



STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION



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Subject: Project No. 300-139
New Haven: Independent Wheel True Facility – New
Haven Rail Yard.

March 24, 2011

NOTICE TO CONTRACTORS:

This is to notify all concerned and especially the prospective bidders that the bid opening for the subject project has been previously postponed to April 6, 2011 at 2:00 P.M. in the Conference Room of the Department of Transportation Administration Building, 2800 Berlin Turnpike, Newington, Connecticut.

In addition to the Contracting Portal (http://www.biznet.ct.gov/scp_search/BidResults.aspx?groupid=64) the Department now has an FTP site which Contractors should utilize to access Project Information. Please refer to the instructions below, disseminate to the proper personnel and share with anyone having a need to know. In addition, the Department has established a general mailbox to receive contractor questions. Please send all future questions to DOTContracts@ct.gov.

Addendum No. 3 is available online via the FTP Site

This addendum is necessary to add and revise Special Provisions, Plan Sheets and to answer questions on the subject project.

The FTP site for Contractors to access Project Information:

Location: <https://sfile.ct.gov/>

Logon: CTDOTContract

Password: ctdotBid123

Folder 102 Addendums

Gregory D. Straka
Contracts Manager
Division of Contracts Administration

MARCH 24, 2011
NEW HAVEN RAIL YARD FACILITIES IMPROVEMENTS:

INDEPENDENT WHEEL TRUE FACILITY

STATE PROJECT NO. 300-139
CITY OF NEW HAVEN

ADDENDUM NO. 3

SPECIAL PROVISIONS

NEW SPECIAL PROVISION

The following Special Provision is hereby added to the Contract:

- **NOTICE TO CONTRACTOR – TEST PITS**

REVISED SPECIAL PROVISIONS

The following Special Provisions are hereby deleted in their entirety and replaced with the attached like-named Special Provisions:

- **ITEM NO. 0101128A – SECURING, CONSTRUCTION AND DISMANTLING OF A WASTE STOCKPILE TREATMENT AREA**
- **ITEM NO. 0969064A – CONSTRUCTION FIELD OFFICE, LARGE**
- **ITEM NO. 1400101A – 6” POLYVINYL CHLORIDE PIPE (SANITARY SEWER)**
- **ITEM NO. 1400102A – 8” POLYVINYL CHLORIDE PIPE (SANITARY SEWER)**
- **ITEM NO. 1400103A – 10” POLYVINYL CHLORIDE PIPE (SANITARY SEWER)**

REVISED CSI SPECIAL PROVISIONS

The following CSI Special Provisions are hereby deleted in their entirety and replaced with the attached like-named Special Provisions:

- **SECTION 05 50 00 – METAL FABRICATIONS**
- **SECTION 07 42 63 – FABRICATED WALL PANEL SYSTEM**
- **SECTION 09 30 00 – TILE**
- **SECTION 26 05 43 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS**
- **SECTION 26 24 13 - SWITCHBOARDS**

PLANS

REVISED PLANS

The following Plan Sheets are hereby deleted and replaced with the like-numbered Plan Sheets:

007-1, 120, 172, 217, 218, 228, 234, 248, 250-1, 254, 293, 296, 297, 298, 299, 337, 338

QUESTIONS & ANSWERS

- Q1.** We request that the self-performed work requirements for this project be reduced from 40% to 15%.
- A1.** The self-performed work requirements will not be reduced, they will remain at 40% for this project, as outlined in Specification Section 1.08 - PROSECUTION AND PROGRESS on page 209 of the specifications.
- Q2.** Is Eaton Cutler Hammer an approved manufacturer on the Switchboard? They are listed on all other distribution equipment but not on the switchboard.
- A2.** Specification section 26 24 13 part 2.1.A includes "Or approved equal" under item 4. This means the prime contractor that is awarded the project can submit shop drawings that contain products by any manufacturer that meets the requirements of the contract. The designer will review these products and approve them for use if all contractual requirements on the plans and in the specifications are met.
- Q3.** Spec Section 26 24 13-7 Part 2.3 Circuit Breakers A through L: Does this apply to only the Main Circuit Breaker or does it apply to the feeder breakers also. In order to supply all functions, the minimum frame breaker on the feeders would be 400 amps; or is there a feeder breaker spec?
- A3.** Any circuit breaker indicated on drawing E5-002 (sheet 299) with at least a 400 amp frame shall comply with the entire specification section indicated with adjustable settings. Circuit breakers with less than 400 amp frames shall be provided with fixed settings and need only comply with the applicable portions of the specification section indicated. Drawings E5-001 (sheet 298) and E5-002 (sheet 299) have been revised in Addendum No. 3 to include this information.
- Q4.** Spec. Section 26 24 13-7 Part 2.2 Transient Voltage Suppression Devices: Which ones? Main Breaker, Switchboard, Feeder breakers?
- A4.** Provide the suppression device at the main circuit breaker and branch circuits powering UPS1 and UPS2. Drawing E5-002 (sheet 299) has been revised in Addendum No. 3 to include this information.

- Q5.** Spec Section 26 24 13-7 Part 2.4 Accessories: Racking? Is the Main a Draw out CB? It does not show that on the one line or state that in the spec?
- A5.** The main circuit breaker is not a draw-out type. Please disregard any reference to racking accessories mentioned in specification section 26 24 13 - SWITCHBOARDS, Part 2.4.A. These requirements have been deleted and a revised specification is included in Addendum No. 3.
- Q6.** Spec Section 26 24 13-7 Part 2.5 Instrumentation A through G: where is all the metering located other than the main? Please explain what meters and where they are mounted.
- A6.** Other than the metering near the main circuit breaker, the meter shall be capable of being monitored via an MNR internet connection. Drawing E5-002 (sheet 299) indicates where the ct's, pt's, and meter are located.
- Q7.** On page 105 of the Special Provisions we are asked to provide Flagman during construction. Is this a RR trained Flagman for RR cars?
- A7.** Flagman are Metro-North employees that are trained to provide protection to non-Metro-North employees that are working on or near active tracks. During construction, Flagman are provided by Metro-North on an as needed basis at the contractors request based on the work being performed. All Metro-North flagging costs are paid for by the Department thru the Metro-North force account. The Contractor will need to hold coordination meetings and request flagmen in advance of the work as outlined in Specification Section 1.05 - CONTROL OF THE WORK, Subsection 1.05.06 - Cooperation With Utilities (including railroads), starting on page 187 of the specifications.
- Q8.** Are the piles located under and within 5 ' of the New Maintenance Facility part of building lump sum?
- A8.** No, piles are not included in the building lump sum Item 01000150A - MAINTENANCE FACILITY. Piles are paid for by their associated unit price items; Item No 0702079A - BITUMEN COATING FOR CONCRETE PILES, Item No 0702080A - COAL TAR EPOXY COATING OF PILES, Item No 0702355 - FURNISHING 16" PRESTRESSED CONCRETE PILES, Item No 0702396A - DRIVING PRESTRESSED CONCRETE PILES, Item No 0702797A - DYNAMIC PILE DRIVING ANALYSIS (P.D.A.) TEST, and Item No 0702801A - PILE LOADING TEST.
- Q9.** Where is Spec. Section 0000354, 4" PVC DUCT BANKS - 12 DUCTS?
- A9.** The Specification for Item for 0000354A - 4" PVC DUCT BANKS - 12 DUCTS was included in the original advertised bid package as part of the multi-item specification starting with Item 0000591A - 3" PVC DUCT BANKS - 2 DUCTS.

- Q10.** Where is Missing Spec. Sections 0000357A, 4" RGS DUCT BANKS - 2 DUCTS?
- A10.** Addendum 1 deleted Item 0000357A - 4" RGS DUCT BANKS - 2 DUCTS from the bid proposal form. This Item no longer applies to this project.
- Q11.** Where is the ConnDOT Storage yard where the removed steel tracks get delivered to as stated on page 452 of the Special Provisions?
- A11.** Removed steel tracks will be stockpiled by the Contractor within the New Haven Rail Yard property, at a location determined by the Engineer during construction, and turned over to Metro-North Railroad.
- Q12.** What is the work shift change out schedule for Rail Road Employees at the Rail Yard? This information is requested so we may schedule our access road activities.
- A12.** The New Haven Rail Yard is an operational rail yard 24 hours a day, 7 days a week. The various Metro-North Departments have different shift changes at different times, but the majority of workers are Metro-North Mechanical employees with the following general shift changes: 12:00 a.m., 8:00 a.m. and 4:00 p.m. All work impacting Railroad Operations needs to be coordinated and approved by Metro-North in advance of any physical work as outlined in Specification Section 1.05 - CONTROL OF THE WORK, Subsection 1.05.06 - Cooperation With Utilities (including railroads), starting on page 187 of the specifications. It will be possible to establish detours and/or close certain sections of the access road during construction; however, these impacts need to be minimized to the greatest extent possible before they will be approved on a case-by-case basis.
- Q13.** On page 12 of the specification the following is stated "The Department cannot ensure a response to inquiries received later than ten (10) days prior to the original scheduled opening of the related bid. ConnDOT will issue an addendum addressing all questions that are made part of the bidding documents.", but on page 10 all site visit questions must be submitted on later than 4 PM Monday, February 28, 2011, please clarify the intent and deadline for RFI.
- A13.** Bidder Questions specific to the site visit noted on page 10 of the specifications were required to be submitted by February 28, 2011. Bidder Questions relative to the Contract Documents are required to be submitted 10 days prior to the original scheduled bid opening, which is March 23, 2011, as noted on page 12 of the specifications.
- Q14.** On page 15 of the specification the following is stated, "Except where specifically indicated in the Contract Plans, all proposed work contained within an area 5 feet outside of the Independent Wheel True Facility exterior building limits shall be included in the lump sum cost of the building." Do items such as piles, dewatering, sidewalk, bollards, earth excavation, structural excavation, disposal of pcb waste and any other items that are

within the 5' area, are to be including within the building unit price or there own respective unit prices?

- A14.** The CSI Specifications describe all work that is included in the Major Lump Sum Item (MLSI). Work described in the CSI Specifications includes work within the building footprint, extending horizontally to a point 5'-0" from the foundation wall including all utility service connections, and extends vertically to the bottom of the concrete slabs, grade beams, equipment pits, and pile caps, and includes the items located within the pits, which also may extend below the bottom of these concrete limits. All other work both within and outside the building footprint not included in the CSI specifications is covered by the Form 816 Items.
- Q15.** On drawing SS-019, detail D/S5-008, there is listed "14 - #17 vert." rebar, is this a typo?
- A15.** On drawing S5-019 (sheet 248) detail D/S5-008, the note which currently calls for "14-#17 VERT." rebar is incorrect. The correct call out should be "14-#7 VERT." Drawing S5-019 (sheet 248) has been revised in Addendum No. 3.
- Q16.** Due to the uncertainty of World events will the DOT consider a Fuel adjustment item similar to the asphalt adjustment costs item?
- A16.** No, the contract duration does not warrant a Fuel Adjustment Item so it will not be added to the project.
- Q17.** Special Provision page 684-685 section 1400101A only calls for Infiltration and Exfiltration testing with no mention of a high pressure test. One option by the designer may be for a Low Pressure test.

Sanitary Note 6 A on Sheet 088 calls for 150 psi testing on the system. I am understanding that the 150 psi test is just for areas where the sanitary and water are within conflict range as outlined.

Question: Can the Sanitary lines be installed and tested following the Sanitary Pipe specification 1400101A for Infiltration, Exfiltration, Optional low pressure test and the 150 psi test is reserved for areas where there are waterline proximity conditions?

- A17.** Sanitary lines shall be installed and tested according to sanitary pipe specification 1400101A - 6" POLYVINYL CHLORIDE PIPE (SANITARY SEWER) for infiltration, exfiltration, and using low pressure test. Note 6A on drawing UW-000 (Sheet 088) only addresses concerns for the sanitary & water conflict during sanitary installation, recommending long-term remedial measures and presumes that measures shall apply only at the conflict location.
- Q18.** Under which bid item are the guy anchor foundations on drawing E-402 (sheet 171) paid?

- A18.** All catenary structure foundations (including guys) shall be paid under Item 0104057A - POLE FOUNDATIONS, TYPE A.
- Q19.** Under which bid items are the relocation of the existing water lines made?
- A19.** The relocation of the existing water lines as shown on drawing UW-002 (sheet 090) is not required. Drawings UW-002 (sheet 090) and UR-002 (sheet 078) were updated in Addendum No. 1 to show the existing water lines as abandoned and to be removed. The removal of the existing water lines is included in Item 0205003A - TRENCH EXCAVATION 0' - 10' DEEP.
- Q20.** Drawing A5-402 Detail 2 Exterior Stair Section. Is the stair to be steel or fiberglass as detail 4/A5-403 shows fiberglass stair treads and stringers?
- A20.** Drawing A5-402 (sheet 216) is correct. Entire exterior stair assembly, including support structure, stair structure, railings and guardrails and treads shall be painted steel. Specification Section 05 50 00 - METAL FABRICATIONS and Detail 4 on Drawing A5-403 (sheet 217) are revised in Addendum No. 3.
- Q21.** On drawing A5-702 Finish Schedule. In Men's and Women's toilet and locker rooms the finish schedule calls for a quarry tile floor and base however the tile spec calls for a porcelain paver tile.
- A21.** Men's and Women's locker and toilet rooms shall be quarry tile. Finish schedule on Drawing A5-702 (sheet 228) and specification section 09 30 00 - TILE are revised in Addendum No. 3.
- Q22.** Fireproofing Question: Code Data Drawing Sheet No 191 calls out for 0 hour rating everywhere except Electrical Room 01 & 02 and Fire Protection Room 04 which get 1 hour. There are no details in drawings showing these areas getting sprayed. Spec section 078100 calls out for light density material, medium density material and intumescent fireproofing. What product goes where?
- A22.** Exposed cementitious sprayed fire-resistive materials shall be used to achieve required rating. Refer to Specification Section 07 81 00 -APPLIED FIREPROOFING, Part 2.2.
- Q23.** In the Wheel truing Pit, the design calls for reinforced Lightweight concrete fill to be placed over the concrete pile cap and slab. The section views on sheet S5-017 state that the top of the slab varies and the contractor is instructed to refer to the Industrial Drawings and the Wheel True Manufacturers approved shop drawings. Are these drawings available? Without these drawings it will be impossible to quantify the cost of placing the lightweight concrete. If the drawings are not available, would the DOT consider making the Lightweight concrete a unit price item?

- A23.** The Wheel True Manufacturer's shop drawings are not completed yet so they can not be provided. A separate unit price item for light weight concrete will not be provided; the cost for this work shall be included in the MLSI Item 01000150A - MAINTENANCE FACILITY. The estimated quantity of lightweight concrete to be placed over the normal weight concrete slab in the wheel truing pit is assumed to be approximately 250 cubic yards. The prime contractor that is awarded the contract is required to confirm and coordinate with pit shop drawings and wheel truing equipment manufacturer's requirements. Please note that formwork and top of concrete for this additional lightweight concrete will vary and will include other embedded items.
- Q24.** Spec Section 099100 Painting. Finish paint schedule item 11 Anti-Graffiti Coating. Do you want this applied over the precast concrete panels since there is no exterior concrete block? Please advise.
- A24.** Anti-graffiti coating is not required. Specification Section 09 91 00 - PAINTING does not apply to the precast concrete panels.
- Q25.** Are there any plans available that show the contours of the site as sits now? The borings location plan (sheet GS-005) does not portray the actual current existing conditions.
- A25.** The existing contours shown on drawing GS-005 (sheet 362) reflect the site prior to the demolition of the existing power plant and subsequent construction of the temporary unpaved parking lot in its footprint. Although there is currently no plan available which depicts the updated contours in the immediate vicinity of the power plant, the grades have not changed significantly from what is shown. The power plant was removed and the parking lot grading was performed to match the existing conditions. Any change in grade should be negligible. The existing concrete barrier configuration in the parking area and the concrete foundations left in place are depicted on Drawing CD-002 (sheet 021). Please note that the background mapping on all the respective site drawings has also been updated to reflect the current conditions.
- Q26.** Item #0203003A Structure Excavation - Earth (Complete) - states that all excavation, preparation of foundations, all necessary filling, and the removal of surplus material. The added paragraph states that the handling and disposal of the contaminated material is paid for under the "Controlled materials Handling" and "Disposal of Controlled Materials". It goes on to state "transport and placement of suitable reusable controlled material . . . will be paid for under "Management of Reusable Controlled Material". Item #0202318A Management of Reusable Controlled Material - states that this soil shall be deemed structurally suitable and this soil can not be placed below the water table.

What material is to be used to backfill the structure below the water table? Where is that paid for? If it is granular fill is it paid for under the pay item #0214022 Compacted Granular Fill or is it paid for under #0203003A Structure Excavation – Earth (Complete)?

