

JUNE 9, 2020
MERRITT 7 RAILROAD STATION IMPROVEMENTS
FEDERAL AID PROJECT NO. N/A
STATE PROJECT NO. 302-014
CITY OF NORWALK

ADDENDUM NO. 1

This Addendum addresses the following questions and answers contained on the “CT DOT QUESTIONS AND ANSWERS WEBSITE FOR ADVERTISED CONSTRUCTION PROJECTS”:

Question and Answer Nos. 3, 8, 9, 13, 14, 17, 19, 20, 23, 24, 26, 28, 30, 32, 33, 36, 39, 42, 44, 46 & 47.

SPECIAL PROVISIONS
NEW SPECIAL PROVISION

The following Special Provision is hereby added to the Contract:

- ITEM NO. 0502234A – TEMPORARY GRADE CROSSING

REVISED SPECIAL PROVISIONS

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

- NOTICE TO CONTRACTOR – MEASUREMENT AND PAYMENT
- NOTICE TO CONTRACTOR – PEDESTRIAN OVERPASS STRUCTURE
- NOTICE TO CONTRACTOR – METRO-NORTH RAILROAD FORCES AND STATE CONTRACTOR WORK DELINEATION MATRIX
- SECTION 1.20 – GENERAL CLAUSES FOR FACILITIES CONSTRUCTION
- ITEM NO. 0751898A – CONCRETE ENDWALL

CSI SECTIONS
REVISED CSI SECTIONS

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

- CSI SECTION 033010 – CAST-IN-PLACE CONCRETE ON PLAZA
- CSI SECTION 051200 – STRUCTURAL STEEL FRAMING

- CSI SECTION 051213 – ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING
- CSI SECTION 099600 – HIGH-PERFORMANCE COATINGS
- CSI SECTION 263353 – STATIC UNINTERRUPTIBLE POWER SUPPLY

DELETED CSI SECTION

The following CSI Section is hereby deleted in its entirety:

- CSI SECTION 095100 – METAL MESH CEILING PANEL

CONTRACT ITEMS

NEW CONTRACT ITEM

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>UNIT</u>	<u>QUANTITY</u>
0502234A	TEMPORARY GRADE CROSSING	L.F.	30

REVISED CONTRACT ITEM

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>ORIGINAL QUANTITY</u>	<u>REVISED QUANTITY</u>
0969062A	CONSTRUCTION FIELD OFFICE, MEDIUM	18 MO.	23 MO.

PLANS

REVISED PLANS

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

PLAN SHEET NO.	DESCRIPTION
02.01.A1	LIST OF REVISIONS
03.021.A1	CONSTRUCTION STAGING PLAN 2
03.022.A1	CONSTRUCTION STAGING PLAN 3
04.02.A1	SIGNING & PAVEMENT MARKING PLAN
05.02.A1	ABBREVIATIONS AND SYMBOLS
05.09.A1	MISC. SCHEDULE
05.70.A1	PLATFORM STAIR PLANS AND SECTIONS
05.72.A1	STAIR HANDRAIL DETAILS
05.91.A1	SIGN TYPES IV
06.06.A1	CANOPY ROOF FRAMING PLAN
06.15.A1	OVERPASS STRUCTURE FOUNDATION/SLAB PLAN
07.25.A1	PLATFORM POWER PLAN
07.28.A1	PLATFORM GROUNDING PLAN
07.48.A1	ELECTRICAL ONE LINE DIAGRAM
07.49.A1	ELECTRICAL GROUNDING DETAILS

The Bid Proposal Form has been revised to reflect 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.

ITEM #0502234A – TEMPORARY GRADE CROSSING

Description: Work under this item shall consist of furnishing, installing, and maintaining a temporary rubber grade crossing at the temporary crossing location shown on the plans, or as directed by Metro-North Railroad (MNR). Work shall also include removing the temporary grade crossing when no longer required for the Contractor's construction activities.

Materials: Materials shall conform to the following as specified by Metro-North Railroad:

Specifications for Rubber Grade Crossings for Timber Ties

Rail Section	140 RE
Elastomer Classification:	ASTM D2000
Tensile Strength:	ASTM D412, 2,000 psi
Hardness:	ASTM D2240 55-75 Durometer Shore A
Ultimate Elongation:	ASTM D412, 350% Min.
Resistance to Ozone Cracking:	ASTM D1171, C12
Accelerated Aging:	ASTM D573, A13
Fasteners Used in Crossing:	AREMA tie plates, cut spikes and drive-on anchors
Field Panels:	Must be full-depth rubber panels; 20" width for 8'-6" timber ties; Must interlock and be capable of installation without use of lag screws.
Gauge Panels:	Must be full-depth rubber panels that encompass the gauge of the track from inside web of both rails. Panels must interlock and be capable of installation without use of lag screws.
End Ramps (deflector plates):	To be included in price and required for crossing

Materials shall be supplied by one of the following vendors or an approved equal:

Hi-Rail, Inc. 2539 Woodcliff Court Lisle, IL 60532 (630) 961-1659	Omni Grade Crossing, Inc. Radnor Station Bldg. #1, Suite 300 290 King of Prussia Radnor, PA 19087 (610) 971-9966	Railway, Inc. 120 Nixon Street PO Box 849 Cascade, IA 52033 (319) 852-7794
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The Contractor shall submit shop drawings for the rubber grade crossing with an installation work plan to the Engineer for MNR review and approval. The crossing panels shall be full depth with the height of panel matching the existing rail size for the crossing location.

Construction Methods:

The Contractor shall install the temporary grade crossing in accordance with the manufacturer’s recommendations and in compliance with the approved installation work plan. All work must be completed under track outages or foul time.

The Contractor shall repair any damage to the temporary rubber grade crossing that may be incurred during construction.

The Contractor shall completely remove and dispose the temporary rubber grade crossing materials when no longer required for the Contractor’s construction activities.

Method of Measurement: This work will be measured for payment per linear foot of full-width temporary grade crossing, installed and accepted, as measured along the centerline of track.

Basis of Payment: This work will be paid for at the Contract unit price per linear foot for “Temporary Grade Crossing,” complete in place, which price shall include furnishing, installing, maintaining, repairing, removing, and disposing the rubber grade crossing with deflector plates and all materials, equipment, tools and labor incidental thereto.

<u>Pay Item</u>	<u>Pay Unit</u>
Temporary Grade Crossing	LF

NOTICE TO CONTRACTOR – MEASUREMENT AND PAYMENT

This Project is being bid with both lump sum and unit price items. The bid items include lump sum and unit price which are IN ADDITION TO the Major Lump Sum Item (MLSI) of the Project, Item No. 0063521A, titled “Rail Facility Upgrade Site No. 1.” These separate items will be measured for payment on a unit price or lump sum basis (whichever is applicable) for which a separate bid price is required, at the quantities indicated in the Bid Proposal Form.

Standard Form 817 items are referenced by their standard item numbers. Refer to the applicable article of Form 817 for the requirements for these items. Special Provisions included in this Contract are referenced by their item number followed by an "A" suffix. Refer to the Special Provisions contained within this Contract for requirements for these items.

All work depicted on the Contract Plans and described in the Contract Specifications, including “mobilization” and “project closeout,” is included in the MLSI of the Project, with the exception of the unit price or other lump sum items listed on the Bid Proposal Form. Any work that is outside the limits stated under “Method of Measurement” and “Basis of Payment” for a specific item, other than the MLSI, but is shown on the Contract Plans or described in the Contract Specifications, is included in the MLSI. Any work that is incidental to an item which is not specifically described or included in the item, but which is required for performance and completion of the work required under the Contract, is included in the MLSI.

Vertical Construction Limits

The vertical construction limits are defined as five (5) feet outside of the vertical projection of the edges of the platform, platform ramp, and platform stairs, and five (5) feet (horizontally) outside the vertical face of footing for the access towers. The following unit price items will only be measured for payment up to the vertical construction limits:

Item No. 0202000A, Earth Excavation

Item No. 0202100, Rock Excavation

Item No. 0203100, Structure Excavation – Rock (Complete)

Item No. 0286001.10, Rock in Drainage Trench Excavation 0’-10’ Deep

Item No. 0286001.20, Rock in Drainage Trench Excavation 0’-20’ Deep

Item No. 0207000, Borrow

Item No. 0213100, Granular Fill

Item No. 0686200.06, 6” Polyvinyl Chloride Pipe 0’-10’ Deep

Work associated with these items located within the vertical construction limits (as defined above) is included in the MLSI.

