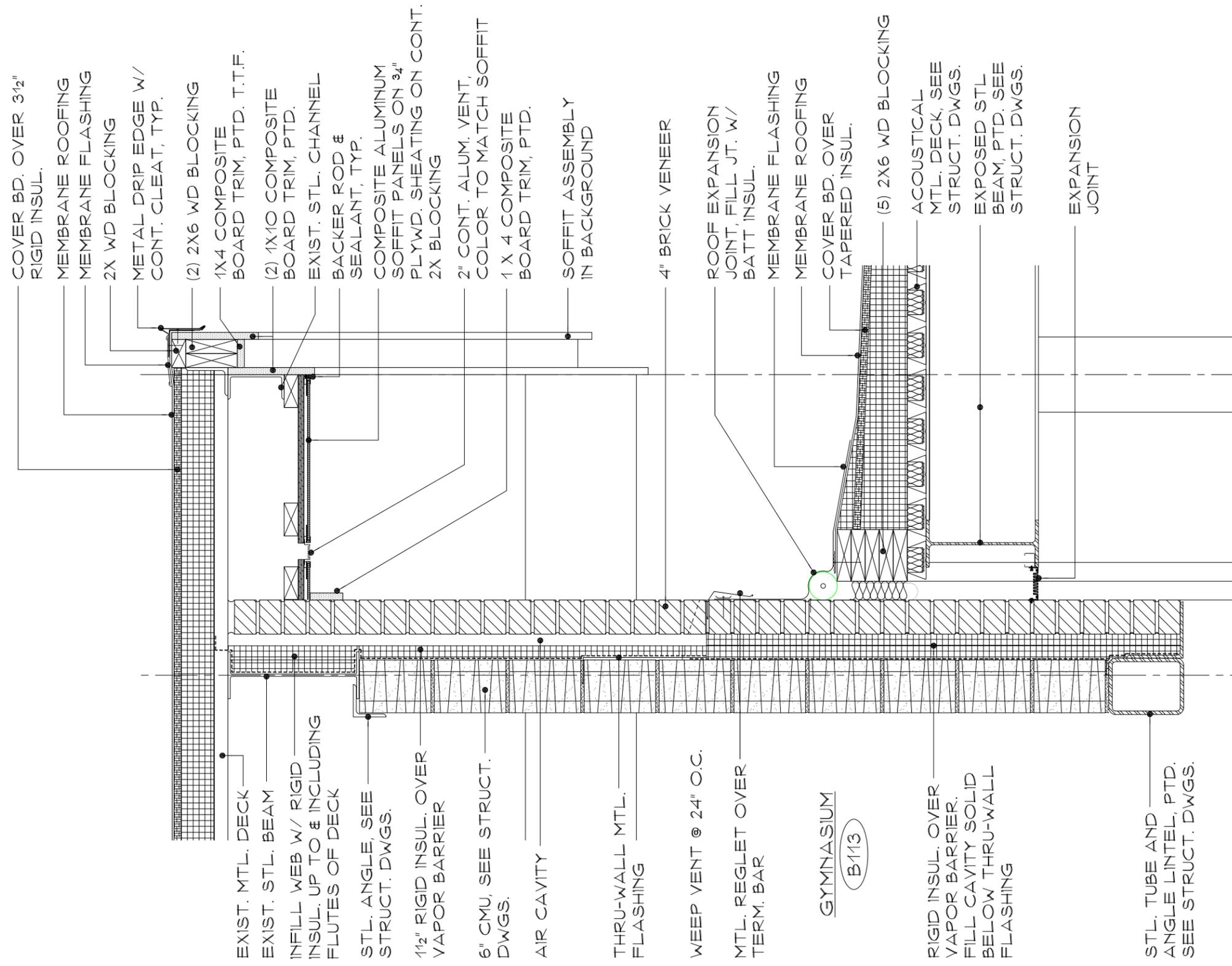
COMPUTER COUNTER - SOUTH

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

6
A724

NOTE:
 ADDED NOTATION TO END SUPPORT PANELS.
 ADDED CENTER SUPPORT PANEL & NOTATIONS.
 REVISED PTD WOOD BASE NOTATION.
 REMOVED PAINTED GYP. BOARD NOTATION.

Drawing Number: BID PHASE	Date: 01/16/14	Scale: AS NOTED	Drawing By: AMC	Project Number: 12-149
SKA16				
Revised Computer Counter Elevation				
SILVER/PETRUCELLI + ASSOCIATES <small>Architects / Engineers / Interior Designers</small> 3190 Whitney Avenue, Hamden, CT 06518-2340 Tel. 203.230.9007 Fax. 203.230.8247 silverpetrucci.com				
				
Expansion and Renovate as New Crystal Lake Elementary School 284 Sandy Beach Road Ellington, Connecticut 06029				



COVER BD. OVER 3/2"
RIGID INSUL.