- A26.** Item 0213013 - GRANULAR FILL shall be used for backfill below the water table. Refer to drawing GG-011 (sheet 010) general note 11 and drawing CM-002 (sheet 039) note 2.
- Q27.** The following specifications sections do not appear to have bid items on the proposal form: #0216003A- Pervious Structure Backfill, #0652101A- Plug pipe, #1700001A- Service Connections (estimated cost).
- A27.** Addendum No 1 deleted the specifications for Item 0216003A - PERVIOUS STRUCTURE BACKFILL, Item 0652101A - PLUG PPE, and Item 1700001A - SERVICE CONNECTIONS (ESTIMATED COST) from the project.
- Q28.** Specification Section #0702396A- Driving Prestressed Concrete Piles is missing Method of Measurement and Basis of Payment description.
- A28.** The Specification included in the Contract for Item 0702396A - DRIVING PRESTRESSED CONCRETE PILES supplements the information provided in section 7.02 of the Form 816, Standard Specifications for Roads, Bridges, and Incidental Construction. Please refer to NOTICE TO CONTRACTOR - STANDARD SPECIFICATIONS and NOTICE TO CONTRACTOR - GENERAL REQUIREMENTS AND COVENANTS OF THE CONTRACT for additional specification information.
- Q29.** Specification Section #1400101A- 6" PVC (sanitary sewer), #1400102A- 8" PVC (sanitary sewer) and #1400103A-12" PVC (sanitary sewer) has note under basis of payment to include dewatering. All other utility specs for storm, water and electrical indicate dewatering to be included under bid item #0204503A- Dewatering. Please clarify.
- A29.** All dewatering operations will be included under Item #0204503A - DEWATERING. The dewatering references in Item 1400101A - 6" POLYVINYL CHLORIDE PIPE (SANITARY SEWER), Item 1400102A - 8" POLYVINYL CHLORIDE PIPE (SANITARY SEWER), and Item 1400103A - 10" POLYVINYL CHLORIDE PIPE (SANITARY SEWER) have been deleted. A revised specification is included in Addendum No. 3.
- Q30.** Concrete Waterstops for storm, water and sanitary piping to be installed every 25 feet, is this correct?
- A30.** Addendum No. 1 modified Drawings UM-001 (sheet 093), UM-098 (sheet 089), UM-015 (sheet 103) and specifications for Items 0651380A - 36" POLYVINYL CHLORIDE PIPE, 0651743A - 6" POLYVINYL CHLORIDE PIPE, 0651746A - 12" POLYVINYL CHLORIDE PIPE, 0651757A - 18" POLYVINYL CHLORIDE PIPE, 0651761A - 24" POLYVINYL CHLORIDE PIPE, 0651762A - 30" P.V.C. PIPE, 1301081A - 6" DUCTILE IRON PIPE (WATER MAIN), 1301082A - 8" DUCTILE IRON PIPE (WATER MAIN), 1301084A - 12" DUCTILE IRON PIPE (WATER MAIN), 1400101A

- 6" POLYVINYL CHLORIDE PIPE (SANITARY SEWER), 1400102A - 8" POLYVINYL CHLORIDE PIPE (SANITARY SEWER), and 1400103A - 10" POLYVINYL CHLORIDE PIPE (SANITARY SEWER) for storm, water and sanitary piping as noted below. Addendum No 1 also added Item 1301080A - 4" DUCTILE IRON PIPE (WATER MAIN), which also included the corrected information.

Storm and Sanitary Pipes: place concrete waterstops full width of trench from bottom of trench to 12" above pipe at the midpoint of each run greater than 100' between structures or as directed by the Engineer. Forms are not required however the contractor may utilize them to restrain the width of the stop. A minimum width of 6" is required for each stop. Waterstops are not required in trenches with less than 100' between structures. Concrete waterstops shall be concrete class "c" with no reinforcing and will be included in the cost of the pipe.

Water Pipes: place concrete waterstop full width of trench from bottom of trench to 12" above pipe every 100' or as directed by the Engineer. A minimum width of 6" is required for each waterstop. Concrete waterstops shall be concrete class "c" with no reinforcing and will be included in the cost of the pipe.

- Q31.** Is the demolition of concrete pits, slabs, pads and footings shown on drawing CD-002 (sheet 021) paid under bid item #0203103-Structural Excavation Rock (complete).
- A31.** Yes, the removal of the concrete pits, slabs, pads and footings shown on drawing CD-002 (sheet 021) will be paid under Item 0203103 - STRUCTURE EXCAVATION ROCK (COMPLETE).
- Q32.** Spec section #0101128A - Construct & Dismantle WSA, who supplies the additional precast concrete blocks for construction of proposed bins? During dismantling of WSA who is responsible for the removal and storage of precast concrete blocks?
- A32.** All concrete blocks required to construct the WSA as shown on the plans are currently available within the New Haven Rail Yard. The Contractor will be compensated for any additional blocks that may become required. The WSA will be left in place as constructed for use on future projects so removal and storage of concrete blocks is not required. The specification for Item 101128A - SECURING, CONSTRUCTION AND DISMANTLING OF A WASTE STOCKPILE AND TREATMENT AREA has been revised in Addendum No. 3.
- Q33.** Spec. Section/Bid Item #406171- HMA SO.375 is not indicated on Drawing CM-001 (sheet 038), Road Section shows HMA SO 1.0. Please clarify.
- A33.** Drawing CM-001 (sheet 038) indicates the use of Superpave 0.5" and Superpave 1.0" for paved access roads and driveways. This is consistent with Contract Item 0406170 - HMA S1 and Item 0406171 - HMA S0.5 which are included on the bid item form. An item for HMA S0.375 is not required and has not been included in this project.

- Q34.** Please clarify if the ballast and track work that is to be installed inside the east and west wings of the building paid for under the unit price or the lump sum.
- A34.** All ballast, subballast and track work within the car storage sheds will be paid for under Item 0728020A - STONE BALLAST, Item 0213902A - SUBBALLAST, and Item 0504010A - RAILROAD TRACK WORK respectively. Refer to Drawing CM-002 (sheet 039) Track Section Car Storage Sheds for requirements of ballast and subballast. Also refer to the method of measurement section in Item 0504010A - RAILROAD TRACK WORK which states that "Track installed within the car storage areas will be included in this measurement".
- Q35.** Please clarify that the Contractor is not responsible for the installation of the Dual Axle Wheel Truing Machine and only has to coordinate the installation with the Supplier as stated in Specification Section 11 90 00 Item 3.5.A.
- A35.** Correct, the contractor is not required to physically install the dual axle wheel truing machine. Please refer to the NOTICE TO CONTRACTOR - PROJECT COORDINATION and the NOTICE TO CONTRACTOR - PROJECT PHASING REQUIREMENTS, which outline the contractor's coordination requirements relative to the dual axle wheel truing machine.
- Q36.** Please clarify that the Contractor is not responsible for the installation of the Car Mover Utility Vehicle and the Contractor is only responsible for the electrical apparatus for battery charging as stated in Specification Section 11 90 00 Item 3.5.B.
- A36.** Correct, the contractor is not required to physically install the car mover utility vehicle. The contractor is only responsible for the electrical apparatus for battery charging as stated in CSI Specification Section 11 90 00 - INSTALLATION OF OWNER FURNISHED EQUIPMENT, Part 3.5.B.
- Q37.** Based on locations for Columns B7, B11, B12 - Base Plate Type C1 and Columns B8, B9, B10 - Base Plate Type C2. The column schedule and the foundation plan elevations the top of footing and bottom of base plate elevation are the same. These two base plate details indicate a "Grout Hole". These two types of columns are on leveling nuts and not 1/4" leveling plates as typically detailed. What will the grout thickness be for base plate details C1 and C2?
- A37.** The top of footing elevation is 8'-5" for the pilecaps supporting columns B7, B8, B9, B10, B11 and B12. The bottom of base plate elevation for these columns should be 8'-6" and not the 8'-5" which is shown on Drawing S5-021-1 (sheet 250-1). The elevation on Drawing S5-021-1 (sheet 250-1) has been corrected in Addendum No. 3. All base plates are to sit on 1/4" leveling plate and 3/4" (5000 psi) non-shrink grout per note 2 on Drawing S5-021 (sheet 250).

- Q38.** It is indicated that the basis of the design is Oldcastle's CarbonCast 8" assembly with 4" of insulation, allowing for tapered insulation around openings, edges, embeds and/or inserts. Coreslab's design is based on an equivalent R value using polyisocyanurate insulation. What is the minimum equivalent R value that Coreslab needs to design to?
- A38.** Per Specification Section 03 45 00 - ARCHITECTURAL PRECAST CONCRETE, Part 2.5A, R values of 5.0 per inch, or R20 for the 4" cavity is required.
- Q39.** Specification 03450 indicates conventional carbon and galvanized steel reinforcement in Section 2.2: Please clarify which is to be used to reinforce the concrete panels?
- A39.** Use galvanized reinforcement per Specification Section 03 45 00 - ARCHITECTURAL PRECAST CONCRETE, Part 2.2.B.
- Q40.** Specification 03450 indicates carbon, galvanized and stainless steel in Section 2.3: Please clarify which is to be used as steel supports, fasteners and embedded items?
- A40.** These items are to be hot-dipped galvanized per Specification Section 03 45 00 - ARCHITECTURAL PRECAST CONCRETE, Part 2.3.D.
- Q41.** Specification 03450 indicates white cement for facing concrete if required in Section 2.4: Please clarify if white cement is required?
- A41.** White cement is required.
- Q42.** Please indicate what color, texture and mix design is the designer's sample?
- A42.** The precast concrete panel sample shall be as follows: Color: PCI color/finish 117 white per Drawing A5-702 (sheet 228) which is revised in Addendum No.3. Texture: Smooth with appearance and surface texture of limestone per Specification Section 03 45 00 - ARCHITECTURAL PRECAST CONCRETE, Part 1.1.A.1. Mix Design: Per Specification Section 03 45 00 - ARCHITECTURAL PRECAST CONCRETE, Parts 2.6 and 2.7.
- Q43.** Specification 03450 indicates to lightly sandblast all surfaces in Section 2.7.G: Please note that the interior surface is a finished troweled and the exterior is cast against the form, as a result each sandblast texture side will be different: Is this acceptable?
- A43.** Yes, this is acceptable.
- Q44.** Please note that the small amount of concrete over the doors (openings) is not adequate enough to translate the wind load to the columns. Panels will require a wind girt or post ups at doors or large openings, drawings do not show intermediate supports for cladding system. Please clarify with the Engineer of Record.

- A44.** The precast concrete panel design and detailing is the responsibility of the contractor's panel fabricator. If intermediate supports are determined to be required, they shall be designed and furnished by the contractor. This work shall also be coordinated with other interfacing trades during the submittal process. Refer to Specification Section 03 45 00 - ARCHITECTURAL PRECAST CONCRETE, Parts 1.4.D and 1.8.D. Additionally refer to Specification Section 07 42 63 - FABRICATED WALL PANEL SYSTEM, Part 1.5 for requirements of the metal panel system.
- Q45.** Please supply additional information for the Hopper (Mark No. 5464) that is to be relocated: 1 - Where is this equipment currently located? 2 - Will a detailed sketch or layout of the Hopper be made part of the Contract Documents prior to the Bid? 3 - Will electrical requirements for the new location of the Hopper be provided? 4 - The Industrial drawings show two bins marked with #5464, but it also shows a Chip Conveyor that goes back to the Wheel Truing Machine. Should there be an allowance to relocate the Chip Conveyor machine?
- A45.** The hopper and chip conveyor equipment are to be supplied and installed by the wheel truing equipment contractor. The prime contractor is required to confirm and coordinate with pit shop drawings and wheel truing equipment manufacturer's requirements. There should be no allowance for the relocation of these items. Additional sketches beyond the contract documents are not necessary.
- Q46.** Are the questions that were submitted going to be answered?
- A46.** Yes, as noted in the NOTICE TO CONTRACTOR - BIDDER QUESTIONS, all questions submitted 10 days prior to the originally scheduled bid opening of March 23, 2011 will be answered.
- Q47.** Section 074263.2.1 – Will Centria panel be accepted as an alternate?
- A47.** Specification 074263 - FABRICATED WALL PANEL SYSTEM was revised in Addendum No 3 to be an "or equal" specification rather than listing only 3 specific manufacturers. This means the prime contractor that is awarded the project can submit shop drawings that contain products by any manufacturer that meets the requirements of the contract. The designer will review these products and approve them for use if all contractual requirements on the plans and in the specifications are met.
- Q48.** Drawing A5-308 Wall Types. Is wall type 4 a fire rated wall?
- A48.** No, wall type 4 is not a fire rated wall.
- Q49.** On drawing SC-001 in the lower left hand corner, it references a drawing SC-004 from project #301-0106. Also on drawings C5-010, and C5-011, there are manholes shown on the risers not shown on the #300-139 contract documents. Please issue additional drawings and/or information to clarify these items.

- A49.** The reference to Drawing SC-004 from Project 301-106 noted on drawing SC-001 (sheet 120) is revised in Addendum No. 3 to read "SEE DWG NO C5-010 FOR CONTINUATION". Drawings C5-010 (sheet 337) and C5-011 (sheet 338) show the entire rail yard site communications infrastructure including all work currently being installed under Project No. 301-0106, which is currently in construction. Due to the schematic nature of these drawings additional information has been added to clarify the physical distances between locations where work is to be performed under the IWT contract. Notes 5 and 7 have been added to Drawings C5-010 (sheet 337) and C5-011 (sheet 338) respectively in Addendum No. 3.
- Q50.** In regards to the two No. 8 Turnouts to be furnished by MNR, please confirm that all necessary hardware and OTM except switch timbers, will also be provided by MNR.
- A50.** Confirmed, all necessary hardware and OTM except switch timbers, will also be provided by MNR.
- Q51.** Specification Section 221316 – Sanitary Waste, Industrial Waste, and Vent Piping: I have seen the mention of Sanitary Waste & Vent Piping in this section but no mention of Industrial Waste Piping. Would like to know where it is in the specifications. Please Advise.
- A51.** The requirements listed in Specification Section 22 13 16 – SANITARY WASTE, INDUSTRIAL WASTE, AND VENT PIPING apply to all soil, waste and vent piping systems within the building, this includes Industrial Waste Piping Systems. Parts 3.2 B & C specify what type of pipe is required for sanitary waste, industrial waste, and vent piping systems based on above or below grade installations; Parts 2.1 & 2.2 describe the specific requirements for each type of pipe.
- Q52.** Specification Section 221219 – Facility Above Ground Waste-Water Storage Tank. There is a specification for it, but the tank is not shown on the Plumbing Drawings. Please advise as to where the 10,000 gallon tank is.
- A52.** Refer to Drawings UM-020 (sheet 106) and UM-021 (sheet 107) for details of the tank specified in CSI Specification 22 12 19 - FACILITY ABOVE GROUND WASTE-WATER STORAGE TANK. The call-out on Drawing P5-112 (sheet 283) refers to Drawing UD-002 (sheet 080) for continuation of the 3”sump pump discharge. Drawing UD-002 (sheet 080) depicts the 10,000 Gallon Holding Tank which is located just to the south of the building.

The Bid Proposal Form is not affected by these changes.

There will be no change in the number of calendar days due to this Addendum.

The foregoing is hereby made a part of the contract.

NOTICE TO CONTRACTOR – TEST PITS

This Notice is to alert the contractor that the Department of Transportation added six (6) new test pits on Drawing CM-005-2 issued in Addendum 2. The Contractor shall complete these test pits within sixty (60) days from notice to proceed.

The Contractor shall coordinate these activities with the Engineer two (2) weeks prior to performing the work. The Engineer will arrange to have the Designer on-site to record all necessary data so the test pits can be backfilled the same day.

The Contractor shall also coordinate these activities, including the necessary track closures, with Metro-North prior to performing the work as outlined in Specification Section 1.05 - CONTROL OF THE WORK, Subsection 1.05.06 - Cooperation With Utilities (including railroads), starting on page 197 of the specifications.

ITEM #0101128A - SECURING, CONSTRUCTION AND DISMANTLING OF A WASTE STOCKPILE AND TREATMENT AREA

Description:

Work under this Item shall consist of the securing, construction and dismantling of the existing temporary Waste Stockpile Area (WSA) located onsite to the south/southwest of the Project area, as designated on the Project Plans and in accordance with the Contract Documents. All Controlled Materials excavated during construction activities shall be stockpiled in the WSA. The WSA shown on the Project Plans is located 1 foot above the 500-year floodplain in accordance with the Environmental Permits and is to be used exclusively for temporary stockpiling of excavated materials from within Project Areas of Environmental Concern (AOECs) for determination of disposal classification.

Materials:

The required materials are detailed on the Project Plans. All materials shall conform to the requirements of the Contract.

Polyethylene plastic sheeting for underlayment shall be a thickness of 30 mil and minimum width of 10 feet. Polyethylene plastic sheeting for covering excavated material shall be a thickness of 10 mil and minimum width of 10 feet.

Sand bags used to secure polyethylene sheeting soil covers shall have a minimum weight of 30 pounds.

Processed aggregate base shall conform to Section 3.04 of the Specifications.

Hay bales shall conform to the requirements of Section 2.18 of the Specifications.

Roll-off/storage containers shall be of watertight, steel-body construction, of the size specified and able to handle the storage and subsequent transportation of material to the disposal facility.

Construction Methods:

The Contractor shall ensure that the existing WSA has been constructed in accordance with the Contract Documents at the location shown on the Project Plans. Any modifications required, as directed by the Engineer, at the existing WSA shall be completed prior to the initiation of construction activities generating Controlled Materials. The Contractor is responsible for the maintenance and protection of all utilities potentially affected during WSA modifications (if necessary). The Contractor shall locate and mark all existing utilities potentially affected prior to initiating WSA modifications.

The existing bins at the WSA shall be cleared of any debris and vegetation as directed by the Engineer. Any objectionable materials, which may result in damage to the polyethylene sheeting underlayment, shall be removed prior to the stockpiling of the excavated Controlled Materials.

It is anticipated that all concrete blocks required to construct the WSA as shown on the plans are currently available on site. However, any additional blocks that are necessary to construct the bins shall be supplied by the Contractor. The cost for supplying additional blocks will be considered extra and the Contractor will be compensated separately.

The Contractor shall comply with the terms and conditions of the Connecticut Department of Environmental Protection (CTDEP) "General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer)," including the General Operating Conditions, except that the Engineer will conduct all soil characterization and perform all record keeping. In particular, the Contractor shall:

1. Modify and repair the WSA in conformance with the requirements of the General Permit.
2. Prevent unauthorized entry onto the stockpiles by the use of fences, gates, or other natural or artificial barriers.
3. Install anti-tracking measures at the WSA to ensure the vehicles do not track soil from the WSA onto a public roadway at any time.
4. Post and maintain a sign that is visible from a distance of at least 25 feet at the WSA identifying the name of the permittee (State of Connecticut, Department of Transportation (DOT)), the DOT field office phone number, the hours of operation for the WSA, and the phrase, "Temporary Soil Staging Area." Lettering shall be at least 1 inch high with a minimum overall sign dimension of 4 feet wide by 2 feet high. Such sign is only required if the capacity of the WSA is equal to or greater than 1,000 cubic yards. If initially the WSA capacity is less than 1,000 cubic yards and the WSA capacity is subsequently increased, the Contractor shall post and maintain the required sign at no additional cost to the State, prior to stockpiling the additional material.