The following unit price items will be measured for payment, whether or not they are enclosed within the vertical construction limits:

- Item No. 0000985A, Track Monitoring
- Item No. 0063500A, Building Site Improvements
- Item No. 0202315A, Disposal of Controlled Materials
- Item No. 0211000, Anti-tracking Pad
- Item No. 0219003, Sedimentation Control Filter Fabric Fence System
- Item No. 0502234A, Temporary Grade Crossing
- Item No. 0716000, Temporary Earth Retaining System
- Item No. 0717000, Earth Retaining System Left in Place
- Item No. 0728020A, Stone Ballast
- Item No. 0751731, 6" Foundation Underdrain
- Item No. 0813001, 5" Granite Stone Curbing
- Item No. 0815001, 5" Granite Curved Stone Curbing
- Item No. 0913021, 6' Chain Link Fence
- Item No. 0913984A, Temporary Protective Fence
- Item No. 0921001A, Concrete Sidewalk
- Item No. 0921024A, Concrete Pavers
- Item No. 0944000, Furnishing and Placing Topsoil
- Item No. 0949003A, Furnishing, Planting and Mulching Trees, Shrubs, Vines and Ground Cover Plants
- Item No. 0949110A, Rain Garden
- Item No. 0950005, Turf Establishment
- Item No. 1017066A, Precast Concrete Transformer Pad

Platform/Station/Site Amenities

There will be no separate payment for platform/station amenities including, but not limited to, benches, trash-recycling receptacles, and bicycle racks. The cost of these amenities, including any hardware and any required excavation and backfill, is included in the MLSI.

Station Signage

There will be no separate payment for station signage located in the station building, on the station platform, or on the plaza level of Building 401 of the Merritt 7 Corporate Complex; this station signage includes but is not limited to station identification signs, kiosks, accessible route signage, tactile signage, schedule holders and other pedestrian wayfinding signs. The cost of these signs, including any hardware, footings, installation and any required excavation and backfill is included in the MLSI.

Canopy Power and Communications

There will be no separate payment for the installation of conduit and cable for the canopy power and communications for lighting, VMSs, trackside phones and/or the public address system. The cost of the conduits, cables, hardware, handholes, junction boxes and/or vaults, and any required excavation and backfill, is included in the MLSI.

Electrical & Communications

There will be no separate payment for furnishing and installing site electrical and communications items including, but not limited to:

- Conduit, duct banks, handholes, junction boxes, cables, and concrete foundations/bases for site lighting fixtures, future parking access and revenue control system provisions, and electric vehicle parking station;
- Conduit, duct banks, handholes, junction boxes, and cables for railroad communications connections; and
- Conduit, duct banks, and cables for electrical and communications service to the station, including portable generator connection.

The costs of excavation, backfill, concrete, reinforcing steel, spacers, formwork, grounding rods, etc. for all site electrical and communications items are included in the MLSI.

Water Connections

There will be no separate payment for the excavation, backfill and materials required for, or the installation of, the water service to the station. All associated material and installation costs for the water service are included in the MLSI.

Railroad Grounding/Bonding Connections

There will be no separate payment for necessary components to complete the station grounding and bonding connections, including associated excavation and backfill. The costs for all grounding items are included in the MLSI.

Station Downspouts, Leaders, and Splash Blocks

There will be no separate payment for the necessary components to complete the drainage systems from the vertical construction to the discharge of the associated runoff. Downspouts, leaders, boots, splash blocks, incidental items, and all necessary excavation and backfill are included in the MLSI.

NOTICE TO CONTRACTOR – PEDESTRIAN OVERPASS STRUCTURE

The Contractor is hereby advised that he is responsible for obtaining all permits, such as Oversize/Overweight permits, that may be required for delivery of the pedestrian overpass structure, and for developing a delivery route, approved by the Department, to the Project site prior to any off-site fabrication and assembly of the pedestrian overpass structure. Refer to Form 817 Article 1.20-1.07.05 for additional information in this regard.

A Site Specific Work Plan (SSWP) detailing the erection/installation of the pedestrian overpass structure shall be submitted to the Engineer and to Metro-North Railroad for review and approval; no work on the installation of the pedestrian overpass structure shall commence until the SSWP has been approved. Metro-North Railroad will be responsible for adjusting the existing overhead communication line located on the east side of the track; the Contractor is responsible for coordinating with MNR for this work.

The Department has determined that, in order to minimize disruption to the railroad, all structural steel, the entire corrugated steel deck, and the conduits under the steel deck shall be in place prior to lifting and installing the bridge. Polycarbonate roofing panels, window assemblies, and other finishes can be installed after the bridge is installed, however all openings in the sides of the bridge must be temporarily covered following erection in accordance with the specifications.

The Contractor is responsible for any damage to the pedestrian overpass structure during transport, lifting, and installation operations, and shall make all necessary repairs and or replacements to the Engineer's satisfaction.

The Contract includes additional information regarding this activity. The Contractor shall comply with all requirements of the NOTICE TO CONTRACTOR – WORK ON RAILROAD PROPERTY to install the pedestrian overpass during allowable track outages.

The Contractor shall bid the Project accordingly.

**NOTICE TO CONTRACTOR – METRO-NORTH RAILROAD FORCES
AND STATE CONTRACTOR WORK DELINEATION MATRIX**

The Contractor is hereby notified that the following table represents construction services and materials to be furnished and completed by both Metro-North Railroad (MNR) Forces and the State's (CTDOT's) Contractor.

The following table may not be all-inclusive and does not relieve the Contractor from his responsibility to furnish and complete the work as shown on the Contract Documents and to coordinate said work with MNR that is required under other Contract provisions.

The Contractor shall also be responsible for the coordination of the work of his various subcontractors. The Contractor shall coordinate his operations with MNR operations associated with Railroad Force Account work.

Work performed by MNR will directly affect the Contractor's operation. Special coordination efforts by the Contractor will be required in support of MNR Force Account work which may be executed in multiple stages and at various times and locations throughout the duration of the Project.

The Contractor shall provide MNR access to the Project site as required for MNR to complete its work.

The Contractor shall bid the project accordingly.

Activity	MNR Department	MNR's Responsibilities	State (CTDOT) Contractor's Responsibility
GENERAL			
Railroad Protection and Outages	Capital Projects	Provide flaggers for work on or near MNR right-of-way (ROW), including protection for hi-rail mounted equipment; MNR will determine the need for flagger protection based on the nature of the Contractor's work and proximity to the ROW and track.	Coordinate with MNR as required for specific needs.
		Coordinate Contractor's need for track outages with Capital Office and Capital Operations.	
		Inspect Contractor's rail-mounted equipment for safety items and operations on track. Hi-rail equipment inspection is required every 90 days.	
Final Inspection	Capital Projects	Inspect railroad-related work performed by Contractor once work is substantially complete.	Coordinate with MNR as work is completed.
C&S			
24-Strand Fiber Optic lines	Communications, Signals	Make final connections to the existing 144-strand fiber optic pullbox and rack fiber patch panel in the MNR security room.	Purchase and install new materials, hardware, etc. as required for new line.

Activity	MNR Department	MNR's Responsibilities	State (CTDOT) Contractor's Responsibility
Existing Overhead Communication Line Adjustment	Communications	Adjust height of overhead communication line as required to facilitate construction of the East Tower and Pedestrian Overpass	Coordinate with MNR
VMSs	Communications	Make final connection to the existing MNR communications system, and testing.	Purchase and install proposed VMSs. Purchase and install conduit, wires, and test wires.
	ITS	PIDS software	
Public Address System	Communications	Make final connection to existing MNR communications system and testing.	Purchase and install conduits, wires, and speakers, and test wires.
Video Surveillance System (VSS)	Communications	Make final connection to existing MNR security system and testing.	Purchase and install conduits, wires, and cameras, and test wires.
Ticket Vending Machine	Communications	Furnish proposed TVM. Make final connection to existing MNR communications system, and testing.	Install MNR-furnished TVM. Purchase and install conduit and fiber between TVM and head-end equipment in communication room.
	ITS	TVM software	
Trash-Recycling Receptacles	Power/Stations	Approve product submittals	Purchase and install trash-recycling receptacles, and install grounding wires. Make final grounding connection and test.

Activity	MNR Department	MNR's Responsibilities	State (CTDOT) Contractor's Responsibility
Station Grounding	Power		Purchase and install grounding wires and conduits. Make final grounding connection and test.
Blue Light Phones	Communications	Determine monitoring responsibility.	Furnish and install blue light phones and all associated cable and conduit, and test system.
CROSSING			
Temporary Grade Crossing	Capital Projects	Inspect crossing work performed by Contractor.	Furnish, install, maintain, and remove temporary rubber grade crossing.

SECTION 1.20 – GENERAL CLAUSES FOR FACILITIES CONSTRUCTION

1.20-1.00 – Facilities Construction – General:

Add the following after the first paragraph:

“The Department has determined that this Project is Facilities Construction and therefore Section 1.20 applies.”