MEMBRANE ROOFING
MEMBRANE FLASHING
2X WD BLOCKING

METAL DRIP EDGE W/
CONT. CLEAT, TYP.

(2) 2X6 WD BLOCKING
1X4 COMPOSITE
BOARD TRIM, PTD. T.T.F.

(2) 1X10 COMPOSITE
BOARD TRIM, PTD.

EXIST. STL. CHANNEL
BACKER ROD &
SEALANT, TYP.

COMPOSITE ALUMINUM
SOFFIT PANELS ON 3/4"
PLYWD. SHEATING ON CONT.
2X BLOCKING

2" CONT. ALUM. VENT,
COLOR TO MATCH SOFFIT
1 X 4 COMPOSITE
BOARD TRIM, PTD.

SOFFIT ASSEMBLY
IN BACKGROUND

4" BRICK VENEER

WEEP VENT @ 24" O.C.

MTL. REGLET OVER
TERM. BAR

GYMNASIUM
B113

RIGID INSUL. OVER
VAPOR BARRIER.
FILL CAVITY SOLID
BELOW THRU-WALL
FLASHING

STL. TUBE AND
ANGLE LINTEL, PTD.
SEE STRUCT. DWGS.

ROOF EXPANSION
JOINT, FILL JT. W/
BATT INSUL.

MEMBRANE FLASHING
MEMBRANE ROOFING

COVER BD. OVER
TAPERED INSUL.

(5) 2X6 WD BLOCKING

ACOUSTICAL
MTL. DECK, SEE
STRUCT. DWGS.

EXPOSED STL
BEAM, PTD. SEE
STRUCT. DWGS.