Following the removal of all stockpiled material, the Contractor shall use dry decontamination procedures, as specified in Item 0101117A, "Controlled Materials Handling," for all surfaces of the WSA as directed by the Engineer. Residual materials shall be disposed of as Controlled Materials or PCB Waste, as applicable. If the results from dry methods are unsatisfactory to the Engineer, the Contractor shall modify decontamination procedures as required.

The Contractor shall be responsible for the collection and treatment/recycling/disposal of any liquid wastes that may be generated by its decontamination activities in accordance with applicable regulations.

Upon completion of the Project and following removal of all residual Controlled Materials (or PCB Waste, as applicable), the Contractor shall remove all materials such as polyethylene

sheeting, sand, and sand bags. Materials shall be disposed of by the Contractor as solid waste in accordance with the Contract and all federal, state and local regulations.

The Contractor shall leave the concrete bins in place as constructed for use on future projects. All additional blocks supplied by the Contractor shall become the property of the owner.

Operation and maintenance of the WSA shall be included under Item 0101117A, "Controlled Material Handling."

Method of Measurement

"SECURING, CONSTRUCTION AND DISMANTLING OF A WASTE STOCKPILE AND TREATMENT AREA" will be measured for payment at the Lump Sum cost for securing, construction, and dismantling of the existing temporary WSA.

Basis of Payment

This work will be paid for at the Contract Lump Sum, which shall include all materials, tools, labor, equipment, permits, and work needed to secure, construct, decontaminate and dismantle the existing temporary WSA, including all clearing, grubbing, and grading (if necessary), clean up, site restoration and seeding.

All materials, labor, and equipment associated with compliance with the "General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer)" will not be measured separately, but will be considered incidental to the Item 0101128A, "Securing, Construction and Dismantling of a Waste Stockpile and Treatment Area."

<u>Pay Item</u>	<u>Pay Unit</u>
Securing, Construction and Dismantling of a Waste Stockpile and Treatment Area	L.S.

ITEM #0969064A - CONSTRUCTION FIELD OFFICE, LARGE

Description: Under the item included in the bid document, adequate weatherproof office quarters will be provided by the Contractor for the duration of the work, and if required, for a maximum of ninety days thereafter for the exclusive use of ConnDOT forces and others who may be engaged to augment ConnDOT forces with relation to the contract. The office quarters shall be located convenient to the work site and installed in accordance with Article 1.08.02, this office shall be separated from any office occupied by the Contractor. Ownership and liability of the office quarters shall remain with the Contractor. The Contractor shall contact the District after award of the Contract to coordinate the field office location and computer submittals.

Materials: Materials shall be in like new condition for the purpose intended and shall be approved by the Engineer.

Office Requirements: The Contractor shall furnish the office quarters and equipment as described below.

	<u>Description:</u>
<u>1,200 SF</u>	<u>Sq. Ft. of floor space with a minimum ceiling height of 7 ft. and shall be partitioned as shown on building floor plan as provided by the Engineer.</u>
<u>2 EA</u>	<u>Minimum number of exterior entrances.</u>
<u>10 EA</u>	<u>Minimum number of parking spaces.</u>

Office layout: The office shall have a minimum square footage as indicated in the table above, and shall be partitioned as shown on building floor plan as provided by the Engineer. The underside of the office shall be fully skirted to the ground.

Lavatory Facilities: The Contractor shall furnish a minimum of two (2) separate lavatories and toilet facilities with signs (“men” and “women”), in separately enclosed rooms that are properly ventilated and comply with applicable sanitary codes. The Contractor shall provide each lavatory with hot and cold running water and flush-type toilets. Provide pipe insulation and heat trace on the water service above ground and underground where the burial depth is less than four feet. Provide underground pipe insulation with heat trace in raceway on the sanitary service where the burial depth is less than eighteen inches. Slope sanitary service ¼” per foot. He shall also supply lavatory and sanitary supplies as required.

Windows and Entrances: The windows shall be of a type that will open and close conveniently, shall be sufficient in number and size to provide adequate light and ventilation, and shall be fitted with locking devices, blinds and screens. The entrances shall be secure, screened, and fitted with a lock for which ten keys shall be furnished for each lock type. All keys to the construction field office shall be furnished to the Department and will be kept in their possession while State personnel are using the office. Any access to the entrance ways shall meet applicable building codes and be slip resistant, with appropriate handrails.

Lighting: The Contractor shall equip the office interior with electric lighting that provides a minimum illumination level of 100 foot-candles at desk level height, and electric outlets for each desk and drafting table. The Contractor shall also provide exterior lighting that provides a minimum illumination level of 2 foot-candles throughout the parking area and for a minimum distance of 10 ft. on each side of the field office.

The Contractor shall provide the following additional equipment, facilities, and/or services at the Field Office on this project to include at least the following to the satisfaction of the Engineer:

Parking Facility: Adequate parking spaces with adequate illumination on a paved surface, with surface drainage if needed. If paved parking does not exist adjacent to the field office, the Contractor shall provide a parking area of sufficient size to accommodate the number of vehicles indicated in the table above. Construction of the parking area and driveway, if necessary, will consist of a minimum of 6 inches of processed aggregate base graded to drain. The base material will be extended to the office entrance.

Field Office Security: Physical Barrier Devices - This shall consist of physical means to prevent entry, such as: 1) All windows shall be barred or security screens installed; 2) All field office doors shall be equipped with dead bolt locks, regular day operated door locks, bars with padlocks; and 3) Other devices as directed by the Engineer to suit existing conditions.

Electric Service: The field office shall be equipped with an electric service panel to serve the electrical requirements of the field office, including: lighting, general outlets, computer outlets, calculators etc., and meet the following minimum specifications:

- A. 120/240 volt, 1 phase, 3 wire.
- B. Ampacity necessary to serve all equipment. Service shall be a minimum 100 amp dedicated to the construction field office.
- C. The electrical panel shall include a main circuit breaker and branch circuit breakers of the size and quantity required.
- D. Additional 120 volt, single phase, 20 amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed at each computer workstation location.
- E. Additional 120 volt, single phase, 20 amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed, for use by the Telephone Company.
- F. Additional 120-volt circuits and duplex outlets as required meeting National Electric Code requirements.
- G. One exterior (outside) wall mounted GFI receptacle, duplex, isolated ground, 120 volt, straight blade for curing box. Located as directed by DOT field personnel.
- H. After work is complete and prior to energizing, the State's ConnDOT electrical inspector, must be contacted at 860-594-2240. (Do Not Call Local Town Officials)
- I. Prior to field office removal the ConnDOT Data Communications office must be notified to deactivate the communications equipment.

Heating, Ventilation and Air Conditioning (HVAC): The field office shall be equipped with sufficient heating, air conditioning and ventilation equipment to maintain a temperature range of

68°-80° Fahrenheit within the field office. Provide maintenance. Change air filters and vacuum returns every three months.

The Following Furnishings and Equipment Shall Be Provided In The Applicable Field Office Type:

Qty	Description:
7 EA	Office desks (2.5 ft x 5 ft) with drawers, locks, and matching desk chairs that have pneumatic seat height adjustment and dual wheel casters on the base.
20EA	Office Chairs.
2 EA	Fire resistant cabinets (legal size/4 drawer), locking.
1 EA	Standard secretarial type desk and matching desk chair that has pneumatic seat height adjustment and dual wheel casters on the base.
1 EA	Conference table, 3 ft x12 ft.
5 EA	Non-fire resistant cabinets (legal size/4 drawer), locking.
1 EA	Storage racks to hold 3 ft x 5 ft display charts.
1 EA	Mail slot bin - legal size.
1 EA	Drafting type tables (3 ft x 6 ft) and supported by wall brackets and legs; and matching drafters stool that have pneumatic seat height adjustment, seat back and dual wheel casters on the base.
1 EA	Flat file (4/drawers).
7EA	Personal computer tables (4 ft x 2.5 ft).
1 EA	Hot and cold water dispensing unit and supply of cups and bottled water shall be supplied by the Contractor for the duration of the project.
2 EA	Electronic office type printing calculators capable of addition, subtraction, multiplication and division with memory and a supply of printing paper.
7EA	Telephone.
1 EA	Telephone answering machine.
1 EA	Plain paper facsimile (FAX) machine capable of transmitting via telephone credit card. All supplies, paper and maintenance shall be provided by the Contractor.
1 EA	Copier/Scanner – Color, high speed, dry, plain paper with stapling and sorting capability, automatic feeder and reducing capability. The copier shall be capable of producing a minimum of 25 copies per minute. It shall produce 8 ½ x 11 and 11 x 17 copies. All supplies, paper and maintenance shall be provided by the Contractor.
7EA	Computer systems as specified below under <u>Computer Hardware and Software</u> . All supplies and maintenance shall be provided by the Contractor.
2EA	Laser printer as specified below under <u>Computer Hardware and Software</u> . All supplies, paper and maintenance shall be provided by the Contractor.
1EA	Digital Camera as specified below under <u>Computer Hardware and Software</u> . All supplies and maintenance shall be provided by the Contractor.
1 EA	Wastebaskets - 30 gal., including plastic waste bags.
7EA	Wastebaskets - 5 gal., including plastic waste bags.
2 EA	Electric pencil sharpeners.
* EA	Fire extinguishers - provide and install type and number to meet applicable State and local codes for size of office indicated, including a fire extinguisher suitable for use on a computer terminal fire.

Qty	Description:
6 EA	Interior partitions - 6 ft x 6 ft, soundproof type, portable and freestanding.
2 EA	Vertical plan racks for 2 sets of 2 ft x 3 ft plans for each rack..
1 EA	Double door supply cabinet with 4 shelves and a lock - 6 ft x 4 ft.
1 EA	Easel/chalkboard.
3 EA	Open bookcases - 3 shelves - 3 ft long.
1 EA	Infrared Thermometer, including certified calibration, case, cleaning wipes.
1 EA	Double door supply cabinet with 4 shelves and a lock - 6 ft x 4 ft.
1 EA	Concrete Curing Box as specified below under <u>Concrete Testing Equipment</u> .
1 EA	Concrete Air Meter as specified below under <u>Concrete Testing Equipment</u> .
1 EA	Concrete Slump Cone as specified below under <u>Concrete Testing Equipment</u> .
1 EA	Indoor Outdoor Thermometer Degrees F.
1 EA	Code Books: Connecticut Specific Edition of the 2003 International Building Code with Commentary, 2003 International Structural Code, 2003 International Mechanical Code, 2003 International Plumbing Code, ICC/ANSI A117.1-203 Accessible and Usable Buildings and Facilities, 2011 and 2005 National Electrical Code with Handbook. Include supplements and amendments. Provide one hard copy, electronic copies or on line access for DOT field personnel.

The furnishings and equipment required herein shall remain the property of the Contractor. Any supplies required to maintain or operate the above listed equipment or furnishings shall be provided by the Contractor for the duration of the project.

Telephone Service: This shall consist of two (2) telephone lines: one (1) line for phone/voice service and one (1) line dedicated for the facsimile machine. The Contractor shall pay all charges except for out-of-state toll calls made by State personnel.

Data Communications Facility Wiring: Contractor shall install a Category 5e 468B patch panel in a central wiring location and Cat 5e cable from the patch panel to each PC station, terminating in a (category 5e 468B) wall or surface mount data jack. The central wiring location shall also house either the data circuit with appropriate power requirements or a category 5 cable run to the location of the installed data circuit. The central wiring location will be determined by the ConnDOT Data Center staff in coordination with the designated field office personnel as soon as the facility is in place. The ConnDOT Project Engineer will provide the Contractor with a copy of the current PC specifications, approved printer list and data wiring schematic as soon as possible after the contract is awarded.

Contractor to run a CAT 5e LAN cable a minimum length of 25 feet for each computer to LAN switch area leaving an additional 10 feet of cable length on each side with terminated RJ45 connectors. Each run / jack shall be clearly labeled with an identifying Jack Number.

The installation of a data communication circuit between the field office and the ConnDOT Data Communication Center in Newington will be coordinated between the ConnDOT District staff, ConnDOT Office of Information Systems and the local phone company. The ConnDOT District staff will coordinate the installation of the data communication service with ConnDOT PC Support

once the field office phone number is issued. The Contractor shall provide the field office telephone number(s) to the ConnDOT Project Engineer as soon as possible to facilitate data line and computer installations.

Computer Hardware and Software:

The ConnDOT Project Engineer will provide the Contractor with a copy of the current PC specifications, approved printer list and data wiring schematic as soon as possible after the contract is awarded.

Before ordering the computer hardware and software, the Contractor must submit a copy of their proposed PC specifications and the type of printer to the ConnDOT Project Engineer for review by the ConnDOT Data Center. If the specification meets or exceeds the minimum specifications listed below, then the Contractor will be notified that the order may be placed.

Before any equipment is delivered to the Data Center, arrangements must be made a minimum of 24 hours in advance by contacting 860-594-3500. All software, hardware and licenses listed below shall be clearly labeled, specifying the (1) Project No., (2) Contractor Name, (3) Project Engineer's Name and (4) Project Engineer's Phone No., and shall be delivered to the ConnDOT Data Center, 2710 Berlin Turnpike, Newington, CT, where it will be configured and prepared for field installation. Installation will then be coordinated with ConnDOT field personnel and the computer system specified will be stationed in the Department's project field office.

The computer system furnished shall have all software and hardware necessary for the complete installation of the latest versions of the software listed, and therefore supplements the minimum specifications below. The Engineer reserves the right to expand or relax the specification to adapt to the software and hardware limitations and availability, the compatibility with current agency systems, and to provide the Department with a computer system that can handle the needs of the project. This requirement is to ensure that the rapid changing environment that computer systems have experienced does not leave the needs of the project orphan to what has been specified. There will not be any price adjustment due to the change in the minimum system requirements.

The Contractor shall provide the Engineer with a licensed copy registered in the Department's name of the latest versions of the software listed and maintain customer support services offered by each software producer for the duration of the Contract. The Contractor shall deliver to the Engineer all supporting documentation for the software and hardware including any instructions or manuals. The Contractor shall provide original backup media for the software.

The Contractor shall provide the computer system with all required supplies, maintenance and repairs (including labor and parts) throughout the Contract life.

Once the Contract has been completed, the computer will remain the property of the Contractor. Prior to the return of any computer(s) to the Contractor, field personnel will coordinate with the

Data Center personnel for the removal of Department owned equipment, software, data, and associated equipment.

A) Computer – Minimum Specification:

Processor – Intel® Core 2 Duo Processor (2.00 GHz, 800 MHz FSB 2MB L2 Cache)

Memory – 4 GB DIMM DDR2 667MHz.

Monitor – 24 inch LCD color monitor.

Graphics – Intel Graphics Media Accelerator 3100 or equivalent.

Hard Drive – 160 GB Ultra ATA/SATA hard drive (Western Digital, IBM or Seagate).

Optical Drive – CD-RW/DVD-RW Combo.

Spare USB Ports 2 each for camera and external hard drive.

Multimedia Package – Integrated Sound Blaster Compatible AC97 Sound and speakers.

Case – Small Form or Mid Tower, capable of vertical or horizontal orientation.

Integrated Network Adapter – comparable to 3COM PCI 10/100 twisted pair Ethernet.

Keyboard – 104+ Keyboard.

Mouse – Optical 2-button mouse with scroll wheel.

Operating System – Windows 7 Professional.

Application Software – MS Office Professional Edition 2007.

Additional Software (Latest Releases, including subscription services for the life of the Contract) –

Norton Anti-Virus and CD/DVD burning software (ROXIO or NERO),

Adobe Acrobat Standard

Resource or Driver CD/DVD – CD/DVD with all drivers and resource information so that computer can be restored to original prior to shipment back to the contractor.

Uninterrupted power supply – APC Back-UPS 500VA.

Note A1: All hardware components must be installed before delivery. All software documentation and CD-ROMs/DVD for Microsoft Windows 7 Professional, Microsoft Office 2007 Professional Edition, and other software required software must be provided. Computer Brands are limited to Dell (preferred) and HP (acceptable) brands only. No other brands will be accepted. The ConnDOT Project Engineer will provide the Contractor with a copy of the current PC specifications and approved printer list as soon as possible after the contract is awarded.

B) Laser Printer – Minimum Specification:

Print speed – 20 ppm.

Resolution – 1,200 x 1,200 dpi.

Paper size – Up to 216 mm x 355 mm (8.5 in x 14 in).

RAM – 16 MB.

Print Drivers – Must support HP PCL6 and HP PCL5e.

Printer cable – 1.8 m (6 ft).

Note B1: Laser printer brands are limited to Hewlett-Packard and Savin brands only. The ConnDOT Project Engineer will provide the Contractor with a copy of the current PC specifications and approved printer list as soon as possible after the contract is awarded.

Note B2: It is acceptable to substitute a multi-function all-in-one printer/copier/scanner/fax machine listed on the approved printer list in place of the required laser printer and fax machine.

C) Digital Camera – Minimum Specification:

Optical – 5 mega pixel, with 3x optical zoom.

Memory – 2 GB.

Features – Date/time stamp feature.

Connectivity – USB cable or memory card reader.

Software – Must be compatible with Windows 7 Professional.

Power – Rechargeable battery and charger.

Supply protective carrying case for camera.

The Contractor is responsible for service and repairs to all computer hardware. All repairs must be performed with-in 48 hours. If the repairs require more than a 48 hours then a replacement must be provided. All supplies, paper and maintenance for the computers, laptops, printers, copiers, and fax machines shall be provided by the Contractor.