1.20-1.02.01 – Facilities Construction - Contract Bidding and Award:

After the first sentence of the third paragraph, add the Following:

In accordance with the provisions of the Construction Contract Bidding and Award Manual, bidders must be prequalified for Group No. 25B Vertical Construction - Intermediate, to be eligible to bid on this project. Bidders that are not prequalified for this work classification will not be approved to bid on this project.

1.20-1.02.04 – Facilities Construction - Examination of Plans, Specifications, Special Provisions and Site of Work:

Replace the third sentence of the fourth paragraph with:

The Department cannot ensure a response to inquiries received later than ten (10) days prior to the original scheduled opening of the related bid.

1.20-1.03.02 – Facilities Construction - Award and Execution of Contract:

After the second sentence of the only paragraph add the following:

The successful bidder is hereby notified of the Department’s intent to award this contract within **51** days of the bid opening.

1.02-1.03.08 – Facilities Construction - Notice to Proceed and Commencement of Work:

Change the first paragraph to read as follows:

The Contractor shall commence and proceed with the Contract work on the date specified in a written Notice to Proceed issued by the Engineer to the Contractor. The date specified will be no

later than 45 calendar days after the date of the execution of the Contract by the Department, however, the contractor is hereby put on notice that it is the Department's intent to issue the Notice to Proceed no later than **31** calendar days after the date of the execution of the Contract by the Department.

1.20-1.05.02— Facilities Construction – Contractor Submittals:

Replace #1, #2, #3, #5, #6, #7, #8, #9, #10, and #11 with the following:

1. General: If the plans prepared by the Department do not show complete details, they will show the necessary dimensions and preliminary details, which when used along with the other Contract documents, will enable the Contractor to prepare submittals necessary to complete the Contract work.

The Contractor is required to prepare submittals as Portable Document Format (PDF) files using Bluebeam Revu.

The Contractor is also required to acquire and maintain access to the Department's COMPASS capital project delivery system. The minimum recommended internet speed is 25MB/sec. For reference, the Department's internet speed is 1 GB/sec.

The Contractor shall submit a request for COMPASS access to the Designer. The Department will provide Web-based access to the required number of Contractor users.

The entry/log-in procedure is described in the CT DOT [COMPASS Contractor's User Manual](#).

2. Submittal Preparation and Processing: The Contractor shall:

(a) Coordinate preparation and processing of submittals with performance of construction activities;

(b) Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay;

(c) Coordinate each submittal with fabrication, purchasing, testing, delivery, and other submittals and related activities that require sequential activity;

(d) Provide separate submittal packages by submittal type as single or multi-page PDF's. Submittal types shall be WD, SD, CD, PD, PS, or QA as defined elsewhere. Incomplete submittal packages will be returned to the Contractor without being reviewed. Multi-page PDF's shall be limited to 250 MB; larger PDF files will need to be broken up and contained in the same submittal. "PDF Packages" shall not be submitted via COMPASS.

(e) Provide submittals for related elements of Project work for a concurrent review of all information.

The Contractor shall allow at least 21 calendar days for initial submittal review by the submittal reviewer, and allow additional time for such review if processing must be delayed to permit coordination with subsequent submittals. The submittal review time begins with the submittal upload. If a subsequent submittal is necessary, the Contractor shall allow at least 21 additional calendar days for processing each subsequent submittal. The submittal reviewer reserves the right to withhold action on a submittal if coordination with other submittals is necessary, until all related submittals are received. The submittal reviewer will promptly inform the Contractor when a submittal being processed must be delayed for such coordination.

The Contractor shall allow at least 28 calendar days for outside agency review of any submittal requiring their approval, including but not limited to the following: any utility, FTA, any

railroad, DEEP, U.S. Coast Guard, Army Corps of Engineers, FM Global, and any Commissioning Authority.

The Engineer will not authorize an extension of Contract time because of the Contractor's failure to transmit submittals to the submittal reviewer or outside agencies sufficiently in advance of the work to permit processing.

The Contractor shall be limited to one acceptable submittal per product. Once a product has been accepted either as originally specified, or as an "Or Equal" to the product specified, the Contractor may elect to submit a subsequent product for consideration, but the Contractor shall be required to reimburse the Department for all costs associated with reviewing the subsequent request.

The Contractor shall attach a Submittal Transmittal Form to the beginning of each PDF submittal. A blank Submittal Transmittal Form is located in the Appendix of the [COMPASS Contractor's User Manual](#). This form will be used for the Contractor to digitally certify that "Having reviewed this submittal, I certify that it is complete, accurate, coordinated in all aspects of the item being submitted and conforms to the requirements of the Contract in all respects, including all Federal requirements such as "Buy America", except as otherwise noted." The digital certification process is detailed in the CT DOT [COMPASS Contractor's User Manual](#).

3. Transmittal of Submittals: The digitally certified PDF submittal package shall be uploaded into COMPASS using the Submittals/Transmittals application. The submittal process is described in the CT DOT [COMPASS Contractor's User Manual](#). The submittal reviewer will not act on submittals received in any other manner.

The Contractor shall use naming conventions described in the CT DOT [COMPASS Contractor's User Manual](#) unless otherwise directed by the Designer.

For those submittals or portions thereof returned to the Contractor with a "Revise and Resubmit" or "Rejected" workflow status, the Contractor shall use the "Replace File" function described in the CT DOT [COMPASS Contractor's User Manual](#) to properly upload the new version of the submittal document(s).

5. Working Drawings (Delegated Design Submittals) [WD]: When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and submit working drawings, signed, sealed and dated by a qualified Professional Engineer licensed to practice in the State of Connecticut, for review.

There will be no direct payment for furnishing any working drawings, procedures or supporting calculations, but the cost thereof shall be considered as included in the general cost of the work.

a. Working Drawings for Permanent Construction: The Contractor shall submit drawings to the Designer on 22 inch × 34 inch sheets with a border and title block similar to the Department standard. Drawings shall be searchable. The first drawing shall include the Contractor's designer's Professional Engineer's digital signature, meeting the requirements of Adobe's Certified Document Services (CDS) or Adobe's Approved Trusted List (AATL), and all other drawings shall include a watermark of the Professional Engineer's stamp in a common area of the border. Calculations, procedures and other supporting data may be submitted in an 8-1/2 inch × 11 inch format and shall be in a single PDF file. The first sheet of calculations shall include the Contractor's designer's Professional Engineer's digital signature, meeting the CDS or AATL requirements. Documents shall be named "Drawings," "Calculations," or "Supporting Documentation" as applicable. The Contractor's designer, who prepares the working drawings, shall secure and maintain at no direct cost to the State a Professional Liability Insurance Policy

for errors and omissions in the minimum amount of \$2,000,000 per error or omission. The Contractor's designer may elect to obtain a policy containing a maximum \$250,000 deductible clause, but if the Contractor's designer should obtain a policy containing such a clause, they shall be liable to the extent of at least the deductible amount. The Contractor's designer shall obtain the appropriate and proper endorsement of its Professional Liability Policy to cover the indemnification clause in this Contract, as the same relates to negligent acts, errors or omissions in the Project work performed by them. The Contractor's designer shall continue this liability insurance coverage for a period of (i) 3 years from the date of acceptance of the work by the Engineer, as evidenced by a State of Connecticut, Department of Transportation form entitled "Certificate of Acceptance of Work," issued to the Contractor; or (ii) 3 years after the termination of the Contract, whichever is earlier, subject to the continued commercial availability of such insurance. The Contractor shall supply to the Assistant District Engineer a certificate of insurance in accordance with 1.20-1.03.07 at the time that the working drawings for the Project are submitted.

b. Working Drawings for Temporary Construction: The Contractor shall submit drawings, calculations, procedures and other supporting data in a format acceptable to the Assistant District Engineer.

6. Shop Drawings [SD]: When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and submit shop drawings for review. Drawings shall be submitted on 22 inch × 34 inch sheets with an appropriate border and with a title block in the lower right-hand corner of each sheet. Drawings shall be searchable.

Shop Drawings consist of fabrication and installation drawings, roughing-in and setting drawings, schedules, patterns, templates and similar drawings, and wiring diagrams showing field-installed wiring, including power, signal, and control wiring. Standard information prepared without specific reference to the Project shall not be considered to be a Shop Drawing. Shop Drawings shall be project specific.

Shop drawings shall include the following information: Contract number, Project description, number and title of the drawing, date of drawing, revision number, name of Contractor and subcontractor submitting drawings, dimensions, identification of products, shop work manufacturing instructions, design calculations, statement of compliance with Contractual standards, notation of dimensions established by field measurement, notation of coordination requirements, relationship to adjoining construction clearly indicated, seal and signature of a professional engineer if specified, and any other information required by individual Contract provisions.

There will be no direct payment for furnishing any shop drawings, procedures or supporting calculations, but the cost thereof shall be considered as included in the general cost of the work.