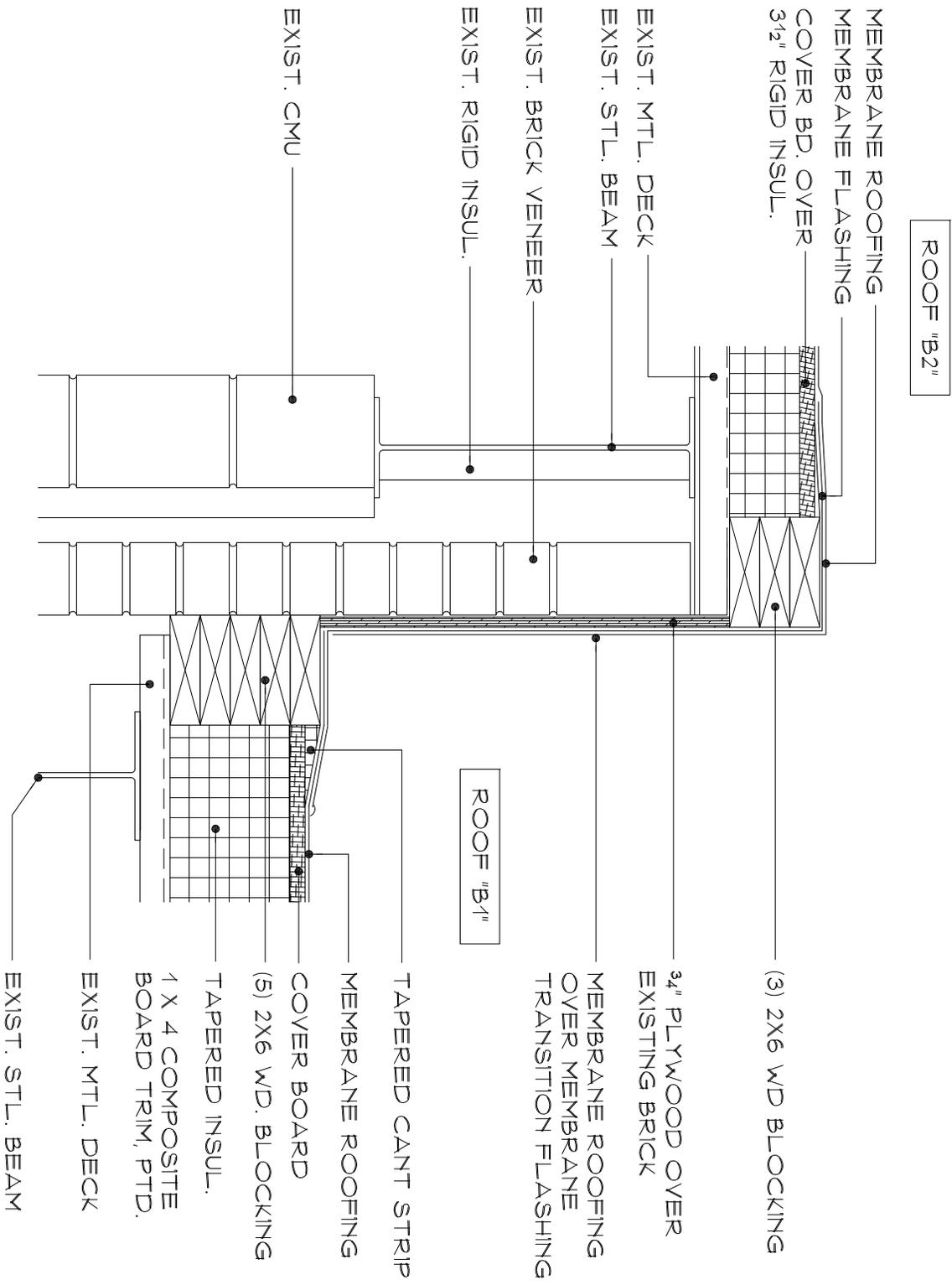
EXPANSION
JOINT

SECTION DETAIL

1
A400

SCALE: 1" = 1'-0"





ROOF "B2"

ROOF "B1"

ROOF DETAIL

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



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Drawing Title:
Roof Detail

Date:
 1/17/2014

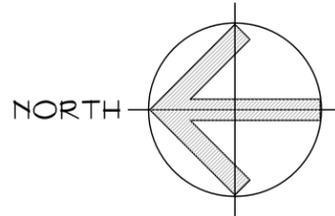
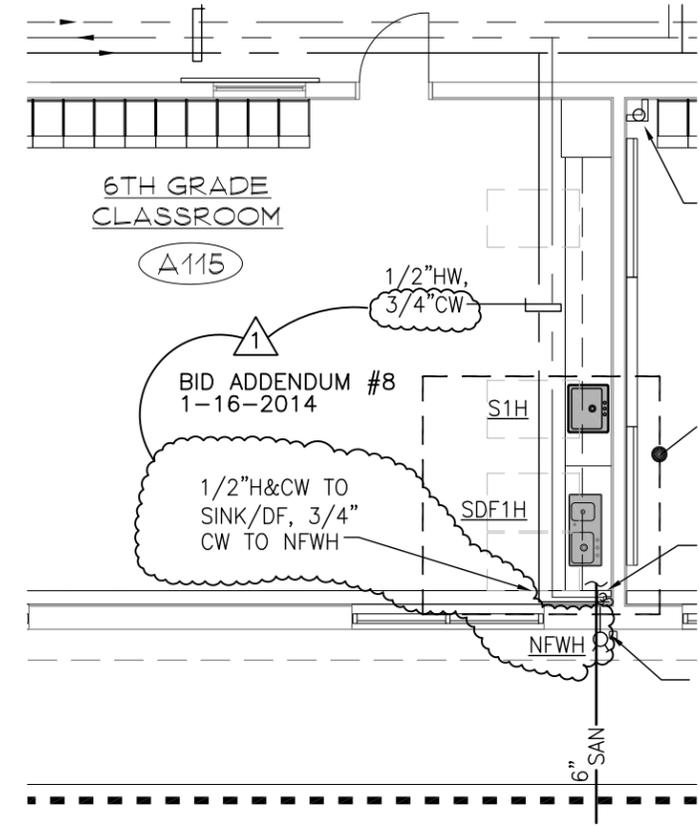
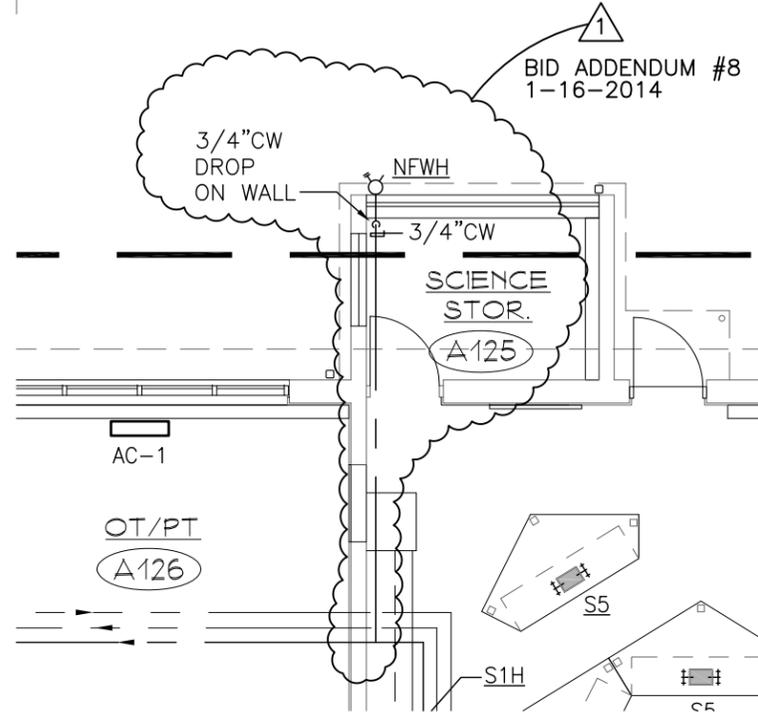
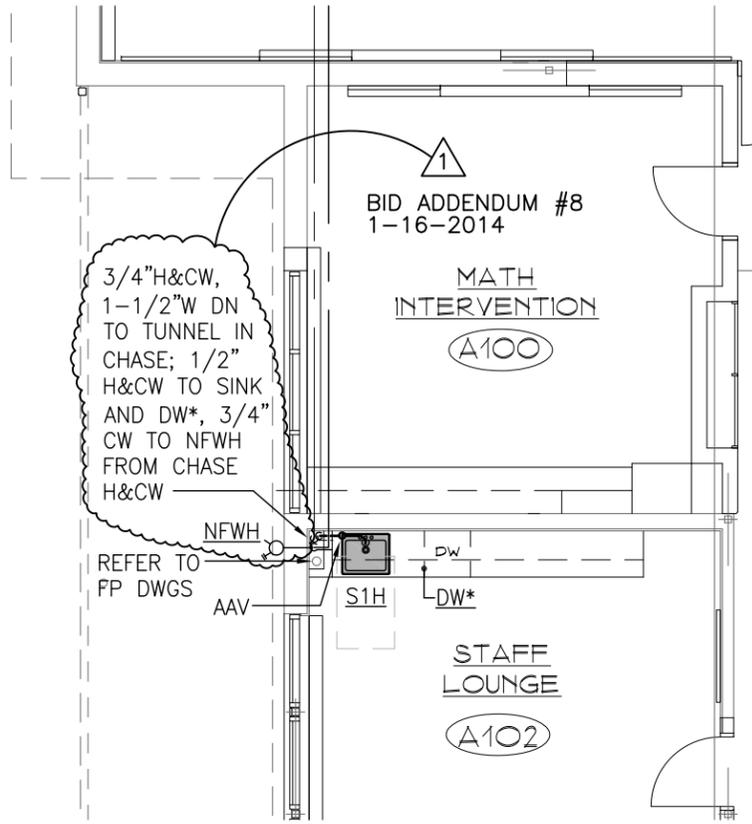
Scale:
 AS NOTED