Concrete Testing Equipment: If the Contract includes items that require compressive strength cylinders for concrete, in accordance with the Schedule of Minimum Testing Requirements for Sampling Materials for Test, the Contractor shall provide the following. All testing equipment will remain the property of the Contractor at the completion of the project.

- A) Concrete Cylinder Curing Box – meeting the requirements of Section 6.12 of the Standard Specifications.
- B) Air Meter – The air meter provided shall be in good working order and will meet the requirements of AASHTO T 152.
- C) Slump Cone Mold – Slump cone, base plate, and tamping rod shall be provided in like-new condition and meet the requirements of AASHTO T119, Standard Test Method for Slump of Hydraulic-Cement Concrete.
- D) Wheel Barrow

Insurance Policy: The Contractor shall provide a separate insurance policy, with no deductible, in the minimum amount of forty thousand dollars (\$40,000.00) in order to insure all State-owned data equipment and supplies used in the office against all losses. The Contractor shall be named insured on that policy, and the Department shall be an additional named insured on the policy. These losses shall include, but not be limited to: theft, fire, and physical damage. The Department will be

responsible for all maintenance costs of Department owned computer hardware. In the event of loss, the Contractor shall provide replacement equipment in accordance with current Department equipment specifications, within seven days of notice of the loss. If the Contractor is unable to provide the required replacement equipment within seven days, the Department may provide replacement equipment and deduct the cost of the equipment from monies due or which may become due the Contractor under the contract or under any other contract. The Contractor's financial liability under this paragraph shall be limited to the amount of the insurance coverage required by this paragraph. If the cost of equipment replacement required by this paragraph should exceed the required amount of the insurance coverage, the Department will reimburse the Contractor for replacement costs exceeding the amount of the required coverage.

Maintenance: During the occupancy by the Department, the Contractor shall maintain all facilities and furnishings provided under the above requirements, and shall maintain and keep the office quarters clean through the use of weekly professional cleaning to include, but not limited to, vacuuming, washing & waxing floors, cleaning restrooms, removal of trash, etc. Exterior areas shall be mowed and clean of debris. A trash receptacle (dumpster) with weekly pickup (trash removal) shall be provided. Snow removal, sanding and salting of all parking, walkway, and entrance ways areas shall be accomplished during a storm if on a workday during work hours, immediately after a storm and prior to the start of a workday. If snow removal, salting and sanding are not completed by the specified time, the State will provide the service and all costs incurred will be deducted from the next payment estimate.

Method of Measurement: The furnishing and maintenance of the construction field office will be measured for payment by the number of calendar months that the office is in place and in operation, measured to the nearest month.

There will not be any price adjustment due to any change in the minimum computer system requirements.

Basis of Payment: The furnishing and maintenance of the construction field office will be paid at the listed unit price per month for the respective item "Construction Field Office, Large", which price shall include all material, equipment, labor, utility services and work incidental thereto.

The cost of providing the parking area, external illumination, trash removal and snow and ice removal shall be included in the monthly unit price bid for the respective item "Construction Field Office, Large".

The State will be responsible for payment of data communication user fees and for toll calls by State personnel.

<u>Pay Item</u>	<u>Pay Unit</u>
Construction Field Office, Large	Month

ITEM #1400101A - 6" POLYVINYL CHLORIDE PIPE (SANITARY SEWER)

ITEM #1400102A - 8" POLYVINYL CHLORIDE PIPE (SANITARY SEWER)

ITEM #1400103A - 10" POLYVINYL CHLORIDE PIPE (SANITARY SEWER)

Description:

The sizes, types and slopes of pipe are indicated on the Contract Drawings, which requirements as to pipe size, type, slope, etc., shall be observed. The types of pipe, which shall be used for various parts of the work as indicated above, shall be as follows:

- a. Gravity Sanitary Sewer Pipe shall be polyvinyl chloride pipe. All pipe to be used shall be subject to approval by the Designer.

This work shall also include the satisfactory testing of the gravity pipe, the backfilling of the casing pipe annular space and the maintenance of existing wastewater flows during the installation of the new work.

Materials:

- a. Polyvinyl Chloride Pipe (PVC): This pipe and fittings shall be suitable for non-pressure drainage of sewage, certain other liquid wastes, where toughness, resistance to deterioration from the action of water and chemicals, dimensional stability, resistance to aging and tight joints are required. Pipe shall conform to the latest ASTM Standard Specifications D3034, Type PSM SDR-35 or ASTM F-679 for pipe over 15 inch diameter.

The pipe and fitting shall be made from Virgin Type 1 Grade 1, Polyvinyl Chloride compounds as defined and described in ASTM Specification D-1784 for "Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds.

Clean rework material, generated from the manufacturer's own pipe or fitting production may be used by the same manufacturer provided the pipe and fittings so produced meet the requirements of this specification.

Physical and Chemical Properties - The physical and chemical properties shall conform to those minimums specified for Type 1, Grade 1 Polyvinyl Chloride compound designated in ASTM Specification D-1784 noted above.

Dimensions – The standard length of pipe provided under this specification shall be a minimum of 10 feet, except that all pipe used in house connections and/or laterals shall not exceed 6 feet in length unless otherwise approved by the Designer.

The pipe shall be manufactured to the following dimensions:

Nominal Size	Minimum Wall Thickness
6	1/5"
8	1/4"
10	1/3"

All dimensions in inches.

Fittings shall be made in sizes and to the dimensions of standard pipe as above. If dimensions, structural design or materials from which they are manufactured vary from other provisions of this specification, it shall be done so with the approval of the Designer.

Joints shall be the bell and spigot type. Joints (ASTM D3212) shall be sealed with a nitrile "O" ring gasket, conforming to ASTM Designation D3034 or approved by the Designer, and shall be of a composition and texture which is resistant to common ingredients of sewage, industrial wastes including oils and ground water, and which will endure permanently under the conditions likely to be imposed by this use.

The tensile strength shall be at least 1300 psi. The elongation at rupture shall be such that 2 inch gauge marks shall stretch to not less than 10 inch. Hardness shall be between 40 and 50, *as* measured with a Shore Durometer. The compression set (constant deflection) shall not exceed 25 percent of the original deflection.

The tensile strength after accelerated aging shall be not less than 80 percent of the original strength. The joint, when assembled, must be able to withstand a hydraulic pressure internally of at least 25 psi.

Fittings: Wyes, Tees, Bends and adapters, and any other fittings required by the Designer shall be provided. Plans for such fittings showing cross sectional views with dimensions shall be provided, and the Designer prior to their use shall approve such plans and fittings. The materials used in the manufacture of fittings shall conform to the requirements for the Pipe with which they shall be used and any variation of such requirements shall be subject to approval of the Designer.

Testing: Pipe shall be tested when requested by the Designer, and all sizes of pipe so designated shall be tested as follows:

Pipe shall be tested in accordance with ASTM D-2412 Standard Method of Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading." The minimum value of Pipe Stiffness at 5% deflection computed from data obtained from the above testing procedure shall be as indicated in Table 1.

**TABLE I
MINIMUM VALUE OF PIPE STIFFNESS AT 5% DEFLECTION**

NOMINAL PIPE SIZE	PIPE STIFFNESS
6 inch	46psi
8 inch	46psi
10 inch	46psi

Marking - Pipe shall be marked along the outside of the barrel in bold style type and shall indicate the manufacturer's name, pipe size, PVC compound used, i.e., PVC Type 1 Grade 1 and the ASTM material specification for the PVC compound used, i.e., ASTM D1784.

Workmanship - The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.

Waterstops - The manufacturer shall provide waterstops, acceptable to the Designer, which shall be applied to the outside of plastic pipe when the pipe is to be enclosed in any structure where concrete or mortar is used which will prevent leakage along the outer wall of the barrel of the pipe.

Waterstops within each trench greater than 100' in length between structures are required and shall be Concrete Class "C" with no reinforcing.

Flexible Couplings - As required shall be manufactured by Femco, Inc. Davison, Michigan or approved equal.

Construction:

LAYING SEWER PIPE:

Sewer pipe, both in main sewer, laterals or connections, shall be of the sizes, type, materials, etc., indicated by the contract documents; all pipe shall be laid, supported, jointed, tested and backfilled as indicated or required for the particular job, location, or condition by

drawings or other contract documents. All pipes when in place shall be precisely true to the line and grade indicated therefore by the Designer, sound, well laid, jointed and bedded and free from defects. Any pipe discovered to be defective after having been laid shall be removed and replaced by a sound and satisfactory piece.

All pipes in main sewer lines will, in general, be laid using a laser. String line will only be allowed with the approval of the Designer. All pipe in main sewer lines laid using a grade string are to be stretched out above the line of pipe between batter boards of profiles averaging twenty three feet and not exceeding thirty feet apart and by measuring down to the bed for each pipe prior to setting it in place, and to the end of each pipe, when it has been placed, by means of a suitable grade pole, and brought to line with a plumb bob, all of which tools shall be furnished by the Contractor and satisfactory to the Designer.

Filter Fabric: The Contractor shall furnish and install new filter fabric along the length of the sewer pipe. The fabric is to be placed over the pipe, between the crushed stone bedding and the bank run gravel backfill. The filter fabric shall be a non-woven type with a minimum grab tensile strength of 122 pound and a minimum Mullen burst strength of 198 pound. The fabric shall be of sufficient width so as to form one continuous liner along the trench width with six inch minimum overlap along the trench length.

Bedding: Pipes, in general, shall be bedded in crushed stone or screened gravel or as otherwise directed by the Designer in accordance with the contract drawings and as described in of these specifications.

Filling Around Pipe: Immediately after pipe has been laid, set to line and grade; crushed stone shall be placed carefully on the sides and top of pipe as detailed and as directed by the Designer.

No walking on or working over pipes after they are laid except as may be necessary in making joints, in placing cradles, and in tamping backfill material will be permitted until pipes are covered with earth to a depth of 18 inches. During construction, all openings to pipe lines shall be protected from entrance of earth or other material. Open ends of branches and pipes when completed shall be sealed with stoppers, or by equally effective methods. Where new pipes are to join existing ones, the Contractor shall do such work *as* necessary to make connections.

The Designer reserves the right to cause the Contractor to place a plumber's plug in the sewer line as it enters the existing sewer system and to leave it until the job is complete and after completion, shall clean and flush the new sewer as directed by the Designer.

Protection of Water Supplies: Wherever sewers cross under water mains, a separating distance of 18 inch or more shall be maintained between crown of sewer and bottom water main. Whenever this distance cannot be maintained, the Contractor shall advise the Designer and await further instructions before proceeding with crossing of water main. Whenever

horizontal separation is less than 10 feet between sewer line and water main, the above mentioned 18 inch separating distance shall also apply, and the Contractor shall advise Designer as previously instructed.

The whole of the lateral trench shall be dug to the required grade before any pipe is laid therein; and the pipe shall be laid closely to line and grade, using a grade line, hand level, or straight edge as may be ordered. House connection laterals will generally be laid at right angles to the main sewer, from wye branches by means of bends of approved form, or from inlets built into other sewers. The Contractor shall take proper means for his own use to temporarily locate all wyes, etc., in main sewer before connections are laid, and will be responsible for finding wyes, etc., from which he is to lay connections or laterals.

Extra care shall be taken to make smooth, close-fitting joints at all bends. Pipes shall be trimmed or extra bends used when ordered to accomplish this, without extra charge. So far as possible, every joint shall be swabbed out inside after being made. All requirements for laying pipe of this size, as described elsewhere herein, shall be observed in laying connection laterals, so far as those requirements apply. The end shall be closed with a vitrified cover caulked in with a cap or oakum, lightly cemented, and allowed to set before being placed in the trench or as otherwise directed.

A stout stake to mark the location and elevation of the end of each lateral will be driven as directed by the Designer near the end of each lateral. This stake will be protected and maintained undisturbed until the Designer has completed all his measurements and if so ordered, will thereafter be removed by the Contractor.

Except where otherwise indicated or ordered, house connection laterals will be 6 inches in diameter. If pipe larger than 6 inch is ordered in a lateral or connection, where such larger size had not previously been indicated and where will be paid the additional cost of the larger size pipe over and above what would have been the cost of equivalent 6 inch size.

Branches: All wye branches, T-branches, slants, inlet pipe, etc., shall be furnished and set as indicated by drawings or as directed by the Designer. Since many times the number of branches to be required on their locations cannot be fully determined in advance, the Designer may determine, as the work progresses, the number to be furnished and set, and where they should be located. Branches set by the Contractor solely for his own convenience for temporary connections or temporary drainage, even if set with the permission and approval of the Designer, will not be paid for.

Markers At Branches: If directed by the Designer, a piece of lumber, not less than 2 inch x 4 inch, will be set vertically and left in place, extending from a point directly in front of but not contact with the outer end of a capped wye, etc., or connection lateral from said pipe up to a point about four feet below the ground surface or finished street grade to guide persons who in future years may have occasion to excavate to find the wye or connection, etc., and to protect the end of the wye, etc., from damage when making such excavation.

Pipe Straightness - No single piece of pipe shall be laid on any project covered by these specifications unless it is found to be generally straight. Such pipe shall have a maximum ordinate as measured from the concave side of the pipe not to exceed 1/16 inches per foot of length. If the deviation from straightness exceeds this requirement then the particular piece of pipe shall be rejected for use until it can comply with this provision.

Installation:

Polyvinyl Chloride Pipe (PVC) shall be installed in accordance with ASTM Standard Recommended Practice D-2321 for underground installation of flexible thermoplastic sewer Pipe.

The Contractor shall remove by pumping, draining, bailing or otherwise, any water which may accumulate or be found in trenches where PVC Pipe is to be installed.

The PVC Pipe shall be laid on a 6 inch crushed stone base and backfilled with crushed stone to 6 inch above the top of pipe. No sand backfill shall be required above the pipe. The backfill above the crushed stone shall be either approved excavated material or bank run gravel, as determined by the Designer.

Upon completion of installation, the Contractor shall provide certified air tests, as directed by the Designer, on all pipe installed under this Contract.

LEAKAGE TESTS AND ALLOWANCES FOR GRAVITY SEWERS:

Rate of infiltration into or leakage out of all gravity sewers and appurtenant constructions shall be tested. Suitable bulkheads, weirs or other devices shall be built by the Contractor to enable the Designer to make measurements of water tightness of sewers after their completion. Leakage tests shall be carried out in a manner approved by the Designer. The Designer will designate the tests to be performed on the basis of the ground water elevations and other physical conditions at the time tests are to be performed. The Contractor will be required to independently test manholes and pipelines. Pipelines will be tested by infiltration when ground water level is 24 inch above the crown of the upper end of the sewer, and by exfiltration when below this level. The maximum length of pipeline to be tested shall not exceed one section (manhole to manhole). The allowable leakage rate into or out of the sewer lines shall not exceed 50 gallons/inch of diameter per day per 1 mile of pipe. The allowable leakage rate out of an individual manhole shall not exceed 0.45 gallons per day per foot of depth. If the measured infiltration/exfiltration rates exceed the allowable rates, the necessary repairs shall be made by the Contractor to reduce leakage to rates stated herein, and additional tests shall be made at the Contractor's expense.

- a. Infiltration Tests: The Contractor shall plug all inlets and outlets into the upstream manhole, except for the line being tested. A V-notch weir shall be placed into the upstream pipe in the downstream manhole, with a watertight seal between the weir and the pipeline. Infiltrating water shall be allowed to build up and level off behind the weir until a steady uniform flow passes over the V-notch weir. After steady flow has been established, measurements of water flow shall be taken at thirty-minute intervals, with not less than

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three (3) consecutive readings. Flow measurement shall be converted to gallons per day infiltration rate.

- b. Exfiltration Tests: The Contractor shall plug all inlets and outlets into upstream manhole, except for line being tested. A tapped plug shall be placed in the inlet pipe of the downstream manhole, with a water supply connection. For filling the pipeline, water shall be introduced into the pipeline at the downstream manhole until the upstream manhole has been filled to a depth of 6 feet, or 6 inch below the beginning of the manhole taper, whichever is less.

The line shall be allowed to stand full for a minimum of twenty four (24) hours before beginning exfiltration measurements. After refilling to original level, the drop in water level over the following four-hour period shall be measured and converted to gallons per day lost through pipeline exfiltration, after appropriate compensation for manhole losses.

LOW-PRESSURE AIR TEST:

The Designer may, at his option, require the Contractor to perform low-pressure air testing of the gravity sewers in lieu of infiltration or exfiltration testing on the pipelines. Water testing of manholes will be required, on order of the Designer. Where air testing is to be substituted, the Contractor will be notified sufficiently in advance to allow him to obtain and transport to the job site all necessary equipment for carrying out the air tests, which will include compressor, control panel, pneumatic plugs, hoses and cables, and all other miscellaneous accessories.

Air testing will be conducted between manholes. The sewer line under test shall be plugged at both ends. An air hose shall be connected to a tapped plug to be used for air inlet to the line. The hose will be connected to portable air control equipment, which must include a shutoff valve, pressure regulating valve, pressure reduction valve and a monitoring pressure gauge with range from 0 to 5 psi.

Air shall be introduced from the air source through the control equipment to the pipeline.

- a. Introduce low pressure air into the sealed sewer pipeline until the air pressure reaches 4 psi gauge greater than the average groundwater pressure.
- b. Allow a minimum of 2 minutes for the air pressure to stabilize to a minimum of 3.5 psi gauge greater than the groundwater pressure. Groundwater is assumed to be at ground surface unless the Contractor can prove otherwise by test pitting.
- c. After the stabilization period, disconnect the air hose from the control panel to the air supply.