7. Coordination Drawings [CD]: When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and submit coordination drawings for review. Drawings shall be searchable.

The Contractor shall prepare coordination drawings according to requirements in other Contract provisions, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

Coordination Drawings shall include Project-specific information drawn accurately to a scale large enough to indicate and resolve conflicts. Coordination Drawings shall not be based on

standard printed data. Coordination Drawings shall include the following information, as applicable: (1) use applicable plans as a basis for preparation of Coordination Drawings and prepare sections, elevations, and details as needed to describe relationship of various systems and components; (2) coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review; (3) indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems; (4) indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation; (5) show location and size of access doors required for access to concealed dampers, valves, and other controls; (6) indicate required installation sequences; (7) indicate dimensions shown on the plans, specifically noting dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements, and (8) provide alternate sketches to the Designer indicating proposed resolution of such conflicts. The Contractor shall ensure the Coordination Drawings are signed by each installer, indicating their approval prior to submission.

There will be no direct payment for furnishing any coordination drawings, but the cost thereof shall be considered as included in the general cost of the work.

8. Product Data [PD]: When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and submit product data for review in a PDF file.

The Contractor shall provide all product data in a single submittal for each element of construction or system and shall mark each submittal with the Contract item number.

The Contractor shall mark each copy of a product data submittal to show applicable choices and options. Where product data includes information on several products that are not required, copies shall be marked to indicate the applicable information. Product data shall include the following information and confirmations to the extent applicable: manufacturer's printed recommendations, compliance with recognized trade association standards, compliance with recognized testing agency standards, application of testing agency labels and seals, notation of coordination requirements, and any other information required by the individual Contract provisions.

There will be no direct payment for furnishing any product data, but the cost thereof shall be considered as included in the general cost of the work.

9. Product Samples [PS]: When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and submit product samples for review.

Product Samples are samples submitted for review and action by the Designer, which are: (1) physically identical to the proposed product or material cured and finished as required by the Contract; or (2) submitted for review of kind, color, pattern, thickness, and texture. Samples shall be used for a final check of these characteristics with other elements, and for a comparison of the characteristics of the approved sample with those of the actual component as delivered and installed.

The following information shall be submitted with product samples to the extent applicable: Contract number; Project description; generic description of the sample (name or trade reference, type or quality or grade, and any further designation necessary to identify the items or materials); sample source; product name; manufacturer's name; confirmation of availability; and anticipated delivery time.

In conjunction with the submission of physical product samples, a digital photograph of the sample shall be uploaded into COMPASS.

The Designer will retain one set of the samples, transmit one set of same to the Engineer. The Engineer will retain the samples at the Project Site for quality comparisons throughout the duration of the Project.

There will be no direct payment for furnishing any product samples, but the cost thereof shall be considered as included in the general cost of the work.

10. Quality Assurance Submittals [QA]: When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and submit quality assurance submittals for review in a single PDF file.

Quality assurance submittals consist of qualification data, design data, certifications, manufacturer's instructions, manufacturer's field reports, test reports, Material Safety Data Sheets (MSDSs), and other quality assurance information required by individual Contract provisions.

Where Contract provisions require certification that a product, material, or installation complies with specified requirements, the Contractor shall submit a notarized certification from the manufacturer certifying said compliance. An officer of the manufacturer or other individual authorized to sign documents on behalf of the company shall sign the certification.

Where Contract provisions require the Contractor shall provide a certification letter on the manufacturer's letterhead to certify that asbestos is not contained in the materials.

The manufacturer certification letter shall be formatted in the following manner: [Addressed to:] Commissioner of Transportation Department of Transportation P.O. Box 317546 Newington, Connecticut 06131-7546 Project Title and Number [We] hereby certify that all materials manufactured by [Insert Manufacturer Name] are asbestos-free. [Signature:] [Name of authorized signatory] [Title]

Submittals associated with these materials will not be reviewed without the required manufacturer certification letter.

There will be no direct payment for furnishing any quality assurance submittals, but the cost thereof shall be considered as included in the general cost of the work.

11. Submittal Reviewer's Action: The Designer or Engineer will review each submittal, mark each with a uniform, self-explanatory action stamp, and return the stamped submittal promptly to the Contractor. The stamp will be marked as follows to indicate the action taken:

(a) If submittals are marked "No Exceptions Noted," the Designer or Engineer has not observed any statement or feature that appears to deviate from the Contract requirements. This disposition is contingent on being able to execute the manufacturer's written warranty in compliance with the Contract provisions.

(b) If submittals are marked "Exceptions as Noted," the considerations or changes noted by the Designer or Engineer are necessary in order for the submittal to comply with Contract requirements. This disposition is contingent on being able to execute the manufacturer's written warranty in compliance with the Contract provisions.

(c) If submittals are marked "Revise and Resubmit," the Contractor shall revise and resubmit the submittal to address the deficiencies or provide additional information requested by the Designer or Engineer

(d) If submittals are marked "Rejected," the Contractor shall prepare and submit a new submittal in accordance with the Designer's notations.

(e) If submittals are primarily for information or record purposes, the Designer will return the submittal marked “No Action Required.” This disposition is contingent on being able to execute the manufacturer’s written warranty in compliance with the Contract provisions.

The Contractor shall not proceed with the part of the Project covered by the submittal until the submittal is marked “No Exceptions Noted,” “Exceptions as Noted,” or “No Action Required” by the Designer or the Engineer. The Contractor shall retain sole responsibility for compliance with all Contract requirements.

The Contractor shall print 1 color copy of each submittal marked “No Exceptions Noted,” “Exceptions as Noted,” or “No Action Required” to the Assistant District Engineer for use by the Engineer within 7 calendar days of the completed submittal review. The Contractor shall not perform physical work related to the submittal until the 2 color copies are provided to the Assistant District Engineer.

The Contractor shall mark up one set of Working Drawings (including any related calculations), Shop Drawings, and Coordination Drawings and retain them as a “Record Document.”

Maintenance manuals and warranties will not be returned unless they are Rejected.”

1.20-1.05.08— Facilities Construction – Schedules and Reports:

Delete the first sentence and replace with the following:

“Transmittals of Schedules: The schedule package shall be uploaded into COMPASS using the Submittals/Transmittals application. The submittal process is described in of the CT DOT [COMPASS Contractor's User Manual](#).

The Contractor shall use naming conventions described in the CT DOT [COMPASS Contractor's User Manual](#) unless otherwise directed by the Designer.

When a project coordinator is not required by the Contract the following shall apply:”

1.20-1.05.23 – Facilities Construction – Requests for Information (RFI’s) and Requests for Change (RFC’s):

Delete the first paragraph and replace with the following:

“The Contractor shall upload all RFIs and RFCs into COMPASS using the Submittals/Transmittals application. The submittal process is described in the CT DOT [COMPASS Contractor's User Manual](#).

The Contractor shall use naming conventions described in the CT DOT [COMPASS Contractor's User Manual](#) unless otherwise directed by the Designer.

The Engineer will forward the RFI or RFC to the Designer for review. Upon receipt of an RFI or RFC, the Designer will attempt to determine if additional information is required from the Contractor to respond to the RFI or RFC and request said information from the Engineer.”

1.20-1.06.08 – Facilities Construction – Warranties

Delete paragraph 8 starting “Prior to the date for the Substantial Completion Inspection to the end of the Article.

“Prior to the date of the Substantial Completion Inspection, the Contractor shall compile each required warranty, properly executed by the Contractor or any other required party. The warranties shall be uploaded into COMPASS using the Submittals/Transmittals application. The submittal process is described in the CT DOT [COMPASS Contractor's User Manual](#).

The Contractor shall use naming conventions described in the CT DOT [COMPASS Contractor's User Manual](#) unless otherwise directed by the Designer.

The Contractor shall submit warranties in PDF format, assembling the complete warranty submittal package into a single electronic PDF file with bookmarks enabling navigation to each item and providing a bookmarked table of contents at beginning of document. The Contractor shall place the warranty documents in an orderly sequence based on the organization of the Contract provisions (including specific CSI-formatted specifications contained within a particular Special Provision). Multi-page PDF’s shall be limited to 250 MB; larger PDF files will need to be broken up and contained in the same submittal. “PDF Packages” shall not be submitted via COMPASS.

The Contractor shall include a description of the product or installation, including the name of the product, and the name, address and telephone number of the Contractor or pertinent subcontractor.