Drawn By:
 PEJ

Project Number:
 12.140

Drawing Number:
 BID PHASE

SK A18



1ST FLOOR PLUMBING PART PLANS, AREA "A"

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

THIS SKETCH MODIFIES PORTIONS OF DRAWING P101

Project Title: Expansion & Renovate as New Project Phase 1

Project Number: 06029

Architect: MBQ

Project Number: 12.140

SKP3

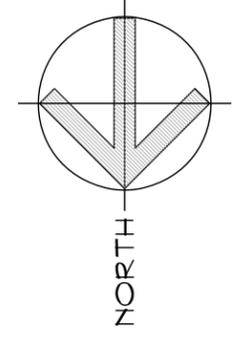
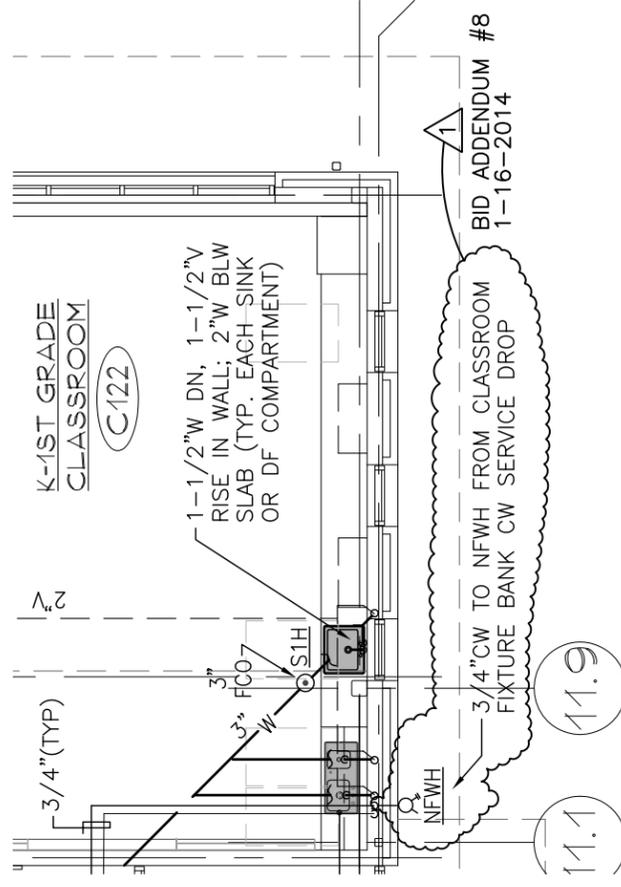
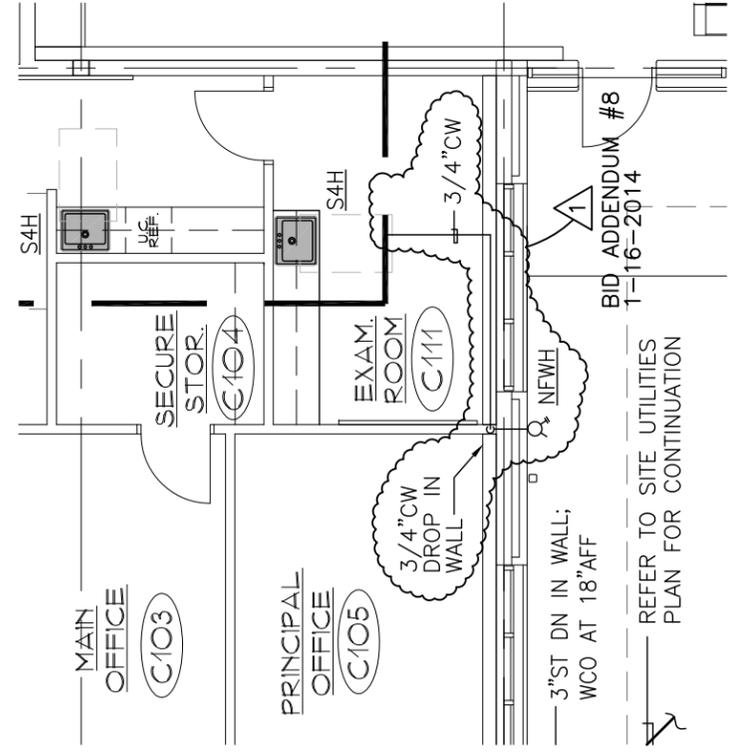
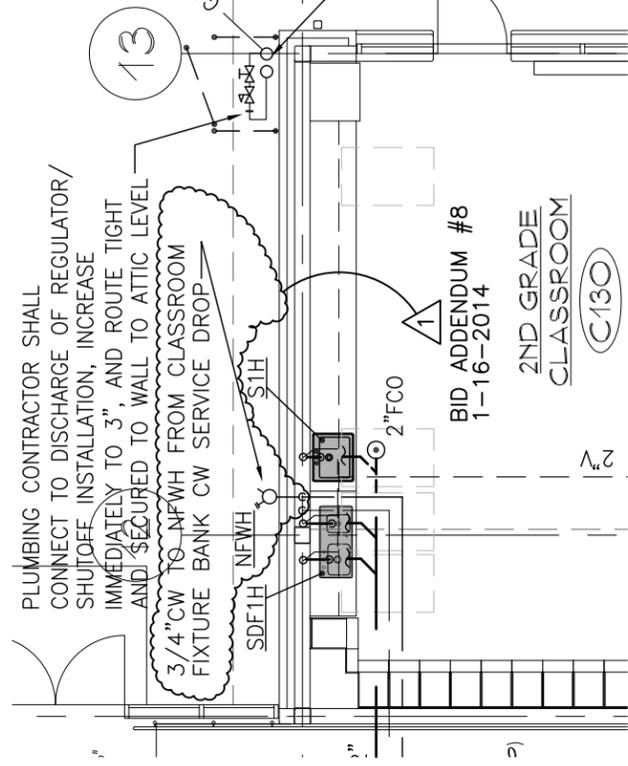
ADD EXTERIOR WALL HYDRANTS - AREA 'A'

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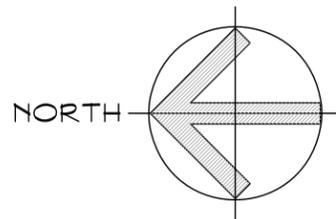
Expansion & Renovate as New Project Phase 1
Crystal Lake Elementary School
284 Sandy Beach Road
Ellington, Connecticut 06029



1ST FLOOR PLUMBING PART PLANS, AREA "C"
 SCALE: 1/8" = 1'-0"