- d. The pipeline will be acceptable if the pressure decrease is not greater than 0.5 psi gauge in the time stated in the following table for the length of pipe being tested:

Time (Min.) for Length of Pipe

Pipe Diameter (mm)	0-99'	99-200'	200-300'	300-400'
4".....	2.0	2.0	2.0	2.0
6".....	3.0	3.0	3.0	3.0
8".....	4.0	4.0	4.0	5.0
10".....	5.0	5.0	6.0	8.0
12".....	5.5	5.5	8.5	11.5
15".....	7.0	8.5	13.0	17.0
18".....	8.5	12.0	19.0	25.0
21".....	10.0	17.5	26.0	35.0
24".....	11.5	23.0	34.0	45.5
27" and larger.....	14.5	29	43.0	58.0

Test Results:

- a. If the installation fails the low pressure air test, determine the source of leakage.
- b. Repair or replace all defective materials and/or workmanship and repeat low-pressure air test at no additional cost to the MNRR.

Allowable Pipe Deflection - Plastic pipe provided under this specification shall be so installed in the ground that a deflection of no more than 5 percent can be anticipated. Such deflection shall be computed by dividing the amount of deflection (nominal diameter less minimum diameter when measured) by the nominal diameter of the pipe.

However, between any two adjacent manholes, the average deflection shall not exceed 6 percent and no deflection at any point in the pipe shall exceed 7.5 percent, computed in the manner described herein.

After completion of the backfill, the Engineer may require that a deflection test be performed. If the test section fails the test for excessive deflection, the contractor shall repair or replace all defective materials and/or workmanship at no additional cost to the governing authority.

Deflection tests should be conducted using a go/no-go mandrel. The mandrel's outside dimension shall be sized to permit no more than 7.5 percent deflection. The percent deflection shall be established from the base inside diameter of the pipe. The mandrel shall be approved by the Engineer prior to use. Lines that permit safe entry may allow other deflection test options, such as direct measurements with extension rulers

Buried Utility Markings: Buried utility markings shall be installed 2 feet above the top of the buried pipeline or as directed by the Designer.

Waterstops: Place Concrete Waterstops full width of trench from bottom of trench to 12” above pipe at the midpoint of each run greater than 100’ between structures or as directed by the Engineer. Forms are not required however the Contractor may utilize them to restrain the width of the stop. A minimum width of 6” is required for each stop. Waterstops are not required in trenches with less than 100’ between structures.

Methods of Measurement:

This work will be measured for payment as follows:

New PVC pipe will be measured for payment by the actual number of feet of pipe of the various sizes and types, completed and accepted and measured in place along the invert.

Bedding Material will be measured as payment as specified elsewhere.

Flexible couplings, sand, filter fabric, testing, reconnection of sanitary laterals, wood cradles and all waterstops will not be measured for payment, their work to be included in other pay items.

Basis of Payment:

A. This work will be paid for as follows:

1. Payment for furnishing and installing sewer lines will be made for at the unit bid price per linear foot of the sizes indicated. The contract unit price for sewer pipe (PVC) shall be full compensation for all labor, materials, and equipment necessary to complete this work including furnishing and installing pipe (including tees and other fittings), filter fabric, buried utility tape, making connections to new and existing manholes, connections to existing sanitary laterals, cleaning, testing, all waterstops, and all else incidental thereto for which payment is not provided under other items.
2. Payment shall also include protection of existing utilities, coring holes for pipes in existing manholes and rebuilding existing manhole inverts.

B. Trench Excavation, Rock-In-Trench Excavation and bedding material shall be paid for separately under the applicable item.

Pay Item

Pay Unit

6” Polyvinyl Chloride Pipe (Sanitary Sewer)
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8" Polyvinyl Chloride Pipe (Sanitary Sewer)

L.F.

10" Polyvinyl Chloride Pipe (Sanitary Sewer)

L.F.

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. The work of this Section includes, but is not limited to, the following:
 - 1. Miscellaneous loose steel lintels.
 - 2. Steel handrails and guardrails.
 - 3. Miscellaneous framing and supports (parapets).
 - 4. Steel support and stabilizing components required for overhead rolling doors.
 - 5. Miscellaneous bearing and leveling plates.
 - 6. Rough hardware.
 - 7. Bollards.
 - 8. Exterior Stair assembly, treads and landing gratings
 - 9. Metal gratings and support assemblies.
 - 10. Stabilizing angles.
 - 11. Hot dip galvanizing of miscellaneous metal materials.
 - 12. Shop priming of miscellaneous metal materials.
- B. This section includes all items made of iron or steel which are not included as part of Section 05 10 00 - Structural Metal Framing, or other metal systems specified elsewhere.

1.2 MATERIALS FURNISHED ONLY, FOR INSTALLATION UNDER OTHER SECTIONS

- A. Section 03 30 00 - Cast-In-Place Concrete: Anchor bolts, inserts and pipe sleeves required to attach items of miscellaneous metals to concrete.
- B. Section 04 22 00 - Concrete Unit Masonry: Loose steel lintels for masonry openings.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Specification sections which directly relate to the work of this section include, but are not limited to, the following:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 04 22 00 - Concrete Unit Masonry.
 - 3. Section 05 10 00 - Structural Metal Framing.
 - 4. Section 07 95 13 - Joint Assemblies.
 - 5. Section 09 91 00 - Painting, painting of metal fabrications.

1.4 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. ASTM A - 36: Specification for Structural Steel.
 - 2. ASTM A - 569: Specification for Steel, Carbon (0.15 maximum percent), Hot-rolled Sheet and Strip, Commercial Quality.
 - 3. ASTM A - 123: Specification for Zinc (hot - galvanized) Coatings on Products Fabricated From Rolled, Pressed, and Forged steel shapes, Plates, Bars and Strip.

4. ASTM A-143: Practice for Safeguarding against Embrittlement of Hot-Dip Galvanized Structural Steel Products and the Procedure for Detecting Embrittlement.

B. Engineer: Provide the services of a Professional Engineer, registered in the State of Connecticut to design and certify that the work of this section meets or exceeds the performance requirements specified in this section. Engineer shall be experienced in providing engineering services of the kind indicated that have resulted in the successful installation of metal fabrications similar in material, design, and extent to that indicated for this project.

1. Items requiring an Engineers certification include, but are not limited to, the following:

- a. Ladders.
- b. Miscellaneous bearing plates.
- c. Handrails and guardrails.
- d. Metal stair system
- e. Counter support brackets.

D. Shop fabricate work to the greatest extent possible. Clearly label pieces in shop to facilitate field assembly.

E. Perform welding in compliance with American Welding Society Code.

F. Certifications:

1. Submit certification that the shop painting has been done in accordance with specifications.
2. Submit certificate of compliance from galvanizer.
3. Provide certification that welders to be employed in work meet the requirements of Article 6.03.03, section 6, subsection (a) of the Form 816.

1.5 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Product Data: Submit manufacturer's product data, installation instructions, use limitations, and recommendations for each material used. Provide certifications stating that materials comply with requirements.

C. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of the work. Provide plans, elevations, and details of anchorages, connections and accessory items. Provide installation templates for work installed by others.

D. Field Measurements: Take accurate field measurements before preparation of shop drawings and fabrication. Allow for field cutting and fitting where taking field measurements before fabrication is not possible. Do not field cut or fit items which have been hot-dip galvanized after fabrication.

E. Calculations: Provide professionally prepared calculations and certification of the performance of this work. Show how design load requirements and other performance criteria have been

satisfied. Calculations shall be stamped and signed by a professional Engineer registered in the State of Connecticut.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.
- B. All materials shall be carefully handled and stacked to prevent deformation or damage. All miscellaneous steel members shall be carefully stored on substantial timbers and blocking, so arranged that the steel will be free from the earth and properly drained, preventing any spattering or accumulation of water in or about the steel. Care shall be taken to prevent damage to the shop coat of paint and prevent the accumulation of mud dirt or other foreign matter on the steel. Such accumulation shall be completely removed prior to erection.

1.7 PROJECT CONDITIONS

- A. Do not permit use of ladders, handrails, guardrails, counters or other work until work is completely and fully installed and ready to assume its intended design loads. Do not permit overloading of any miscellaneous metal system.

1.8 SOURCE QUALITY CONTROL

- A. The registered engineer as referenced in Paragraph 1.4 B. above shall make periodic visits to the site to inspect and test as necessary the stair, handrail, and other metal work assemblies. After completion of the work and based on these inspections, an affidavit stamped with the seal of the engineer is to be issued. The affidavit shall state that the work has been installed in accordance with his/her design.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

- A. Steel Shapes: Steel shapes shall conform to the requirements of Standard Specifications for Structural Steel, ASTM A - 36. All necessary holes and sinkages shall be provided for attaching hardware or other items, and all anchorage for attachment to adjacent construction shall be included.
- B. Steel Tubing: ASTM A500 or A501, hot or cold rolled.
- C. Steel Sheet: ASTM A366, A570 or A611, of grade required for design loading.
- D. Steel Pipe: ASTM A53, black schedule 40 for 3" diameter pipe and under and schedule 80 for pipe over 3" in diameter. Type and grade as required for design loading.
- E. Iron Castings: ASTM A47 or A48, grade and class are manufacturer's option.
- F. Grout: Pre-mixed, non-staining, non-corrosive, non-shrink, non-metallic cement based grout requiring only the addition of water. Grout shall exhibit shrinkage compensation characteristics in both the plastic and hardened states, and conform with ASTM C1107, "Grade C", CRD-C621-91, *Standard Specification for Packaged Dry Hydraulic Grout - Non Shrink*. One of the following grouts, or approved equal, may be used:

1. "Five Star Grout 100 by Five Star Products Inc."
 2. "SikaGrout 212 as manufactured by Sika Corporation."
 3. "Masterflow 928 by Master Builders, Inc."
- G. Bolts and Fasteners: ASTM A307 and other types as appropriate and approved by Designer.
- H. Concrete: Comply with requirements of Section 03 30 00 - Cast-In-Place Concrete.
- I. Field Painting: Surface preparation and field painting shall be as specified in Section 099100.
- J. Aluminum: Provide alloy and temper recommended by aluminum producer or finisher for the type of use and finish indicated:
1. Extruded bar and shapes: ASTM B 221, 6061-T6, 6063-T6.
 2. Extruded pipe and tube: ASTM B 429, 6063-T6.
 3. Drawn Seamless tube: ASTM B 483, 6063-T832.
 4. Plate and sheet: ASTM B209, 3003-H14.
- K. Expansion Fastening Systems: Expansion bolts shall be HILTI KWIK bolts or approved equal. Other acceptable manufacturers are Powers Fastening, Inc. or ITW Ramset/Redhead. Install bolts as recommended by manufacturer. Provide minimum 1/2 inch diameter bolts with 3-1/4 inch embedment unless otherwise indicated.
- L. Adhesive Anchor Rod System: Adhesive anchor rod system shall be Hilti HY150, W.R. Meadows Rezi-weld LV, Five Star RS anchor Gel or approved equal, utilizing ASTM F 593 AISI 304 threaded stainless steel rods or approved equal. Preparation, drilling and installation shall be as recommended by manufacturer. Install rods as recommended by manufacturer. Unless otherwise indicated, provide adhesive anchor rod system for fastening support steel to concrete or precast concrete walls/panels and floors.

2.2 FABRICATION

- A. General Fabrication: Fabricate work to be straight and true, plumb, level and square and to sizes, shapes, and profiles indicated on approved shop drawings. Ease exposed edges. Cut, reinforce, drill and tap metalwork as necessary for proper assembly and use.
1. Fabricate all miscellaneous metal supports, brackets, braces and the like required to fully complete the work of this project.
 2. Coordinate miscellaneous metal requirements with other specification sections to ensure proper interface of various parts of the work.
 3. Obtain loading requirements from suppliers of work to be supported and design and fabricate support systems with factor of safety of at least 6.
- B. Work Exposed To View: Take special care in choosing materials that are smooth and free of blemishes such as pits, roller marks, trade names, scale and roughness. Fabricate work with uniform, hairline tight joints. Form welded joints and seams continuously and grind flush and

smooth to be invisible after painting. For exposed fasteners, use hex head bolts or Phillips head machine screws.

- C. Galvanizing: All steel to be installed in, on or to exterior portions of building, including bolts and washers, and all steel framing members at exterior soffits, lintels, shelf angles, stabilization angles, and ladders shall be coated by hot-dip process after fabrication in accordance with ASTM A - 123. All hot-dipped galvanized steel shall be inspected for compliance with ASTM A - 123 and shall be marked with a stamp that indicates the ASTM number and the number of ounces of zinc per square foot of steel. A notarized certificate of compliance shall be required from the galvanizer. Zinc for galvanizing shall be applied by the hot-dip process, Deltagalv® by Duncan Galvanizing is listed as a reference standard for quality characteristics. The galvanizing bath shall contain high grade zinc and other earthly materials. Immediately before galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The use of the wet kettle process is prohibited. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards. **NOTE:** All items of work noted or specified to be galvanized shall be galvanized after fabrication. Where size of assembly is to large for galvanizing, only these assemblies will be galvanized prior to fabrication.

1. Touch Up: Touch up damaged or abraded galvanized surfaces with ZRC Cold Galvanizing Compound as manufactured by ZRC products company, Zirp Cold Galvanizing Compound as manufactured by Duncan Industries, Brite Zinc as manufactured by Brite Products or approved equal.

D. Factory-Applied Primer Over Hot-Dip Galvanizing:

1. Factory-Applied Universal Primer: Provide factory-applied polyamide epoxy primer over specially prepared galvanized steel, 2.0 - 3.0 mils dry film thickness minimum.. Apply primer within 12 hours after galvanizing in a controlled environment meeting applicable environmental regulations, and as recommended by coating manufacturer. Epoxy primer shall be one of the following or approved equal:
 - a. Tnemec 27 WB
 - b. E.I. DuPont Imron 1.5 PR
 - c. PPG PMC Aquapon WB

E. Painting and Preparation of Non-Galvanized Steel Products:

1. Thoroughly clean all steel of all loose mill scale by SSPC SP 7 Brush Blast, power wire-brushing or sand blasting. Remove all rust, dirt weld flux, weld splatter and other foreign matter by wire brushing or scraping (power wire brushing if necessary). Grind smooth any sharp projections. Oil and grease deposits shall be removed by solvent.
2. All steel members, except galvanized items, after they are prepared, shall be painted before shipping. All surfaces shall be painted, except machine surfaces, surfaces which are to be welded and surfaces to be encased in concrete. Paint shall be applied thoroughly and evenly on the surfaces and worked into the joints and other open surfaces. Surfaces inaccessible after assembly shall be given two coats. Painting materials shall be as noted above in 2.2 D.1.

- F. Ladder Fabrication: Comply with ANSI A14.3. Unless otherwise indicated, provide 3/8" x 1-1/2" bar side rails spaced 18" apart with 3/4" diameter solid structural galvanized steel bar rungs at 12" on center vertically. Rungs shall have non-slip top surface as provide by the manufacturer.

Provide extended side rails at least 42" above top rung and return to wall or structure. Fit rungs in holes drilled in side rails. Weld and grind smooth to touch. Securely anchor each ladder side rail with clip angles at top, bottom and intermediate points spaced not more than 5'-0" on center. Provide 7" clearance from walls to centerline of rungs.

- G. Aluminum Ladders and Cage Assemblies: Ladders shall be fabricated of heavy tubular alloy 6063-T6 aluminum side rails assembled from two interlocking aluminum extrusions no less than 1/8" wall thickness by 3" wide. Construction shall be self locking stainless steel fasteners, full penetration TIG welds and clean, smooth, and burr free surfaces. Ladder rungs shall be no less than 1-1/4" in section and 18-3/8" long, formed from tubular aluminum extrusions, alloy 6063-T6 and shall be deeply serrated on all sides. Rungs shall be able to withstand a 1,000 pound load without failure. Safety cage shall be fabricated from 3/16" by 2" aluminum bar, alloy 6063-T5. Walk-through rail extensions shall be no less than 3'-6" above the landing and shall have deeply serrated square, tubular grab rails. Platform landing shall have 6" x 2" x 1/8" formed channel stringers supporting 1-1/4" high x 4-1/8" deep aluminum serrated treads.
- H. Stair Fabrication: Design and fabricate stair systems with dimensions, spacing and details and anchorages to conform to size and arrangements shown and required. Comply with applicable codes and ordinances.
1. Design stair system to support design live load of 100 lbs./ft² or a concentrated load of 300 pounds at a location to cause greatest stress, whichever is greater. Design anchors, connections, support brackets and all other interfaces with the supporting structure.
 2. Dimensional Uniformity: Take field measurements to accurately determine actual floor to floor heights and fabricate stairs so that there shall not be variation exceeding 3/16 inch in the depth of adjacent treads or in the height of adjacent risers. The tolerance between the largest and smallest riser or between the largest and smallest tread shall not exceed 3/8 inch in any flight of stairs.
 3. Fabricate stringers from steel channels or plates. Galv. Steel grating to the shape shown on approved shop drawings. Weld tread and landing pans to supporting frames.
 4. Shop weld and assemble stair system to the greatest extent possible. Locate bolted connections in inconspicuous areas.
- I. Handrail, guardrails, gates and support components: Fabricate all exterior metal handrails, railings, gates and connections to design, dimensions and details indicated on plans. Exterior railings shall be hot-dipped galvanized black steel, ASA 40 sizes as shown on the Plans. Provide members in materials, sizes and profiles indicated, with support elements of size and spacings shown, but not less than required to withstand the following structural loads without exceeding the allowable design working stress of the material involved, including anchors and connections. Apply each load to produce the maximum stress in each respective component of each metal fabrication.
1. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbs applied at any point nonconcurrently, vertically downward, or horizontally.