The Contractor shall furnish to the Department a written warranty for all Project work accompanied by a cover letter with the following contents:

[Addressed to:] Commissioner of Transportation Department of Transportation P.O. Box 317546 Newington, Connecticut 06131-7546 Project Title and Number [We] hereby warrant all materials and workmanship for all work performed under this Contract for a period of one (1) year from [date of issuance of C.O.C.] against failures of workmanship and materials in accordance with the Contract. Furthermore, as a condition of this warranty, [we] agree to have in place all insurance coverage identified in the Contract for the performance of any warranty work. [Signature:] [Name of authorized signatory] [Title]

Upon determination by the Engineer that Project work covered by a warranty has failed, the Contractor shall replace or rebuild the work to an acceptable condition complying with Contract

requirements. The Contractor is responsible for the cost of replacing or rebuilding defective construction or components and those which may have needed to be damaged or removed in order to cure the defective work including costs of material, equipment, labor, and material disposal, regardless of whether or not the State has benefited from use of the work through a portion of its anticipated useful service life. The Contractor shall respond to the Project Site when Project work covered by a warranty has failed within 3 calendar days, unless in the Engineer's opinion said failure is deemed to be an emergency, in which case the Contractor shall respond to the Project Site as directed by the Engineer.

When Project work covered by a warranty has failed and been corrected by replacement or rebuilding, the Contractor shall reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the time that remains on the original warranty period at the time of the failure.”

1.20-1.08.03—Facilities Construction – Prosecution of Work:

Add the following as a new section 6:

“6. Project Phasing: Although the Contractor is responsible for developing its own phasing plan for the Engineer's approval for the Project work, the Contractor shall construct the project in stages in general accordance with the suggested sequence of construction outlined on the Construction Staging Plans for each stage.

The Contractor shall not initiate demolition of the existing Merritt 7 station in Stage 4 prior to receiving written direction to do so from the Engineer.

The Contractor shall install the final course of bituminous concrete pavement on Glover Avenue at the end of the last stage and after completion of other roadway and site improvements involving drainage installations, curb installation, and curb ramp installation. Final pavement markings shall be installed on the final course of bituminous concrete pavement in accordance with Article 9.71.03 as contained in the Special Provision “Maintenance and Protection of Traffic.”

1.20-1.08.04—Facilities Construction – Limitation of Operations:

Add following the last paragraph.

CONTRACTOR REQUIREMENTS FOR WORK AFFECTING THE RAILROAD

1. In general, unless otherwise authorized by the Railroad, the Contractor's construction activities and operations directly over or adjacent to the operating right-of-way will be performed during the following track outage periods shown below.

Outage	Time
Off-Peak	Weekdays (Sunday night to Thursday night): 12:45 AM to 5:30 AM Weekends (Friday night to Saturday night): 12:45 AM to 6:30 AM
Off-Peak Request for Foul Time	Weekdays: Upon Request Weekends: Upon Request

Additional Outage Notes:

- i. The above outages are not guaranteed at all times.
 - ii. No full track outages will be permitted on weekends, either immediately before or after holidays, nor any weekend between Thanksgiving and New Years day.
2. The Contractor's plan for demolition, erection, and any operation adjacent to or within the Railroad right-of-way shall be submitted to the Engineer for Railroad approval, prior to start of work.
 3. Track outages will be considered as requests are submitted and received. Additional track outages will be considered for approval as requested by the Contractor for the completion of work.
 4. While every effort is made to accommodate the Project needs, the above track outages cannot be guaranteed at all times. Track outages are dependent on many circumstances; including weather, availability of protective personnel, conflicts with other projects and unforeseen operating problems. Therefore, no claims may be made against Metro-North Railroad for delays due to unavailability of track. Further, outages are granted on the basis of what is deemed necessary for construction, not merely for the Contractor's convenience.
 5. The hours shown for track outages are the times that the tracks will be out of service. These outage times do not represent the time the track(s) are available to the Contractor. Time needs to be allowed to take the track out of service. At a minimum, it should be anticipated that the Contractor will lose 30 minutes at the beginning and end of each window noted above. Also, there are freight trains that operate overnight between 10 pm and 4 am, on varying schedules that are subject to change; as of January 2019, freight trains operate on Monday, Tuesday, and Wednesday each week.
 6. Station area work shall be performed and flag protection acquired in accordance with Metro-North Railroad Safety Procedures. For work on the east side of the track, all vehicles, equipment and materials for excavation, stockpiling, construction and associated activities shall cross the track in the location identified in the Contract drawings or as approved by MNR.

7. Metro-North Railroad employees, unless specifically designated otherwise within the Contract, will perform all work involving rail, ties, and other track components on active (in service) tracks. The Contractor may not remove abandoned track (out of service) unless given prior written approval from the Engineer and Metro-North Railroad.
8. Work performed 10 feet or more beyond the centerline of track can be performed without fouling the track or track outage.

TIME RESTRICTIONS FOR MAINTENANCE AND PROTECTION OF TRAFFIC

In order to provide for traffic operations as outlined in the Special Provision "Maintenance and Protection of Traffic," the Contractor's work may be restricted on public roadways in the project area as follows:

Glover Avenue

The Contractor may only close Glover Avenue to through traffic Monday through Friday from 1:00 AM to 5:30 AM and detour traffic as shown in the detour plans.

All Other Public Roadways

The Contractor may detour traffic as shown in the detour plans Monday through Friday from 1:00 AM to 5:30 AM.

OTHER TRAFFIC LIMITATIONS

It is anticipated that work on adjacent projects may be on-going simultaneously with this project. The Contractor shall be aware of those projects and anticipate that coordination will be required to maintain proper traffic flow at all times on all project roadways, in a manner consistent with the specifications and acceptable to the Engineer.

The Contractor will not be allowed to perform any work that will interfere with traffic operations on a roadway when traffic operations are being restricted elsewhere on that same roadway, unless the closures have been coordinated and are acceptable to the Engineer.

The field installation of a signing pattern shall constitute interference with existing traffic operations and shall not be allowed except during the allowable periods.

If there is more than one alternating one-way traffic operation at one time, then there shall be at least 500 feet between signing patterns.

No bituminous roadway, with the exception of transition areas, shall be open to traffic unless the appropriate pavement markings have been installed. The transition areas shall have pavement markings applied immediately upon opening to traffic.

Longitudinal dropdowns greater than 3 inches will not be allowed during those periods when the maximum number of lanes of through traffic is required. The Contractor shall temporarily provide a 4:1 traversable slope of suitable material in those areas where a longitudinal dropdown exists. The cost of furnishing, installing and removing this material shall be included in the contract lump sum for "Maintenance and Protection of Traffic."

The Contractor shall schedule operations so that pavement removal and roadway resurfacing shall be completed full width across a roadway section by the end of a workday (worknight). All transverse height differentials on all roadway surfaces shall be tapered to negate any "bump" to traffic as specified elsewhere in this contract or as approved by the Engineer. Material for this taper shall be as approved by the Engineer.

All protective systems and traffic control devices as called for by the contract or ordered by the Engineer must be on-hand and available in sufficient quantity for immediate installation prior to any stage change.

CONSTRUCTION NOISE LIMITATIONS

The following construction operations will not be permitted on the Project due to noise during overnight work periods, which are defined between the hours of 9 pm and 6 am daily:

- Milling of bituminous concrete pavements
- Sawcutting of pavements
- Demolition of buildings, structures, and pavements
- Excavation
- Driving of sheeting or piles

Demolition activities on the Merritt 7 Corporate Complex shall only be performed on weekends to minimize disturbance of tenants. Specific hours are:

- Saturdays between 8 am and 8 pm
- Sundays between 9 am and 8 pm

MERRITT 7 CORPORATE COMPLEX ACCESS LIMITATIONS

The Contractor's access to driveways, drive aisles, and parking spaces on the Plaza Level of the Merritt 7 Corporate Complex during construction are defined by the Access Easement and Construction Easement that have been acquired for the Project. The easements are illustrated on the Right of Way Survey, Serial No. 6, Sheet 1 of 2, revised January 22, 2020.

The Contractor's personnel and equipment **shall not block or obstruct** access by others through the Access Easement and Construction Easement during the following times:

- Weekdays between 7 am and 9 am
- Weekdays between 4 pm and 6 pm

The Contractor's movement of personnel and equipment **may temporarily block or obstruct – but at no time shall prohibit** – access by others through the Access Easement and Construction Easement during the following times:

- Weekdays between 9 am and 4 pm
- Weekdays between 6 pm and 7 am
- All Day Saturdays
- All Day Sundays

Additionally, the Contractor shall maintain access to all parking, driveways, drive aisles, pedestrian accommodations, building entrances/exits, and emergency egress routes located on the Merritt 7 Corporate Complex site and **outside the easements at all times.**

1.20-1.08.14 – Facilities Construction – Acceptance of Project

Delete 4. Operation and Maintenance Manuals down to “Product Maintenance Manual” and replace with the following:

“4. Operation and Maintenance Manuals: Prior to the date of the Semi-Final Inspection, the Contractor shall compile operation and maintenance manuals in the form of instructional manuals for use by the Owner. The operation and maintenance manuals shall be uploaded into COMPASS using the Submittals/Transmittals application. The submittal process is described in the CT DOT [COMPASS Contractor's User Manual](#).