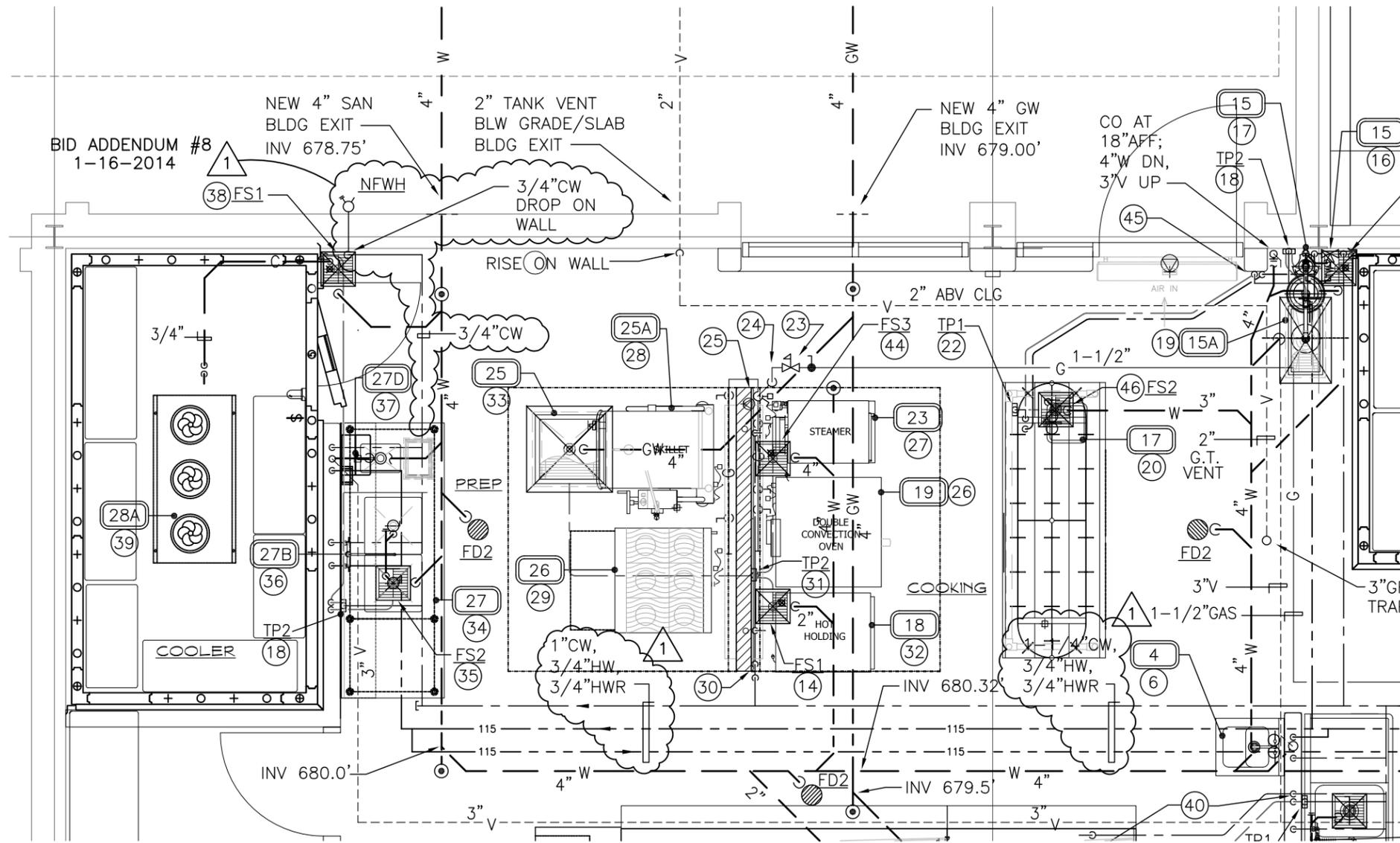
THIS SKETCH MODIFIES PORTIONS OF DRAWING P103

<p>Expansion & Renovate as New Project Phase 1 Crystal Lake Elementary School 284 Sandy Beach Road Ellington, Connecticut 06029</p>	 <p>SILVER/PETRUCCELLI + ASSOCIATES Architects / Engineers / Interior Designers 3190 Whitney Avenue, Hamden, CT 06518-2340 Tel. 203 230 9607 Fax. 203 230 8247 silverpetrucci.com</p>	<p>Project Title: ADD EXTERIOR WALL HYDRANTS - AREA 'C'</p> <p>Drawing Title: ADD EXTERIOR WALL HYDRANTS - AREA 'C'</p> <p>Project Number: 12.140</p>
<p>Date: BID - ADD. #8 JAN. 16, 2014 As Noted MBQ</p>		
SKP4		