- b. Uniform load of 100 lbs per lineal foot, applied vertically, concurrently with 50 lbs per lineal foot horizontal uniform load.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
- 2. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbs applied at any point nonconcurrently, vertically downward, or horizontally.
 - b. Uniform load of 50 lbs per lineal foot, applied nonconcurrently, vertically downward or horizontally.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
- 3. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 lbs applied to one square foot at any point in the system including panels, intermediate rails, balusters, or other elements composing the infill area.
 - a. Above load need not be assumed to act concurrently with uniform horizontal loads on the top rails of the railing systems in determining stress on the guard.
- 4. Fabricate work to be straight, plumb, level and square.
- 5. Brackets, Flanges, Fittings and Anchors: Provide brackets, fittings and anchors for the interconnection of handrail and railing components to other work.
- 6. Welded Connections: Perform welding to comply with AWS for recommended practices, using method appropriate for metal and finish indicated. Grind exposed welds flush and smooth to blend with adjoining finish metal surfaces.
- 7. Bends: Form bends by use of prefabricated elbow fittings and radius bends, as applicable.
- 8. Curves: Form simple and compound curves by bending members in jigs designed to produce uniform curvature with uniform profile of member throughout entire bend without buckling, twisting or deforming in any way.
- 9. Steel support elements required for railing systems shall be fabricated using standard or custom bolts, anchors, hangers, dowels and other miscellaneous metal items as needed to satisfy loading requirements. mentioned above. Provide malleable iron wall brackets railing supports equal to Julius Blum model 378 or approved equal.
 - a. Concealed Fasteners: Provide concealed fasteners for the interconnection of handrail and railing components, and for all other connections, except where exposed fasteners are unavoidable.
- J. Lintel Fabrication: Fabricate lintels for openings and recesses in walls and partitions where shown and elsewhere as needed. Provide at least 8" bearing at each end, unless otherwise detailed. Weld together individual members of composite lintels made up of more than one member.

- K. Bearing and Leveling Plate Fabrication: Design and fabricate plates for steel and wood members bearing on masonry or concrete that are not indicated or required on structural plans. Provide flat, uniform bearing areas of size and thickness required for loading conditions encountered. Use standard AISC and AITC design criteria. Drill plates as necessary to receive anchor bolts and for grouting access.
- L. Overhead Door Support Fabrication: Fabricate support system to carry the entire load of overhead doors support to the structure above without transferring any horizontal or vertical load to ceiling system. Provide frequently spaced holes for multiple adjustment. Provide diagonal braces. Unistrut type members are acceptable.
- M. Rough Hardware: Provide standard and custom fabricated bolts, anchors, hangers, dowels and other miscellaneous metal items as needed to properly complete the work of the project.
- N. Stabilizing Angles: All stabilizing angles shall be furnished and installed by Section 05 50 00 METAL FABRICATIONS, sizes as indicated on the structural plans. If stabilizing angles are not indicated on structural plans provide 4" x 4"x 6" long x 12 gauge steel angles at top of masonry partitions, 4 feet on center, staggered to resist lateral movement. Contractor is to provide details of the various conditions needed to meet project requirements.
- O. Galv. Steel Gratings: Grating shall be capable of supporting a minimum uniform load of 400 psf.
- P. Q. Interior Bollards: Provide 6" diameter schedule 40 steel pipe bollards as indicated on plans. Pipe shall be hot dip galvanized and factory prime painted. Pipe bollards shall have a ½ inch thick base plate, size as shown on drawings, welded to the pipe. The base plate shall be pre drilled, set on non-shrink grout and attached to structural slab using 1 inch diameter adhesive anchors at the ground floor. Following setting of pipe and after initial set of grout, pipe bollards shall be filled with concrete. Form a concave cap at top of pipe with concrete.
 - 1. Bollards shall be field painted following installation in accordance with coating systems specified in Section 09 91 00 and as indicated on plans.

PART 3 - EXECUTION

3.1 INSTALLATION/ERECTION

- A. Provide suitable anchors and fasteners to connect miscellaneous metal items to other construction. Provide setting templates and diagrams and coordinate with other work so that adequate anchor bolts, blocking and bracing is in place and accurately located. Beginning work means Installer accepts substrates and conditions.
- B. Set work accurately and plumb, level and aligned. Make field assembly and connections with the same level of quality as shop fabricated work.
- C. For bearing and leveling plates, clean concrete and masonry bearing surfaces and roughen to improve bond. Thoroughly clean steel bearing surfaces. Set loose plates on shims or wedges. Level and plumb work, then tighten anchor bolts. Cut off protruding shims and wedges and pack voids solidly with grout.
- D. Adjust handrails and guardrails prior to final anchoring and grouting. Plumb posts in both directions. Provide 1-1/2" clearance from inside of handrails to face of walls. Provide wall brackets at spacing shown, or if not shown, at not more than 6'-0" on center. Securely anchor

wall brackets into structure or very secure blocking. Connections shall withstand loading specified for handrails and guardrails.

3.2 TOLERANCES

A. The following allowable installed tolerances are allowable variations from locations and dimensions indicated by the Contract Document and shall not be added to allowable tolerances indicated for other work.

1. Allowable Variation from True Plumb: $\pm 1/8$ " in 20'-0"

2. Allowable Variation from True Level: $\pm 1/8$ " in 20'-0"

3. Allowable Variation from True Line: $\pm 1/8$ " in 20'-0"

3.3 REPAIRING, CLEANING, AND PROTECTION

A. Touch up damaged coatings and finishes to eliminate evidence of repair.

B. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.

END OF SECTION 05 50 00

SECTION 07 42 63 - FABRICATED WALL PANEL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. The work of this Section includes, but is not limited to, the following:
 - 1. Designing, engineering and providing all framing elements, fasteners, connections and sealants related to the horizontal and vertical wall panel systems.
 - 2. Steel faced, pre-finished, insulated composite wall panels with double interlocking side joints, integral vapor seals, and concealed structural fastening.
 - 3. Aluminum face and liner, composite factory formed wall panel units with integral reveals and rout and return joinery.
 - 4. Furnishing and installation of integrated fixed & sliding aluminum windows, louvers and translucent panels within the insulating wall panel systems.
 - 5. Furnishing and installation of glazing within the aluminum composite panel system.
 - 6. Sealants and gasketing between panels, windows and their intersections.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Carefully examine all of the Contract Documents for requirements which affect the work of this section.
- B. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:
 - 1. Section 03 45 00 - Architectural Precast Concrete
 - 2. Section 04 22 00 - Concrete Unit Masonry; substrate.
 - 3. Section 05 10 00 - Structural Metal Framing.
 - 4. Section 05 50 00 - Metal Fabrications; requirements for miscellaneous supports.
 - 5. Section 07 92 00 - Joint Sealants; sealant requirements.
 - 6. Section 08 41 13 - Aluminum Framed Entrances and Storefronts.
 - 7. Section 08 81 00 - Glass and Glazing

1.3 REFERENCES

- A. American Architectural Manufacturer's Association (AAMA):
 - 1. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems.
 - 2. AAMA 605.2 - Voluntary Specification for High Performance Organic Coatings.
 - 3. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - 4. AAMA 508-05 – Test method for Pressure Equalized Rain Screen Wall Systems.

B. American Society of Civil Engineers (ASCE):

1. ASCE 7- Minimum Design Loads for Buildings and Other Structures.

C. ASTM International (ASTM):

1. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A 755 - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
3. ASTM A792 – Standard Specification for Steel Sheet 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
4. ASTM C 1363 - Standard Test Method for thermal performance of building materials and envelope assemblies by means of a Hot Box Apparatus.
5. ASTM C 645 - Specification for Nonstructural Steel Framing Members.
6. ASTM C 920 - Specification for Elastomeric Joint Sealants.
7. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
8. ASTM E 84 - Test Methods for Surface Burning Characteristics of Building Materials.
9. ASTM E 96 - Test Methods for Water Vapor Transmission of Materials.
10. ASTM E 119 - Test Methods for Fire Tests of Building Construction and Materials.
11. ASTM E 283 - Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen.
12. ASTM E 330 - Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
13. ASTM E 331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
14. ASTM E 1886 – Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
15. ASTM E 1996 – Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

D. Factory Mutual Global (FMG):

1. FMG 4880 Standard for Evaluating Insulated Wall & Roof/Ceiling Assemblies.

E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):

1. Architectural Sheet Metal Manual.

F. Underwriters Laboratories, Inc. (UL):

1. UL 263 - Fire Resistance Tests of Building Construction and Materials.
2. UL 723 - Test for Surface Burning Characteristics of Building Materials.
3. UL Fire Resistance Directory.
4. UL 1715 Room Corner Test.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Provide siding systems which are the products of one manufacturer. Manufacturer shall have a minimum 10 years experience in manufacturing of architectural metal panel systems.
- B. Installer: A firm which has at least five years experience in work of the type required by this section and which is acceptable to the manufacturer of the wall panel system.
- C. Mock-Ups: Before beginning primary work of this section, complete 9 linear feet of the wall panel system that incorporates both types of panels, translucent panels, aluminum windows and louvers to serve as a mock-up and obtain Designer's acceptance of visual qualities. Protect and maintain acceptable mock-ups throughout the work of this section to serve as criteria for acceptance of this work. Approved mock-up may be incorporated into the finished work. Use mock-up area for required field tests.
- D. Subdivision of Work: To limit responsibility, assign the complete prefabricated metal siding system including, but not limited to, panels, framing, subframing, fasteners, flashings, counterflashings, joint sealers and fillers, to one manufacturer and one installer.
- E. Fire Resistance Ratings: Where indicated by design designations, provide metal wall panels tested per ASTM E 119 or UL Standard 263 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Test-Response Characteristics per ASTM E 84 or UL Standard 723:
 - a. Flame spread index: 25 or less.
 - b. Smoke developed index: 450 or less.
 - 2. FMG Listing: Class 1 Insulating Wall or Ceiling Panel per FMG 4880.
 - 3. UL Listing for UL 1715 room corner test.
 - 4. NFPA 286 room corner test.
 - 5. NFPA 285 ISMA test.
- F. Pre-Installation Meeting: Convene a pre-installation meeting to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.5 PERFORMANCE REQUIREMENTS

- A. Secondary support framing system for the metal wall panels, louvers, windows and translucent panel system shall be designed in accordance with AISC or Aluminum Association design procedures.
- B. The support system for the complete wall panel systems shall be designed and installed by the wall panel manufacturer and certified wall system contractor.
 - 1. Secondary supports shall not vary from theoretical plane by more than the specified tolerances.
 - a. $\frac{1}{4}$ inch in any 20 foot length vertically or horizontally.

- b. + or - 1/2 inch maximum in building elevation.
 - c. + or - 1/8 inch within 5 feet of any change in plane such as corners and soffits.
2. Cold-formed steel girts, subgirts, or studs which insulated metal panels are attached shall be minimum 16 gauge (SSMA 54 mils). Cold formed steel 18 gauge (SSMA 43 mils) or lighter shall not be used as structural supports. All cold-formed framing shall be designed in accordance with the latest edition of AISI or North American Standard Specification. Double studs or minimum 4" wide bearing surface shall be provided at all vertical joints of horizontal panel systems and at all horizontal stack joints of vertical panel systems to insure the integrity of the liner side seal.
- C. Air Infiltration: Maximum 0.06 cfm/sf per ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sf, using minimum 10 feet by 10 feet test panel that includes horizontal and vertical joints.
- D. Water Penetration – Dynamic Testing: No uncontrolled water penetration per AAMA 501.1 at a minimum pressure differential of 15 lb/sf using a minimum 10 feet by 10 feet test panel.
- E. Horizontal Panel Joint Performance - Static test per ASTM E331 with all horizontal seals removed - 1 inch in 10 feet lengths to simulate seal defects. No uncontrolled water penetration permitted at a pressure of 15 lb/sf.
- F. Pressure Equalization of Horizontal Joinery – Passes the Criteria for a Pressure Equalized Horizontal Joint in accordance with AAMA 508-05 a test method for Pressure Equalized Rain Screen Wall Systems.
- G. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated, per ASTM E 72:
- 1. Wind Loads: Determine loads based on uniform pressure indicated on Plans or calculated per IBC 2003 whichever is more stringent.
 - 2. Deflection Limits: Withstand test pressures of inward and outward wind-load design pressures with maximum deflection of L/180 of the span with no failure.
 - 3. Secondary Framing: Design secondary framing system according to AISI "Standard for Cold-Formed Steel Framing - General Provisions." Provide bearing surface for metal wall panels at the following locations:
 - a. Horizontal Panel System: At vertical joints 4 inches minimum.
 - b. Vertical Panel System: At horizontal stack joints 4 inches minimum.
- H. Seismic Performance: Comply with ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads".

1.6 SUBMITTALS

- A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

- B. Product Data: Manufacturer's data sheets for metal wall panels and accessories.
- C. Shop Drawings: Prepared by manufacturer. Include elevations showing metal wall panels, windows, louvers and translucent panels and details of each condition of installation and attachment. Indicate coordination dimensions related to structural support system elements provided by others as well as secondary framing provided as part of this specification section.
 - 1. Include structural data indicating compliance with performance requirements.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square, representing actual product, color, and patterns.
- F. Warranty: Submit proposed warranty meeting requirements of this Section.
- G. Quality Assurance Submittals:
 - 1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR - POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
 - 2. Source quality-control test reports.
 - 3. Field quality-control test reports.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.
- B. Protect metal wall panels during shipping, handling, and storage to prevent staining, denting, or other visible damage. Deliver, unload, store, and erect metal wall panels and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.

1.8 WARRANTIES

- A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Panel System Warranty: Provide written warranty signed by manufacturer, installer and Contractor, agreeing to repair or replace work which exhibits defects in materials or workmanship. "Defects" is defined to include, but is not limited to, leakage of water, abnormal aging or deterioration, and failure to meet performance requirements. Include requirement for removal and replacement of covering and connected adjacent work.
 - 1. Warranty Period: 5 years from date of issuance of the Certificate of Compliance.
- C. Finish System Warranty: Provide written warranty signed by manufacturer, installer and Contractor, agreeing to repair or replace work which exhibits defects in finish materials or workmanship. "Defects" is defined to include, but is not limited to, checking, crazing, cracking, lifting, mottling, peeling, fading, noticeable color change, and other defects. Color change shall not exceed 5E units [National Bureau of Standards] throughout the warranty period.

1. Warranty Period: 20 years from date of issuance of the Certificate of Compliance.
- D. Special Installer's Warranty: In form acceptable to the Department, in which Installer agrees to repair or replace metal wall panel assemblies that fail in materials and workmanship within two years from date of issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
1. IPS Insulated Panel Systems.
 2. KingSpan Insulated Panels.
 3. Metlspan Architectural Wall Panels.
 4. Or Approved Equal.

2.2 PRODUCTS

A. PANEL DESIGNS

1. Panel units shall consist of roll formed steel face and liner elements bonded to an insulated core.
2. Panel edges shall be double tongue and groove design with factory applied vapor seal. Structural fasteners and clips shall be concealed within the side joint, mechanically engage both face and liner elements and be designed to prevent crushing of the insulated core during fastener installation.
3. Panel units shall be the following:
 - a. Vertical Panel Units: 3 inch thick by 36 inch wide panel with a tested R value minimum of 20, or approved equal.
 - b. Horizontal Panel Units: Custom panel module as indicated on the Architectural Drawings with a total R value minimum of 20, or approved equal.
4. Custom width panels shall be required to achieve layout pattern shown on plans.

2.3 INSULATED METAL WALL PANELS

A. Panel exterior skin shall be the following:

1. Horizontal Panel Units: ASTM A653, Grade 37, G90 galvanized steel or Galvalume Grade 37 in accordance with ASTM 792; in non-directionally embossed surface, 22 gauge.
2. Vertical Panel Units: ASTM A653, Grade 37, G90 galvanized steel or Galvalume Grade 37 in accordance with ASTM 792; in non-directionally embossed surface, 22 gauge.

B. Panel interior skin shall be the following:

1. Horizontal Panel Units: ASTM A653, Grade 37, G90 galvanized steel or Galvalume Grade 37 in accordance with ASTM 792; non-directionally embossed in 22 gauge.
 2. Vertical Panel Units: ASTM A653, Grade 37, G90 galvanized steel, non-directionally embossed and planked in 22 gauge
- C. Panels Insulation shall be a polyisocyanurate core which between the steel face and liner to fill all voids in the panel and have the following minimum physical properties:
- Density - 2.6 pcf
 Shear stress - 20 psi
 Compressive strength - 20 psi
 Tensile strength - 25 psi
- D. Strippable plastic film shall be used to protect the exterior finish through all stages of roll forming and fabrication

2.4 SECONDARY SUPPORT FRAMING SYSTEM

- A. The design, fabrication and installation of the secondary support framing system including bracing as required for the support of the wall systems specified herein shall be the responsibility of the panel manufacturer and certified wall system installer.
- B. Secondary support system shall include all tubes, girts, subgirts, angles and clips required for the support of the insulated metal wall panel, windows, louvers and translucent panels. These supports are to be distinct and separate from the supports shown and sized in the structural drawings. Other required supports for the supports of frames, doors, pre-cast panels and other elements not specifically included in this section shall be furnished and installed under separate specification sections.
- C. Secondary support framing shall meet the performance requirements as outlined in section 1.5 Performance Requirements.
- D. All structural framing furnished and installed as part of this specification section shall be designed by a professional engineer. Structural calculations shall be sealed by a professional engineer licensed in the state of Connecticut.

2.6 INTEGRATED TRANSLUCENT PANELS

- A. Integrated Translucent Windows will be supplied by the wall panel manufacturer as a part of the integrated wall panel assembly. The complete system will be engineered and installed as a single source responsibility wall system including wall panels, louvers, windows and translucent panels. The translucent window units will include grid pattern, clips, fasteners and accessories at locations as shown on the drawings.
- B. Panels shall be as specified in Section 08 45 00 - Translucent Panel Wall Unit System.