The Contractor shall use naming conventions described in the CT DOT [COMPASS Contractor's User Manual](#) unless otherwise directed by the Designer.

The Contractor shall submit manuals in the form of a multi-page PDF format for each manual type required using electronic files prepared by the manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable size. The Contractor shall place the warranty documents in an orderly sequence based on the organization of the Contract provisions (including specific CSI-formatted specifications contained within a particular Special Provision). Multi-page PDF's shall be limited to 250 MB; larger PDF files will need to be broken up and contained in the same submittal. “PDF Packages” shall not be submitted via COMPASS.

For each manual, the Contractor shall:

- (a) Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- (b) Provide a title page as the first page of each manual with the following information: subject matter covered by the manual; Contract number and title; date of submittal; name, address, and telephone number of the Contractor; and cross-reference to related systems in other sections.

- (c) Provide a table of contents, arranged systematically according to the organization of the Contract provisions (including specific CSI-formatted specifications within a particular Special Provision).
- (d) Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. The Contractor shall list the name, address, and telephone number of the subcontractor, the maintenance contractor, and the local source for replacement parts and equipment for each product.
- (e) Include manufacturer's standard data and mark each sheet to identify each part or product included in the Project, identify each product using appropriate references from the Contract, and delete references to information that is not applicable. The use of project record documents as part of operation and maintenance manuals is not permitted.
- (f) Prepare supplementary text to provide operation and maintenance information when the manufacturer's standard data is not available or the data is insufficient and the information is necessary for proper operation and maintenance of equipment or systems, organize text in a consistent format under separate headings for each procedure, and provide a logical sequence of instruction for each operation or maintenance procedure.
- (g) Provide drawings where necessary in order to supplement manufacturer's data to illustrate the relationship of component parts of equipment or systems or to provide control or flow diagrams. The Contractor shall coordinate these drawings with information contained in project record drawings to ensure correct illustration of the completed installation. The use of Project record documents as part of operation and maintenance manuals is not permitted.
- (h) Provide estimated life cycle costs to maintain each product included in the manual to reach maximum useful life (i.e. annual, mid-life overhaul, end of life overhaul, or programmed interval replacement)."

Delete the last 2 paragraphs of 5. Training ("The Contractor shall submit ... owner for unlimited reproduction.") and replace with the following:

"The Contractor shall video record each training session."

ITEM #0751898A – CONCRETE ENDWALL

Description: Work under this article shall include precast or cast-in-place concrete endwalls for reinforced concrete pipe culverts to be installed or built in the locations indicated, and to the lines, grades, and dimensions shown on the plans, in accordance with this special provision. The Contractor shall prepare and submit working drawings for the endwalls, signed, sealed and dated by a qualified Professional Engineer licensed to practice in the State of Connecticut, for review in accordance with Section 1.20-1.05.02.

Materials: The materials furnished and used in the work shall be as follows:

Cast-in-place concrete shall be Class ‘A’ concrete meeting the applicable requirements of M.03.

Reinforcing steel shall be epoxy coated and shall meet the requirements of M.06.01.

Precast concrete for endwalls shall meet the requirements of M.08.02-4.

Brick shall meet the requirements of M.11.03.

Mortar shall be as specified in M.11.04.

Granular fill shall meet the requirements of M.02.01.

Construction Methods:

Cofferdams and dewatering, as required for construction in the dry, shall be provided in accordance with the conditions of the approved environmental permits for this project and in accordance with Section 2.04.

Excavation and satisfactory disposal of excess material for the construction of endwalls shall be provided in accordance with Section 2.03.

Granular fill shall be placed to the lines, grades, and dimensions shown on the plans and in accordance with Section 2.13.

Construction of endwalls shall be provided in accordance with Section 5.06.03-2 and the pertinent sections of 6.01.03. Where shown in the details, brick and mortar shall be used to infill the space between the required pipe opening and the specified pipe; this work shall be performed by a competent and experienced mason. After the mortar has cured, approved backfill shall be placed behind the endwall up to the prescribed surface; approved fill shall also be placed on the sides of the endwall and around the front of the endwall to the lines and grades needed for the placement of riprap, as shown in the details. Riprap shall be placed immediately upon final grading of the surface and slopes around the endwall; placement of riprap is covered under Section 7.03.

Method of Measurement: This work will be measured for payment by the number of EACH concrete endwall, installed and accepted.

Basis of Payment: This work will be paid for at the Contract unit price each for “Concrete Endwall,” complete in place, which price shall include working drawings, excavation, disposal of excavated material, granular fill, concrete endwall with brick and mortar infill around pipe, backfill, and all materials, equipment, tools and labor incidental thereto. Cofferdams and

dewatering, and riprap, will be paid under their respective pay items.

<u>Pay Item</u>	<u>Pay Unit</u>
Concrete Endwall	EA

SECTION 033010 CAST-IN-PLACE CONCRETE ON PLAZA

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817 – 2016, and supplemental specifications thereto, shall be a part of this specification.
- B. Special Provision for Section 1.20 – General Clauses for Facilities Construction.

1.02 SECTION INCLUDES

- A. Cast-in-place concrete for building frame members, floors, and supported slabs.
- B. Floors and slabs on grade.
- C. Additional miscellaneous concrete work as specified in Supplementary General Requirements, the Form of Bid, or elsewhere in the Contract Documents.

1.03 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Concrete - Slab-on-fill or Grade: By the square foot or as described in the bid form.
- B. Concrete - Vertical in Forms: By the square foot or as described in the bid form.
- C. Concrete - Includes concrete, placement accessories, consolidating and leveling, troweling, climate protection and curing.

1.04 REFERENCES

- A. ACI 211.1 - Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- B. ACI 211.2 - Selecting Proportions for Structural Lightweight Concrete.
- C. ACI 301 - Structural Concrete for Buildings.
- D. ACI 302 - Guide for Concrete Floor and Slab Construction.
- E. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- F. ACI 305R - Hot Weather Concreting.
- G. ACI 306R - Cold Weather Concreting.
- H. ACI 308 - Standard Practice for Curing Concrete.

- I. ACI 318 - Building Code Requirements for Reinforced Concrete.
- J. ASTM C33 - Concrete Aggregates.
- K. ASTM C94 - Ready-Mixed Concrete.
- L. ASTM C138 - Test method for unit weight, yield, and air content of concrete.
- M. ASTM C150 - Portland Cement.
- N. ASTM C260 - Air Entraining Admixtures for Concrete.
- O. ASTM C330 - Light Weight Aggregates For Structural Concrete.
- P. ASTM C494 - Chemical Admixtures for Concrete.
- Q. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

1.05 SUBMITTALS

- A. Submit the following in accordance with Article 1.20-1.05.02 in Form 817 and the special provisions.
- B. Product data for proprietary materials and items, including forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Engineer.
- C. The Contractor shall submit trial mix proportion with compressive strength test results to the Engineer for approval. Proportion design mixes as defined in ACI 301 Article 3.9. Include the following information for each concrete mix design submission:
 - 1. Method used for mix design.
 - 2. Gradation of fine and coarse aggregates (ASTM C33).
 - 3. Proportions of all admixtures added at the plant or at job site.
 - 4. Water/cement ratio.
 - 5. Slump (ASTM C143).
 - 6. Certification of chloride content of admixtures.
 - 7. Air Content of freshly mixed concrete (ASTM C31 and ASTM C173)
 - 8. Unit weight of concrete (ASTM C138).
 - 9. Strength at 3, 7, 28 days.
- D. The Testing Agency shall submit test results of cylinders for each day's testing, information shall include the following:
 - 1. Slump (ASTM C143).
 - 2. Air Content of freshly mixed concrete (ASTM C31 and ASTM C173)
 - 3. Unit weight of concrete (ASTM C138).

4. Strength at 3, 7, 28 days.
 5. Concrete temperature at placement time.
 6. Air temperature at placement time.
- E. The Contractor shall submit the proposed pouring sequence and construction joint layout for approval by the Engineer.
- F. Minutes of pre-construction conference.