1ST FLOOR PLUMBING PART PLAN, AREA "B" - VICINITY OF KITCHEN B106

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



THIS SKETCH MODIFIES A PORTION OF DETAIL 1 ON DRAWING P401

BID - APP. #8
JAN. 16, 2014
AS NOTED
MBQ
12.140

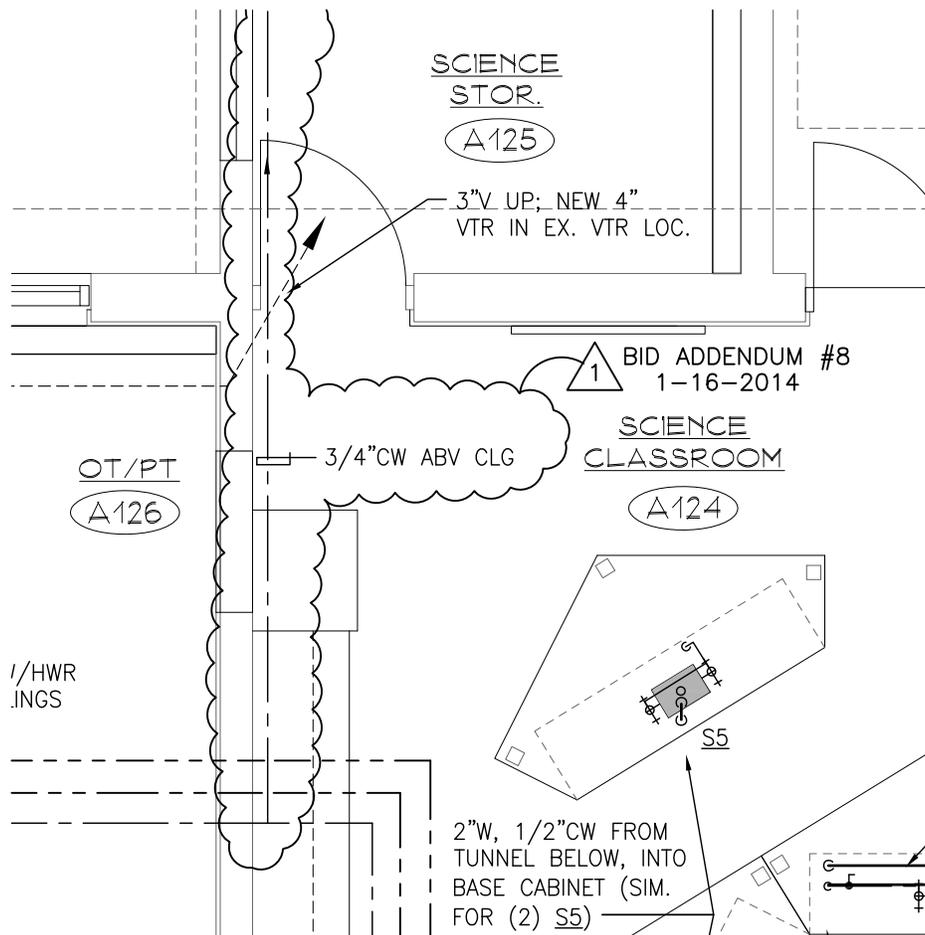
ADD EXTERIOR WALL HYDRANT - AREA 'B' - KITCHEN

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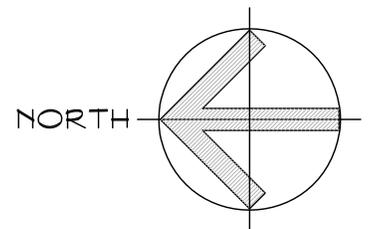
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Crystal Lake Elementary School
 284 Sandy Beach Road
 Ellington, Connecticut 06029

SKP5



1ST FLOOR PLUMBING PART PLAN, AREA "A" -
VICINITY OF SCIENCE CLASSROOM A124

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



THIS SKETCH MODIFIES A PORTION OF DETAIL 2 ON DRAWING P401

Project Title:

Expansion & Renovate as New
Crystal Lake Elementary School
284 Sandy Beach Road
Ellington, Connecticut 06029



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Drawing Title:

ADD EXTERIOR
WALL HYDRANT -
AREA 'A' - SCIENCE
STORAGE A125

Date: BID ADD. #8

JAN. 16, 2014

Scale:

AS NOTED

Drawn By:

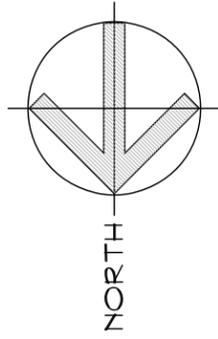
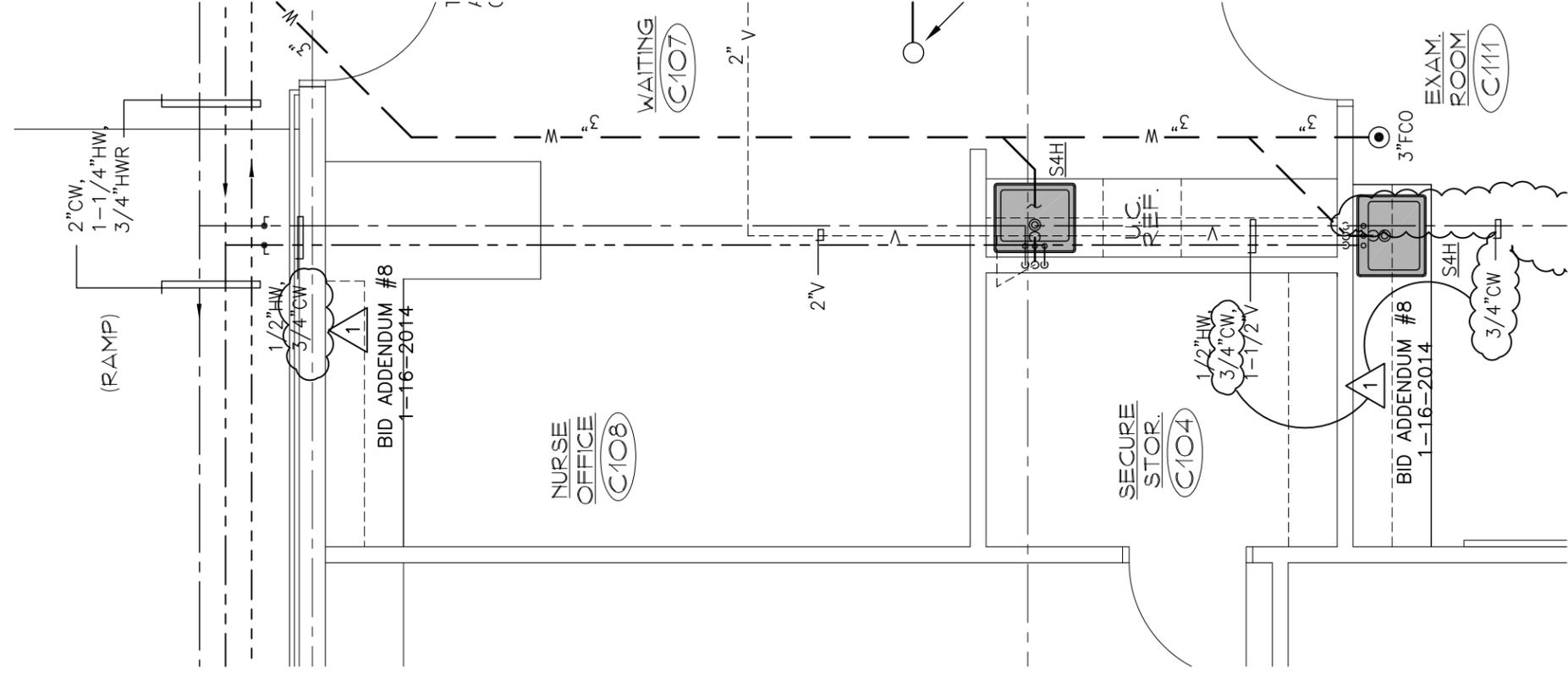
MBQ

Project Number:

12.140

Drawing Number:

SKP6



1ST FLOOR PLUMBING PART PLAN, AREA "C" -
VICINITY OF EXAM ROOM C111

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

THIS SKETCH MODIFIES A PORTION OF DETAIL 2 ON DRAWING P402

Project Title:
Expansion & Renovate as New Project Phase 1
Crystal Lake Elementary School
284 Sandy Beach Road
Ellington, Connecticut 06029



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Drawing Title:
ADD EXTERIOR
WALL HYDRANT -
AREA 'C' - ADMIN.

Drawing Number:
Date: BID - ADD. #8
JAN. 16, 2014
Scale:
AS NOTED
Designer: MBQ
Project Number:
12.140

SKP7

FIXTURE NAME	FIXTURE TYPE	FIXTURE HEIGHT	ROOMS NAME/NR.	AFF HEIGHT (BOTTOM OF FIXTURE)
P2	PR1601-F270	17.5"	MEDIA CENTER READING	11' * **
P3	PR1201-F170	14"	CAFETERIA B105	10' **
P3	PR1201-F170	14"	WAITING C102	9" **

NOTE:

* IN MEDIA CENTER ROOM C141, ALL PENDANT FIXTURES TYPE 'P2' CAN ALL BE SET UNIFORMLY AT 11'-0" ABOVE THE FINISH FLOOR TO BOTTOM OF FIXTURES, PER ARCHITECT REQUEST. NOTE THAT THE STRUCTURE IS SLOPE IN THIS AREA. ADJUST STEM AS REQUIRED.

** MEASURE PRIOR ORDERING THE STEM LENGTH. COORDINATE IN FIELD WITH FINAL STRUCTURAL END SUPPORT CONNECTION. REFER TO ARCHITECT AND ARCHITECTURAL SECTIONS FOR FINAL AFF HEIGHTS.

IMP. NOTE: EQUAL OF P2, P3 AND G FIXTURES MUST BE APPROVED BY ENGINEER PRIOR ANY OF FIELD WORK, ALONG WITH IES PHOTOMETRICAL CALCULATION RESULT OF THE AREA WHERE TO BE INSTALLED. FIXTURES P2 AND P3 SHALL HAVE SATIN ANODIZED BRIGHTNESS CONTROL BAND AS SHOWN, NO EXCEPTIONS WILL BE GRANTED.

Project Title:

Expansion & Renovate as New
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Drawing Title:

Pendant Lts
Heights

Date:

JAN 17, 2014

Scale:

AS NOTED

Drawn By:

MS- ELE. ENG.

Project Number:

12.140

Drawing Number:

SK
E1