2.7 INTEGRATED LOUVERS

- A Extruded aluminum louvers will be supplied by the wall panel manufacturer as a part of the integrated wall panel assembly. The complete system will be engineered and installed as a single source responsibility wall system including wall panels, louvers, windows, and aluminum or steel through tube supports. The louvers will include blades; special heads, sill and jambs that integrate with the metal panels joinery; and accessories at locations as shown on the drawings.
1. The Louver Frame shall integrate with the surrounding panel joinery without face sealing and be tested to perform at 12 PSF per ASTM E331.
 2. Louver Model : A 4157 Double drainable fixed extruded mullion louver by Construction Specialties or approved equal.
 3. Depth: 4 inches
 4. Free Area Required: 51.4 %
 5. Rain Defense: 1123 fpm when measured in accordance with AMCA.
 6. Standard 500 Static Pressure Drop: 0.19 in. H₂O
 7. Flashing at Louver penetrations will not be accepted
 8. Finish: Provide minimum 1.2 mil dry film thickness of thermo-cured fluorocarbon coating containing minimum 70% Kynar 500 resin over substrate which has been prepared by inhibited chemical cleaning, conversion coating, and priming in compliance with coating manufacturer's instructions and recommendations.
 - a. Colors: Provide colors as selected by Designer from manufacturer's complete line of standard colors.

2.10 FACTORY PAINT FINISH

- A. Panels exterior finish shall be the following in manufacturer's standard color for that finish.
1. 0.8 mil primer with 0.8 mil 70 percent PVDF fluoropolymer color coat, and a 0.8 mil 70 percent PVDF fluoropolymer clear top coat or approved equal.
 2. Colors: Provide color as selected by Designer from Panel Manufacturer's standard series (non-mica, metallic or brilliant series) or custom color as selected from within this range of colors. Allow for up to three (3) colors for the exterior metal wall panels.
 3. The interior finish for the metal wall panels where exposed to view shall be 0.2 mil primer and 0.6 mil polyester in a color selected by the Designer. Where the metal panel interior face is concealed manufacturer's standard primer and wash coat will be acceptable.
- B. Manufacturer shall warrant that the exterior coating shall not blister, peel, crack, chip, or experience material rust through for 20 years and that for a period of 20 years chalking shall not exceed #8 - ASTM and fading shall be 5 ΔE Color Difference Units or less.

2.11 ACCESSORIES

- A. Metal wall panel accessories:
1. Provide complete metal wall panel assembly incorporating trim, copings, fascia, parapet caps, soffits, sills, inside and outside corners, jambs and miscellaneous flashings. Include required fasteners, gaskets, closure strips and sealants.

2. All accessories as indicated in A.1. above to be extrusions of 6063-T5 aluminum unless as noted on the contract plans.

a. Provide extrusions at the wall base and at all head, sill and jamb conditions for windows, doors and other wall openings that are thermally broken and have no thermal shortcuts.

3. All exposed trim and extrusions shall be finished to match panels.

2.12 MISCELLANEOUS MATERIALS

A. Sealant: Synthetic non-skinning butyl rubber sealant, as recommended by panel manufacturer, for metal wall panel assemblies to remain watertight.

B. Fasteners: Self-tapping screws, bolts, nuts, and other acceptable fasteners recommended by panel manufacturer. Where exposed fasteners cannot be avoided, supply corrosion-resistant fasteners with heads matching color of metal wall panels by means factory-applied coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The Installer/Erector shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

B. Examine metal wall panel supports, substrates, and conditions for compliance with requirements for installation tolerances and other conditions affecting work.

1. Verify that structural panel support members and anchorage have been installed within the following tolerances:

- a. +/- 1/4-inch in 20 feet.
- b. +/- 1/2-inch across building elevation.
- c. +/- 1/8-inch within 5 feet of any change in plane.

2. Correct out of tolerance work and deficient conditions prior to proceeding with metal wall panel installation.

3.2 PREPARATION

A. Install miscellaneous framing and anchorage according to ASTM C 754, metal wall panel manufacturer's written recommendations, and approved shop drawings.

3.3 METAL WALL PANEL INSTALLATION

A. Install metal wall panels and accessories in accordance with manufacturer's recommendations and approved shop drawings.

- B. General: Install metal wall panels in orientation, sizes, and locations indicated. Anchor metal wall panels and other components securely in place. Provide for thermal and structural movement.
 - 1. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as approved by manufacturer.
 - 2. Field cutting of metal wall panels is not permitted.
 - 3. Fasten metal wall panels to supports with concealed clips at each joint at location, spacing, and with fasteners recommended by manufacturer. Install clips to supports with self-tapping fasteners. Metal chips resulting from the installation of the self-tapping screws shall be completely removed from the channel at the base of the wall panel.
 - 4. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- C. Fasteners for Steel Wall Panels:
 - 1. Exterior: Stainless-steel.
 - 2. Interior: Carbon steel.
- D. Metal Protection: Provide metal wall panel manufacturer's recommended permanent separation material where dissimilar metals will contact each other or corrosive substrates.
- E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies.
 - 1. Seal metal wall panel end laps to supports or back-up flashing sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer. Do not install sealant in locations that will interfere with drainage of pressure-equalized panel chambers.
 - 2. Prepare joints and apply sealants per requirements of Section 07 92 00 "Joint Sealants."

3.4 ACCESSORY INSTALLATION

- A. General: Install metal wall panel accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install related flashings and sheet metal trim per requirements of Section 07 60 00 "Flashing and Sheet Metal."
 - 2. Install components required for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 3. Comply with performance requirements and manufacturer's written installation instructions.
 - 4. Provide concealed fasteners except where noted on approved shop drawings.

5. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: An independent testing and inspecting agency acceptable to the Department to perform field tests and inspections and to prepare test reports.
- B. Water-Spray Test: After completing portion of metal wall panel assembly including accessories and trim, test 2-bay area selected by the Designer for water penetration, according to AAMA 501.2. Wall areas should be tested as a routine QA procedure. Areas erected by each crew should be checked at various stages of erection.
- C. Manufacturer's Field Service: Engage a service representative authorized by metal wall panel manufacturer to inspect completed installation. Submit written report. Correct deficiencies noted in report.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective films. Clean finished surfaces as recommended by metal wall panel manufacturer. Clear weep holes and drainage channels of obstructions, metal chips resulting from self-tapping screw installation, dirt, and sealant. Maintain in a clean condition during construction.
- B. Replace damaged panels and accessories that cannot be repaired by finish touch-up or minor repair.

END OF SECTION 07 42 63

SECTION 09 30 00 - TILE

PART 1 - GENERAL

1.1 SUMMARY

- A. The work of this Section includes, but is not limited to, furnishing and installation of the following:
1. Quarry tile floors.
 2. Quarry tile base.
 3. Marble Thresholds.
 4. Setting materials and grout.
 5. Waterproofing materials.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Carefully examine all of the Contract Documents for requirements which affect the work of this section.
- B. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:
1. Section 03 30 00 - Cast-In-Place Concrete; floor tolerances.
 2. Section 03 45 00 - Architectural Precast Concrete
 3. Section 04 22 00 - Concrete Unit Masonry; concrete masonry walls to be tiled.
 4. Section 07 92 00 - Joint Sealants; sealants required

1.3 QUALITY ASSURANCE

- A. Reference Standards:
1. American National Standards Institute (ANSI):
 - a. A108.5 Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
 - b. A108.6 Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy.
 - c. A118.4 Latex-Portland Cement Mortar Specifications.
 - d. A118.8 Modified Epoxy Emulsion Mortar/Grout.
 - e. A118.10 Load-Bearing, Bonded Waterproofing Membranes for Thin-Set Ceramic Tile and Dimension Stone Installations.
 2. American Society for Testing and Materials (ASTM):
 - a. C-144: Aggregate for Masonry Mortar.
 - b. C-150: Portland Cement.
 - c. C-206: Finishing Hydrated Lime.
 - d. C-207: Hydrated Lime for Masonry Purposes.

3. Tile Council of America, Inc. (TCA):

- a. TCA 137.1: Recommended Specifications for Ceramic Tile.
 - b. TCA: TCA Handbook for Ceramic Tile Installation 2007
- B. For each type of tile required for the work of this section, provide products of one manufacturer. Provide mortar grout and adhesive materials which are acceptable to the tile manufacturers.
- C. Mock-Up: Before beginning primary work of this section, provide minimum 4' x 4' mock-ups of each type of tile work and installation required under the Contract at locations acceptable to Designer and obtain Designer's acceptance of visual qualities and construction techniques. Protect and maintain acceptable mock-up throughout the work of this section to serve as criteria for acceptance of this work. Approved mock-ups may be incorporated into the finished work.

1.4 SUBMITTALS

- A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.
- B. Samples: Manufacturer's stock samples of wall and floor tile of the types specified, indicating full range of standard colors for selection by Designer.
- C. Verification Samples: Submit in duplicate grouted panel for each selected color and type. Panel shall be minimum 24" X 24".
- D. Product Data: Manufacturer's data for mortars, adhesives and grouts to certify that materials:
1. Are suitable for intended use.
 2. Meet or exceed standards of American National Standards Institute or other specified standard.
- E. Instructions: Furnish manufacturer's instructions for use of mortars, adhesives and grouts.
- F. Quality Assurance Submittals:
1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR - POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
 2. Source quality-control test reports.
 3. Field quality-control test reports.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.
- B. Deliver materials and products in manufacturer's original sealed containers.
1. Label legible and intact, identifying brand name and contents.
 2. Tile cartons grade-sealed by manufacturer in accordance with TCA 137.1.
 3. Grade-seals unbroken.

4. Manufactured mortars and grouts shall contain hallmarks certifying compliance with reference standards and by types recommended by tile manufacturer for application.

5. Adhesives in containers labeled with hallmarks certifying compliance with reference standards.

C. Deliver dry set mortar in sealed, moisture proof containers.

D. Store materials under cover in manner to prevent damage or contamination.

1.6 PROJECT CONDITIONS

A. Environment: Perform work only when conditions are within the limits established by manufacturers of the materials and products used. Comply with minimum temperature recommendations of manufacturers for bonding and grouting materials in other than Portland cement mortar. Maintain manufacturer's recommended curing/setting temperatures for at least 7 days after installation.

B. Substrates: Proceed with work only when substrate construction and penetrating work is complete.

C. Ventilation: Comply with manufacturer's requirements and recommendations. Vent temporary heaters (if used) to prevent damage from carbon dioxide build-up.

1.7 PRE-INSTALLATION MEETING

A. Conduct pre-installation meeting in accordance with Form 816.

B. Convene one week prior to commencing work of this section.

C. Require attendance of installation material manufacturer, tile supplier, tile installer and installers of related work. Review installation procedures and coordination required with related work.

D. Meeting agenda includes but is not limited to:

1. Surface preparation.

2. Tile and installation material compatibility.

3. Edge protection, transition and pre-fabricated movement joint profiles.

4. Waterproofing techniques.

5. Crack isolation techniques.

PART 2 - PRODUCTS

2.1 TILE

Conforming to TCA 137.1, standard grade.

A. Quarry Paver Tile: Unglazed Quarry paver tile at the Men's & Women's locker and toilet rooms shall conform to section 5.3 TCA 137.1. Paver tile types shall be as distributed by Daltile Co., Inc. (978-835-7793), or approved equal. Pavers shall measure 8" x 8" x 1/2" with color and

texture or surface finish as listed below. Provide matching bull nose cove base with all required shapes, inside and outside corners. Pavers shall conform to the following properties:

<u>Property</u>	<u>Test #</u>	<u>Result</u>
Water Absorption	ASTM C373	.03-09%
Breaking Strength	ASTM C645	460-630 lbs.
Coefficient of Friction (Abrasive)	ASTM C1028	Wet Range ≥ 0.80 Dry Range: ≥ 0.80
Range of Thickness	ASTM C499	.02"-.04"
Color MOH's:		Throughout body 7.0-9.0

2.2 SETTING MATERIALS

- A. Dry-Set Mortar: Conforming to ANSI A118.1.
- B. Latex-Portland Cement Mortar: ANSI A118.4. Provide one of the following or approved equal:
 - 1. Ardex FB 9 L Pourable Shearflex Mortar or X 9 Premium Shearflex Mortar; Ardex Engineered Cements
 - 2. Laticrete 4237 with 211 Crete Filler Powder; Laticrete International.
 - 3. Keralastic/Kerabond; Mapei Corporation

2.3 GROUTING MATERIALS

- A. Epoxy Setting and Grouting Mortars: Provide stainless, 100% solids, highly chemical resistant epoxy grout for ceramic tile at horizontal surfaces and base locations. Epoxy grout shall be resistant to urine, acids and alkalis, petroleum. distillates, oil solvents and food wastes and shall meet or exceed the following requirements:

Property	Test Method	Value
Density	108 lbs/ft ³	
Compressive Strength	ASTM C109 Modified	>6,600 psi
Shear Bond Strength	ANSI A118.3	>1000 psi
Water Absorption	ANSI A118.4	<1/2%.
Hardness	ASTM D2240	D70
Water Cleanability	ANSI A118.3	45 min.
Workability	at 72°F	1 hour.
Installation Temp. Range		50°F to 90°F
Service Temp. Range		230°F
Time to Traffic	at 70°F	Normal 24 hours

- 1. Provide one of the following or approved equal:
 - a. Ardex WA Epoxy Adhesive and Grout; Ardex Engineered Cements
 - b. "Kerapoxy" 100 percent solids epoxy grout by Mapei Corporation.
 - c. "Hydroment Color-Poxy" by Bostik Construction Products Division.
 - d. "Latapoxy SP-100" by Laticrete International.

2.4 SEALANTS

- A. Sealants: Provide sealants for horizontal surfaces in compliance with specification Section 07 92 00.

2.5 ACCESSORIES

- A. Marble Thresholds: Provide ASTM C503 Marble Institute of America Class A beveled thresholds cut to fit door frame profile.

- 1. Threshold Color: White as approved by the Designer.

2.6 MEMBRANE WATERPROOFING: Products: Subject to compliance with requirements, provide one of the following or approved equal:

- 1. Latex-Rubber Waterproofing:
 - a. Ardex 8 + 9 Waterproofing Compound; Ardex Engineered Cements
 - b. Laticrete 9235 Waterproof Membrane; Laticrete International, Inc.
 - c. PRP M19 by Mapei.
- 2. Waterproofing shall be applied at all floor tile installations except at the ground floor.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surfaces to receive ceramic tile, setting bed, or accessories before tile installation begins for:

- 1. Defects or conditions adversely affecting quality and execution of tile installation.

- 2. Deviation beyond allowable tolerance of surface to receive tile.

- a. Dry-Set and Latex-Portland Cement Mortar, Methods:

- 1) Maximum variation in sub-floor surface: 1/8 inch.
- 2) Maximum variation in vertical surfaces: 1/8 inch.

- b. Modified Epoxy Mortars and Dry-Set and Latex-Portland Cement Mortar, Methods:

- 1) Maximum variation in sub-floor surface: 1/8 inch in 10 feet.
- 2) Maximum variation in vertical surfaces: 1/8 inch in 8 feet.

- 3. Do not proceed with installation work until unsatisfactory conditions are correct.

- B. Condition of Surfaces to Receive Tile: Surfaces shall be firm, dry, clean, and free of oily or waxy films.

- 1. Grounds, anchors, plugs, hangars, bucks, electrical and mechanical work in or behind tile to be installed prior to proceeding with tile work.

3.2 INSTALLATION

- A. Manufacturer's Instructions: Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Waterproofing
 - 1. Install waterproofing in strict compliance with manufacturer's instructions.
 - 2. Flash waterproofing up adjacent walls in accordance to manufacturer's details, to a height of 4 inches.
 - 3. Flood test waterproof membranes after fully cured.
 - 4. Field Quality Control water test when required.
- C. General Installation Requirements: Lay quarry tile in grid pattern with floor and base joints accurately aligned. Center tile in both directions to avoid use of less than 1/2 tile units.
 - 1. Extend tile work into recesses and under and behind fixtures.
 - 2. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignment.
 - 3. Cut and drill tile without damaging decorative surfaces. Fit tile closely to fixtures, piping and other work.
 - 4. For tile placed in sheets, make joints between sheets exactly the same width as joints within sheets.
 - 5. Layout wall tile to next full tile beyond dimension indicated. Extend wall tile at least 3" above suspended acoustical ceilings, unless a wainscot is indicated.
- D. Tile Installation Standards: Comply with requirements of Tile Council of America *Handbook for Ceramic Tile Installation* and ANSI 108 series *Standard Specifications for the Installation of Ceramic Tile*. Provide complete installations including expansion joints as recommended by these standards even if not shown or otherwise indicated. Install tile to comply with the following referenced standards as follows:
 - 1. Thinset Floors, Base and Thresholds Over Concrete Subfloor: TCA F113, thinset with Latex-Portland cement mortar and Epoxy grout.
 - 2. Thinset Floors, Base and Thresholds Over Waterproof Membrane and Concrete Subfloor: TCA F122, thinset with Latex Portland cement mortar and Epoxy grout.
 - 3. Other Walls and Floors: TCA W243 [metal studs], TCA W202 [masonry], and TCA W245 [Coated Glass Mat Water Resistant Gypsum Backer Board], water resistant Portland cement mortar and epoxy grout.
- E. Grouting: Mix and install grout in strict compliance with manufacturer's instructions and recommendations. Protect work from foot traffic for at least seven (7) days after grouting.
- F. Expansion and Control Joints: Provide sealant filled crack control joints matching width of standard grout joints at all inside vertical corners in compliance with Section 07 92 00 - Joint Sealants. Provide minimum 1/4 inch wide sealant filled expansion joints over all cracks and

joints in concrete subfloors, over all changes in backing materials, where tile abutts a restraining surface such as perimeter walls, columns, ceilings, and dissimilar floors, and as follows:

1. Interior Not Exposed to Direct Sunlight or Standing Water: 24 feet maximum on center in each direction.
2. Interior Exposed to Direct Sunlight or Standing Water: 12 feet maximum on center in each direction.