1.06 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
1. ACI 301, "Specifications for structural concrete for buildings", ACI 318, "Building Code Requirements for Reinforced Concrete", OR AASHTO specifications.
 2. Independent testing agency employed by Owner and acceptable to the Engineer.
- B. Materials and installed work may require testing and retesting at any time during progress of work. Retesting of rejected materials for installed work, shall be done at Contractor's expense.
- C. Pre-Construction Conference: Conduct conference at Project site and the following.
- D. At least 21 days prior to start of the concrete construction schedule, the contractor shall conduct a meeting to review the proposed mix designs and discuss the required methods and procedures necessary to achieve the required concrete quality. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Request that representatives of each entity directly concerned with cast-in-place concrete attend conference, including, but not limited to, the following:
1. Contractor's superintendent.
 2. Laboratory responsible for concrete design mixes.
 3. Laboratory responsible for field quality control.
 4. Ready-mix concrete producer.
 5. Concrete subcontractor.
 6. Primary admixture manufacturers.
 7. Architect or Owner's representative.
- E. Test Placement: Prior to beginning structural concrete flatwork placements and after approval of the proposed mixture proportions by the engineer, contractor shall conduct one test placement at location selected by the Engineer. Contractor shall use the placing, finishing, evaporation protection, and curing techniques proposed for use on the project. These techniques and the final finished appearance of the microsilica

concrete shall be reviewed by the Engineer and the representative of the microsilica admixture manufacturer. Actual flatwork placements shall not begin until the test placement has been approved by the Engineer.

- F. The minutes shall include a statement by the concrete contractor indicating that the proposed mix design and placing techniques will produce the concrete quality required by these specifications.

PART 2 –PRODUCTS

2.01 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I, non air-entraining, of recent manufacture and free of lumps.
1. Use one brand and type of cement throughout project unless otherwise acceptable to Engineer.
 2. Use of "fly ash" and "new cem" in the concrete mix is not permitted.
- B. Normal Weight Aggregates: ASTM C-33 and as herein specified. Provide aggregates from a single source for exposed concrete. Coarse aggregates shall be clean, sound crushed and graded limestone or approved equal conforming to ASTM C33. No chert shall be permitted.
1. Use ¾” nominal size conforming to ASTM C33, Table 2.
 2. Chloride ion level in aggregate shall be tested by laboratory making trial mixes. Test shall conform to FHA Report No. FHWA-RD-77-85, “Sampling and Testing for Chloride Ion in Concrete” or AASHTO Method T260. Water soluble chloride ion content of mix from all constituents shall not exceed 0.1% by weight of cement.
- C. Water: Potable water: ASTM C94.
- D. Sand: ASTM C-33. Sand shall be clean and sharp and shall be provided from a single source.
- E. Admixtures, General: (ACI 301) Provide admixtures for concrete that are free from chloride ions. Use of any admixtures must be approved by Engineer prior to its use. Use approved admixtures in strict accordance with manufacturer’s recommendation.
- F. Air-Entraining Admixture: ASTM C-260, certified by manufacturer to be compatible with other required admixtures.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. "Air-Mix" or "Perma-Air," Euclid Chemical Co.
 - b. "Darex AEA" or "Daravair," W.R. Grace & Co.
 - c. "MB-VR" or "Micro-Air," Master Builders, Inc.
 - d. "Sika AER," Sika Corp.

- G. Water-Reducing Admixture: ASTM C 494, Type A.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. "Eucon WR-75, Eucon WR-89 or Eucon MR" Euclid Chemical Co.
 - b. "WRDA with Hycol," W.R. Grace & Co.
 - c. "Pozzolith 322N or Polyheed 997," Master Builders, Inc.
 - d. "Plastocrete 161," Sika Corp.

- H. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F or Type G.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. "Eucon 37, Eucon 1037 or Plastol 5000" Euclid Chemical Co.
 - b. "Daracem," W.R. Grace & Co.
 - c. "Rheobuild 1000, or Rheobuild 716" Master Builders, Inc.
 - d. "Sikament 300," Sika Corp.

- I. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. "Eucon Retarder 75," Euclid Chemical Co.
 - b. "Daratard-17," W.R. Grace & Co.
 - c. "Pozzolith R," Master Builders, Inc.
 - d. "Plastiment," Sika Corporation.

2.02 RELATED MATERIALS

- A. Reglets: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, fill reglet or cover face opening to prevent intrusion of concrete or debris.

- B. Moisture-Retaining Cover: Burlap complying with ASTM C 171.

- C. Clear Curing and Sealing Compound (A.I.M. Regulations – VOC Complaint, 350 g/l): Liquid-type membrane-forming curing compound, clear styrene acrylate type, complying with ASTM C1315, Type I, Class A, 25% solid contents minimum. Moisture loss not more than 0.4 Kg./sq.m. when applied at 300 sq. ft./gal.
 - 1. Available Products for normal concrete: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. "Super Diamond Clear VOX, or Super Rez Seal Vox" Euclid Chemical Company.

- b. "Masterkure100W," Master Builders, Inc.
- D. Curing Compound (Strippable) – VOC Complaint, 350 g/l): The water based compound shall conform to ASTM C 309. Use strippable curing compound on surfaces to be covered with finish or coating material applied directly to concrete, such as liquid densifier/sealer, waterproofing, dampproofing, membrane roofing, flooring, painting, and other coatings and finish materials.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. "Kurez DR VOX" Euclid Chemical Company.
- E. Vapor Barrier: A flexible, preformed sheer membrane having a water-vapor permeance rate no greater than 0.012 perms when tested in accordance with ASTM E154, Section 7 and otherwise conforming to ASTM E1475, Class B or higher. Vapor barrier shall be no less than 10 mils thick in accordance with ACI 302.1R-96.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. "Griffolyn Vaporguard," Reef Industries.
 - b. "Stego Wrap (15 mils) Vapor Barrier," Stego Industries L.L.C., San Juan Capistrano, CA, PH: 877-464-7834.
 - c. "Premoulded membrane with PLASMATIC CORE," W.R. Meadows.

2.03 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for concrete by laboratory trial batch or field experience methods as specified in ACI 301. Use an independent testing facility acceptable to the Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.
- B. Submit written reports to the Engineer of each proposed mix at least 15 days prior to start of work. Do not begin concrete production until proposed mix designs have been reviewed and approved by the Engineer.
- C. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:
 - 1. 5,000-psi, 28-day compressive strength; W/C ratio, 0.38 maximum, and other admixtures as per manufacturer's recommendations.

2.04 ADMIXTURES

- A. Use high-range water-reducing admixture (Superplasticizer) in concrete for placement and workability.
- B. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content of 6.0% with a tolerance of plus or minus 1.0 percent.

- C. Use admixtures for water reduction and set control in strict compliance with manufacturer's directions.
- D. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
 - 1. Not more than 3 inches initial slump.
 - 2. Not more than 8 inches final slump after the addition of plasticizing agent.

PART 3 – EXECUTION

3.01 PRODUCTION OF CONCRETE (ACI 301, CHAPTER 7)

- A. Concrete shall be produced by a ready-mix plant. On-site volumetric batching and concrete production shall be approved by the Engineer prior to start of the work.
- B. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as specified.
- C. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
- D. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
- E. No water shall be added to concrete batch at site. Addition of superplasticizers at site shall be as directed by concrete manufacturer and admixture manufacturer. Truck shall be equipped with admixture dispenser or other auxiliary equipment, capable of adjustment for variation of dosage, calibration and accurate measurement.

3.02 PREPARATION

Demolition and surface preparation shall be performed as shown on details and as per Section 020600 of this specification at locations shown on plans and selected by the Engineer.

- A. The existing delaminated slab shall be removed using sawcutting and jackhammers. The structural slab shall be sounded using the chain drag method. The delaminated and unsound concrete areas shall be marked in the presence of the Engineer.
 - 1. Removal: The floor slab in or adjacent to delaminated and unsound concrete area shall be shored to sustain dead and construction loads. The shoring shall be carried down one level below.

2. The periphery of the repair area shall be sawcut (½ inch minimum) prior to demolition.
3. The delaminated and unsound concrete over the metal decking shall be removed full depth. Concrete shall be removed a minimum of ¾" below exposed rebars for partial depth repairs. Partial depth demolition shall be such that the existing embedded reinforcing is not damaged. All exposed reinforcing shall be sandblasted clean free of all rust and foreign materials.
4. All existing reinforcing steel bars are to remain and bars that have lost 20% or more of their cross-sectional areas shall be supplemented as directed by the Engineer.
5. Install additional mild steel rebars as shown in details.

3.03 FORMS

- A. General: Formwork as per Section 03300 of this specification.

3.04 PLACING, FINISHING AND CURING

A. Bonding Grout: (Partial Depth)

1. After the surface has been cleaned and immediately before placing concrete, a thin coating of bonding grout shall be scrubbed into the saturated, prepared surface of the existing concrete. The existing concrete surface shall be saturated by prewetting for 2 hours (min.) prior to concrete placing. Proper workmanship shall be exercised to insure that all existing surfaces receive a thorough, even coating and that no excess grout permitted to collect in pockets. The rate of progress in applying grout shall be limited so that the grout does not become dry before it is covered with new concrete.
2. Bonding grout for patching concrete to existing concrete shall consist of Portland Cement and a 50:50 mix of SBR Latex and water mixed in a portable mechanical mixer to a plastic consistency. The Water/Cement shall be the same as that of the topping mix.
3. Should the bonding grout dry before the concrete is placed, the Contractor will remove the dried grout and sandblast clean the grouted surface, at his expense, before placing fresh bonding grout.