3.3 REPAIR, CLEANING AND PROTECTION

- A. Repair: Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired. Leave work free of broken, chipped and loose tile.
- B. Cleaning: Clean exposed surfaces using materials and methods recommended by manufacturer of tile being cleaned. Remove and replace work that cannot be successfully cleaned. Do not use acid cleaners unless specifically permitted by tile manufacturer and only after completely curing tile and grout. Protect adjacent surfaces from contact with acid cleaners and thoroughly flush with clean water.
- C. Protection: Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

END OF SECTION 09 30 00

SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
 - 2. Handholes and boxes.

- B. Related Sections include the following:
 - 1. Division 26 Section 26 05 33 “Raceway and Boxes for Electrical Systems”.

1.2 DEFINITION

- A. ANSI: American National Standards Institute.
- B. ASTM: ASTM International.
- C. RMC: Rigid Metal Conduit (also know as RGC; Rigid Galvanized Steel Conduit).
- D. RNC: Rigid Nonmetallic Conduit.

1.3 SUBMITTALS

- A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For the following:
 - 1. Duct-bank materials, including separators and miscellaneous components.
 - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Accessories for, 15kV switch and transformer pad, and generator pad.
 - 4. Warning tape.
- C. Duct-Bank Coordination Plans: Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

2. Plans shall be signed and sealed by a qualified professional engineer.

- D. Product Certificates: For concrete and steel used in precast concrete, as required by ASTM C 858.
- E. Qualification Data: For professional engineer and testing agency.
- F. Source quality-control test reports.
- G. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.
- B. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

1.6 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Designer.

1.7 WARRANTY

- A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. RMC: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Electri-Flex Company.
 - 2. Lamson & Sessions; Carlon Electrical Products.
 - 3. RACO; a Hubbell Company.
 - 4. Or approved equal.
- B. Underground Plastic Utilities Duct: NEMA TC 2, Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.
- C. Duct Accessories:
 - 1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacing while supporting ducts during concreting or backfilling.
 - 2. Warning Tape: Underground-line warning tape specified in Division 26 Section 26 05 53 "Identification for Electrical Systems"

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-80-PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80-PVC, in concrete-encased duct bank, unless otherwise indicated.
- C. Ducts for Electrical Feeders 600 V and Less used under the floor slab: RNC, NEMA Type EPC-80-PVC, in direct-buried duct bank, unless otherwise indicated. Handholes are not allowed and duct bends shall be in conformance to NFPA 70. Under slab conduit supports shall be configured and spaced as per details in the Structural Drawings.
- D. Ducts for Telephone, Communications, or Security: RNC, NEMA Type EPC-80-PVC, in concrete-encased duct bank, unless otherwise indicated.

- E. Underground Ducts for Telephone, Communications, or Security used under the floor slab: RNC, NEMA Type EPC-80-PVC, in direct buried duct bank, unless otherwise indicated. Handholes are not allowed and duct bends shall be in conformance with NFPA 70. Under slab conduit supports shall be configured and spaced as per details in the Structural Drawings.

3.2 EARTHWORK

- A. Excavation and Backfill: See civil sections.
- B. Under this section, the Contractor shall coordinate where all ducts are to be located, install all ducts (with concrete encasement if required; as previously indicated), and be responsible that all back fill is completed in accordance with NFPA 70.

3.3 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 36 inches, both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches on-center for 5-inch ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid metal conduit at least two (2) feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install expansion/deflection fittings on all below grade penetrations with the ability to expand at least two (2) inches and deflect four (4) inches. Install conduit seals on building penetrations as specified in Division 26 Section 26 05 00 "Common Work Results for Electrical" and as indicated on the Contract Documents.
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

- G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
 3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
 4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
 7. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
 8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.
 9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
 10. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct

bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

I. Direct-Buried Duct Banks:

1. Install similar as Concrete Encased Ducts.
2. Under slab conduit supports shall be configured and spaced as per details in the Structural Drawings.
3. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling.

3.4 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install removable hardware, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- E. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports in accordance with Form 816 Article 1.20-1.05.10 and as follows:
 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.7 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 43

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service entrance switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

1.2 PERFORMANCE REQUIREMENTS

A. Switchboards shall be arc resistant per IEC 61641 or ANSI/IEEE C37.20.7-2007.

B. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.3 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

C. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.

6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
8. Include schematic and wiring diagrams for power, signal, and control wiring.

D. Qualification Data: For qualified testing agency.

E. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

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

F. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

G. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in the Standard Specifications, include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

- C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Comply with NEMA PB 2.
- G. Comply with NFPA 70.
- H. Comply with UL 891.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and connect factory-installed space heaters to temporary electrical service to prevent condensation.
- C. Handle and prepare switchboards for installation according to NECA 400 NEMA PB 2.1.

1.6 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
 - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F.
 - b. Altitude: Not exceeding 500 feet.
- C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 500 feet.
- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Engineer no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Engineer's written permission.
4. Comply with NFPA 70E.

1.7 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

- A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS for additional information.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of issuance of the Certificate of Compliance.

1.9 SPARE PARTS

- A. Furnish spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no less than one of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 2. Siemens Energy & Automation, Inc.
 - 3. Square D; a brand of Schneider Electric.
 - 4. Or approved equal.
- B. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Moldedcase, individually mounted.
 - 2. Sections front and rear aligned.
- C. Nominal System Voltage: 480Y/277 V.
- D. Main-Bus Continuous: 2000 A minimum.
- E. Connections: incoming, conduit and cable from below. Outgoing, conduits out the top of switchboard.
- F. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."
- G. Indoor Enclosures: Steel, NEMA 250, Type 1.
- H. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
 - 1. Power for space heaters, ventilation, lighting, and receptacle provided by a remote source.
- I. Barriers: Between adjacent switchboard sections.
- J. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.
- K. Cubicle Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
- L. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- M. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

- N. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, with tin-plated copper feeder circuit-breaker line connections.
 - 2. Ground Bus: 1/4-by-2-inch- hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - 3. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 4. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 - 5. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- O. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- P. Electrical Insulating Matting: Provide corrugated rubber (rubber is generically used for elastomers and elastomer compounds) electrical insulating matting in conformance to ASTM D178, Type II, Class 4, and MIL-DTL-15562G. Matting shall be oil and ozone resistant and be four (4) feet longer than the front of the electrical equipment.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 2. Siemens Energy & Automation, Inc.
 - 3. Square D; a brand of Schneider Electric.
 - 4. Or approved equal.
- B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, , solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:
 - 1. Fuses, rated at 200-kA interrupting capacity.
 - 2. Fabrication using bolted compression lugs for internal wiring.
 - 3. Integral disconnect switch.
 - 4. Redundant suppression circuits.
 - 5. Redundant replaceable modules.
 - 6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 - 7. LED indicator lights for power and protection status.
 - 8. Audible alarm, with silencing switch, to indicate when protection has failed.
 - 9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of

- 10. Four-digit, transient-event counter set to totalize transient surges.
- C. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.
- D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
- E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 -V, three-phase, four-wire circuits shall be as follows:
 - 1. Line to Neutral: 800 V for 480Y/277.
 - 2. Line to Ground: 800 V for 480Y/277.
 - 3. Neutral to Ground: 800 V for 480Y/277.

2.3 CIRCUIT BREAKERS

- A. Description: Comply with IEEE C37.13.
- B. Ratings: As indicated for continuous, interrupting, and short-time current ratings for each circuit breaker; voltage and frequency ratings same as switchgear.
- C. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:
 - 1. Normal Closing Speed: Independent of both control and operator.
 - 2. Slow Closing Speed: Optional with operator for inspection and adjustment.
 - 3. Stored-Energy Mechanism: Electrically charged, with optional manual charging.
 - 4. Operation counter.
- D. Trip Devices: Solid-state, overcurrent trip-device system consisting of one or two current transformers or sensors per phase, a release mechanism, and the following features:
 - 1. Functions: Long-time-delay, short-time-delay, and instantaneous-trip functions, independent of each other in both action and adjustment.
 - 2. Temperature Compensation: Ensures accuracy and calibration stability from minus 5 to plus 40 deg C.
 - 3. Field-adjustable, time-current characteristics.
 - 4. Current Adjustability: Dial settings and rating plugs on trip units or sensors on circuit breakers, or a combination of these methods.
 - 5. Three bands, minimum, for long-time- and short-time-delay functions; marked "minimum," "intermediate," and "maximum."
 - 6. Pickup Points: Five minimum, for long-time- and short-time-trip functions. Equip short-time-trip function for switchable I^2t operation.
 - 7. Pickup Points: Five minimum, for instantaneous-trip functions.
 - 8. Ground-fault protection with at least three short-time-delay settings and three trip-time-delay bands; adjustable current pickup. Arrange to provide protection for the following:
 - a. Three-wire circuit or system.

- b. Four-wire circuit or system.
- 9. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
- 10. In addition to the above mentioned, provide ground fault protection of equipment in all circuit breakers rated 1,000 amperes or more including, but not limited to, the electrical service per NEC 230.95.
- E. Auxiliary Contacts: For interlocking or remote indication of circuit-breaker position, with spare auxiliary switches and other auxiliary switches required for normal circuit-breaker operation, quantity as indicated. Each consists of two Type "a" and two Type "b" stages (contacts) wired through secondary disconnect devices to a terminal block in stationary housing.
- F. Arc Chutes: Readily removable from associated circuit breaker when it is in disconnected position, and arranged to permit inspection of contacts without removing circuit breaker from switchgear.
- G. Operating Handle: One for each circuit breaker capable of manual operation.
- H. Electric Close Button: One for each electrically operated circuit breaker.
- I. Key Interlocks: Arranged so keys are attached at devices indicated. Mountings and hardware are included where future installation of key-interlock devices is indicated.
- J. Undervoltage Trip Devices: Adjustable time-delay and pickup voltage.
- K. Shunt-Trip Devices: Where indicated and required per Code.
- L. Indicating Lights: To indicate circuit breaker is open or closed, for main and bus tie circuit breakers interlocked either with each other or with external devices.

2.4 ACCESSORIES

- A. Accessory Set: Furnish tools and miscellaneous items required for circuit-breaker and switchboard test, inspection, maintenance, and operation.
 - 1. Portable test set for testing all functions of circuit-breaker, solid-state trip devices without removal from switchgear.
 - 2. Relay and meter test plugs suitable for testing switchgear meters and switchgear class relays.
- B. Spare-Fuse Cabinet: Identified and compartmented steel box or cabinet with lockable door.
- C. Storage for Manual: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

2.5 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
 2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; bar or window type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1.
1. Meters: 4-inch diameter or 6 inches square, flush or semiflush, with antiparallax 250-degree scales and external zero adjustment.
 2. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.
- C. Instrument Switches: Rotary type with off position.
1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
 2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.
- D. Feeder Ammeters: 2-1/2-inch minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for indicated feeder circuits only.
- E. Watt-Hour Meters and Wattmeters:
1. Comply with ANSI C12.1.
 2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
 3. Suitable for connection to three- and four-wire circuits.
 4. Potential indicating lamps.
 5. Adjustments for light and full load, phase balance, and power factor.
 6. Four-dial clock register.
 7. Integral demand indicator.
 8. Contact devices to operate remote impulse-totalizing demand meter.
 9. Ratchets to prevent reverse rotation.
 10. Removable meter with drawout test plug.
 11. Semiflush mounted case with matching cover.
 12. Appropriate multiplier tag.
- F. Impulse-Totalizing Demand Meter:
1. Comply with ANSI C12.1.
 2. Suitable for use with switchboard watt-hour meter, including two-circuit totalizing relay.

3. Cyclometer.
4. Four-dial, totalizing kilowatt-hour register.
5. Positive chart drive mechanism.
6. Capillary pen holding a minimum of one month's ink supply.
7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
8. Capable of indicating and recording five-minute integrated demand of totalized system.

G. A Digital Metering System (DMS) shall be provided as follows:

1. The DMS shall be UL listed and CE marked and shall be rated for use at temperature from -25 degrees C to $+70$ degrees C
2. The DMS shall accept input from standard instrument transformers (5A secondary current transformers and 120 volt secondary potential transformers). The DMS shall accept a voltage monitoring range of up to 600 volts, phase to phase.
3. The DMS shall withstand 200% rated current continuously. It shall withstand 10X rated current for at least 3 seconds.
4. The DMS shall be capable of connection to a three phase, four wire wye system or a three phase, three wire, open delta system.
5. Surge withstand shall conform to IEEE C37.90.1
6. The DMS shall be user programmable to any PT or CT ratio. Programming data shall be password protected. DIP switches or other fixed ratio designs shall not be acceptable.
 - a. Voltage and current connections shall be segregated from each other on the back of the monitor to provide safe connections.
 - b. The DMS shall have an accuracy of $\pm 0.2\%$ or better for volts and amps, and 0.4% for power functions.
 - c. The DMS shall be capable of providing readings for both instantaneous and average readings.
 - d. The DMS shall measure real power.
 - e. The DMS shall measure apparent power.
 - f. The DMS shall measure reactive power.
 - g. The DMS shall record and store total bi-directional energy. It shall include separate registers for positive and negative energy.
 - h. The DMS shall record and store total bi-directional accumulated energy and total accumulated apparent energy. Reporting total accumulated reactive energy shall be an available option.
 - i. The DMS shall monitor max/min average demand values for all current and power readings. The demand interval shall be user programmable.
7. The DMS shall include a three line, integrated, light-emitting diode (LED) display.
8. The measured values shall be displayed on LED's that are at least 0.56" high on each of the 3 separate lines.
9. The DMS shall be capable of displaying one leg of volts, amperes, and total power simultaneously.
10. The display shall provide user access to all phase voltages (phase to neutral and phase to phase), currents (phase and neutral), watts, VARs, VA, power factor, frequency and kWh.
11. The display shall provide user access to max/min values for all displayed quantities.
12. The DMS shall include output options for analog milli-amp signals.
13. The DMS shall have multiple channels of analog output, 0-1mA or 4-20mA, with maximum of 10 channels available.
14. The analog outputs shall map to any of the instantaneous readings.
15. At least 3 of the 0-1mA analog outputs shall be bi-directional.

16. The DMS shall include output options for pulse outputs and relay/alarm outputs.
17. The DMS shall have two form C, dry contact relay outputs for alarm or control and 1 KYZ pulse output related to Watt/HR, VA/HR, or VAR/HR.
18. The DMS shall be capable of tripping its dry contact outputs for the following conditions:
 - a. Over/Under Voltage - Phase to Neutral and Phase to Phase
 - b. Over/Under Current - Phases A, B, C and Neutral
 - c. Voltage Phase Reversals
 - d. Voltage Imbalance
 - e. Reverse Power
 - f. Over/Under KVA
 - g. Over/Under PF Lag or Lead
 - h. Over/Under % THD or K-Factor
 - i. Over/Under Frequency
19. The DMS shall also offer both hysteresis and fail-safe modes for each of the two tripping relays.
20. The DMS shall have “and/or” logic, relay set delays, relay reset delays and positive/negative logic.
21. The DMS shall also have the capability of offering 3 distinct KYZ pulses with outputs that can be mapped to any Watt/hr, VAR/hr or VA/hr reading.
22. The DMS shall be microprocessor based and shall be fully user programmable.
23. The DMS shall store 3 separate copies of the critical setup data in a write protected EEPROM. All 3 copies of the critical data shall have independent checksums.
24. The DMS shall be configured through the front panel or through a computer interface. It shall not be necessary to dismantle the DMS to perform programming functions.
25. Configuration data shall be password protected.
26. The DMS shall be capable of utilizing either an RS232 or RS485 digital communications port.
 - a. The DMS shall have a MODBUS RTU/ MODBUS TCP/IP/ ASCII, DNP 3.0 and EI Bus protocol available as standard protocols.
 - b. The DMS shall have Ethernet communications 10MB/Sec, Serial 485 and a communications baud rate of 9600 or higher.
 - c. The DMS shall have the capability of having up to 9999 separate addresses for multi-point communication.
 - d. The digital port connections shall be separated from the voltage and current connections.
27. The DMS shall be capable of gathering and reporting harmonic data.
28. The DMS shall calculate the harmonic signature, %THD and K-Factor for all voltage and current inputs with valid data for harmonic spectrum capability to the 31st harmonic.
29. The DMS shall be capable of capturing a graphic image of the waveform for each of the 6 channels of Voltage and Current and make it available in a RAM buffer for retrieval through the digital communication port.
30. The DMS case shall be fully enclosed and shielded.
31. The DMS shall fit a standard 4 1/2” switchboard instrument size mounting per ANSI C39.1. Any other mounting configuration shall be unacceptable.
32. The DMS shall have a separable input module, which can be remote mounted up to 3 feet from the display mounting.
33. The DMS shall be rated for use at temperature from –25°C to +70°C.
34. The DMS shall be Siemens ISGS or approved equal.
35. The DMS shall support control power options for 120 VAC, 230 VAC, 125 volts AC/DC, or 24-48 VDC.

2.6 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- C. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.8 IDENTIFICATION

- A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.
 - 1. Nameplate: At least 0.032-inch- thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.
- B. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.
 - 1. Nameplate: At least 0.0625-inch- thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.
- C. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.
- D. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.
- E. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.
- F. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section 03 30 00 "Cast-in-Place Concrete".
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Install spare-fuse cabinet.

- I. Comply with NECA 1.

3.3 CONNECTIONS

- A. Comply with requirements for terminating feeder bus specified in Division 26 Section 26 25 00 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.
- B. Comply with requirements for terminating cable trays specified in Division 26 Section "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section 26 05 53 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section 26 05 53 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:
 - a. Switchboards.
 - b. Circuit breakers.
 - c. Protective relays.
 - d. Instrument transformers.
 - e. Metering and instrumentation.
 - f. Ground-fault systems.
 - g. Battery systems.
 - h. Surge arresters.
 - i. Capacitors.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated and/or as specified in Division 26 Section 26 05 73 "Overcurrent Protective Device Coordination Study."

C. PROTECTION

D. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 26 24 13