B. Placing and finishing:

1. Receive Owner's and Engineer's written approval of surface finish used on flatwork before beginning work.
2. Do not place concrete when temperature of air is less than 50 degrees F. unless the following conditions are met:
 - a. Place concrete only when temperature of surrounding air is expected to be above 40 degrees F. and rising and expected to be above 45degrees F. for at least 36 hours after the pour.
 - b. When above conditions are not met, concrete may be placed only if insulation or heating enclosures are provided in accordance with ACI

- 306 (Recommended practice for cold weather concreting). Submit proposed protective measures for Engineer's approval.
- c. Cost of precautionary measures shall be borne by the Contractor.
3. For hot weather concrete placement the following conditions shall apply:
 - a. Do not place concrete if concrete mix temperatures exceeds 90 degrees F.
 - b. Do not place concrete under hot weather conditions. Hot weather is defined as air temperature which exceeds 80 degrees F. or any combination of high temperature, low humidity and high wind velocity which causes evaporation rate in excess of 0.10 pounds per square foot per hour as determined by ACI 305R, Figure 2.1.5.
 4. Concrete shall be deposited as close to its final position as possible. All concrete placement shall be continuous and terminated only at bulkheads and designated construction joints.
 5. On ramps with greater than 5 percent slope, all concreting shall begin at the low point and end at high point. Contractor shall make necessary adjustments to slump or equipment without any irregularities or roughness.
- C. Finishing (ACI 301, Chapters 10 and 11)
1. All flatwork finishers shall hold current ACI Flatwork Finishers Certification.
 2. Partial Depth Placement: After the bonding grout has been applied, concrete shall be placed, consolidated by vibration, and shall be finished by screeding and floating to bring the finished surface to specified elevation. The surface shall then receive a light broom finish. The reinforcing steel shall have a minimum concrete cover as shown on plans. The finished concrete shall be protected by barricades with lights, until the completion of the required curing period.
- D. Curing: All normal concrete is to be cured using water only, unless approved by Engineer otherwise. When water is required to wet the surface of the newly placed concrete, it shall be applied as a fine spray so that it will not mark or pond on the surface. Except where otherwise specified, the curing period shall be at least 72 hours. If high early strength Portland Cement is approved by the Engineer, the curing period may be reduced as directed by the Engineer. Curing shall be accomplished by wet curing only. The curing membrane shall only be used in floor areas approved by the Engineer.
1. The surface of the newly poured concrete shall be covered with wetted burlap as soon as the concrete has hardened sufficiently to prevent marring of the surface. The burlap shall overlap six inches. At least two layers of wetted burlap shall be placed on the finished surface. The burlap shall be kept saturated by means of a mechanically operated sprinkling system. In place of the sprinkling system, two layers of burlap may be substituted for one layer of burlap and impermeable covering.

The burlap sheets shall be placed so that they are in contact with the vertical faces of concrete slabs after removal of slab forms, and that portion of the material in contact with those faces shall be kept saturated with water.

2. Membrane Curing Method. Membrane curing will not be permitted unless approved in writing by the Engineer. Colored and stamped concrete shall be cured by membrane curing method as specified below.

After the concrete has been finished and immediately after the final texture has been achieved and the water sheen has disappeared from the surface of the concrete, the surface shall be sealed with specified curing and sealing compound or the strippable curing compound. The seal shall be maintained for the specified curing period. The vertical faces of concrete slabs shall, likewise, be sealed immediately after the forms are removed. Two separate applications, applied at least one minute apart each at the rate of not less than one gallon per 300 square feet, will be required upon all surfaces of the concrete. These applications shall be made with mechanical equipment.

At locations where the coating is discontinuous or where pin holes show or where the coating is damaged due to any cause and on areas adjacent to sawed joints, immediately after sawing is completed, an additional coating of membrane curing compound shall be applied at the rate of one gallon per 250 square feet.

3. The Engineer may order curing by another method specified herein if unsatisfactory results are obtained with membrane curing compound. Prior to starting The Work, the Contractor shall have available, at the site of The Work, a supply of one of the other approved curing materials sufficient for curing one day's production.
4. The Contractor's construction operations including the management of traffic, shall be such as to avoid damage to the coatings of curing compound for period of not less than the curing period specified. Any curing membrane that is damaged or that peels from the concrete surface within the curing period specified, shall be repaired by the Contractor without delay and in an approved manner. No additional compensation will be allowed to the Contractor for performance of this work.

3.05 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.
 1. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried.
 2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture

and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

- B. Repair of Concrete Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry-pack mortar, or precast cement cone plugs secured in place with bonding agent.
 - 1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

3.06 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. A. General: The Owner will employ a testing laboratory to perform tests and to submit test reports.
- B. Sampling and testing for quality control during placement of concrete may include the following, as directed by Architect.
- C. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - 1. Slump: ASTM C 143; one test at point of discharge for each truck delivering the concrete; additional tests when concrete consistency seems to have changed.
 - 2. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each truck of air-entrained concrete.
 - 3. Water Content: The water content of freshly mixed concrete will be tested each time cylinders are made as directed by the Engineer in accordance with AASHTO TP 23, Proposed Standard Method for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.
 - 4. Concrete Temperature: Test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and each time a set of compression test specimens is made.
 - 5. Compression Test Specimen: ASTM C 31; one set of 6 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cure test specimens are required.
 - 6. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. more than the first 25 cu. yds. of each concrete class placed in any one day; one specimen

- tested at 3 days, one specimen tested at 7 days, 3 specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
7. When frequency of testing will provide fewer than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
 8. When total quantity of a given class of concrete is less than 50 cu. yds., Architect may waive strength test if adequate evidence of satisfactory strength is provided.
 9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 10. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.
- D. Test results will be reported in writing to the Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for 7-day tests and 28-day tests.
- E. Non-Complaint Test Reports: All test reports indicating non-compliance should be faxed immediately to all parties on the test distribution list. Copies shall be on different colored paper.
- F. Nondestructive 3-day Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- G. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION

SECTION 051200 – STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 – 2004 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Metro-North Railroad regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the Notices to Contractor and other specifications in the Contract.

1.02 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Grout.
- B. Related Requirements:
 - 1. Section 051213 – “Architecturally Exposed Structural Steel Framing”.
 - 2. Section 055000 – “Metal Fabrications” for miscellaneous steel fabrications and other metal items not defined as structural steel.
 - 3. Section 099600 – “High-Performance Coatings” for surface preparation and priming requirements.

1.03 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A6/A6M with flanges thicker than 1-1/2 inches.
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.
- C. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.04 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.05 ACTION SUBMITTALS

- A. Submit the following in accordance with Article 1.20-1.05.02 in Form 817 and the special provisions.
- B. Product Data: For each type of product.
- C. Shop Drawings: Show fabrication of structural-steel components:
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 - 5. Identify members and connections of the Seismic-Load-Resisting System.
 - 6. Indicate locations and dimensions of protected zones.
 - 7. Identify demand critical welds.
- D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
 - 1. Power source (constant current or constant voltage).
 - 2. Electrode manufacturer and trade name, for demand critical welds.
- E. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.06 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Article 1.20-1.05.02 in Form 817 and the special provisions.

- B. Special Inspections program for Structural Steel Framing.
- C. Qualification Data: For fabricator, shop-painting applicators, testing agency, and professional engineer.
- D. Welding certificates.
- E. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- F. Mill test reports for structural steel, including chemical and physical properties.
- G. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shear stud connectors.
 - 5. Shop primers.
 - 6. Nonshrink grout.
- H. Survey of existing conditions.
- I. Source quality-control reports.
- J. Field quality-control reports.

1.07 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F1852 fasteners and for retesting fasteners after lubrication.
- C. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

PART 2 – PRODUCTS

2.01 BUY AMERICA COMPLIANCE

- A. Not applicable to this Contract.

2.02 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
 1. Select and complete connections using schematic details indicated and AISC 360.
 2. Use Allowable Stress Design; data are given at service-load level.
- B. Moment Connections: Type FR, fully restrained.

2.03 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes and WT-Shapes: ASTM A992/A992M
- B. Channels, Angles, S-Shapes: ASTM A36/A36M
- C. Plate and Bar: ASTM A36/A36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B, structural tubing.
- E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
 - 1. Weight Class: Per Drawings.
 - 2. Finish: Black except where indicated to be galvanized.
- F. Welding Electrodes: Comply with AWS requirements.

2.04 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade C, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959, Type 325, compressible-washer type with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959, Type 490, compressible-washer type with plain finish.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
- D. Headed Anchor Rods: ASTM F1554, Grade 55, weldable straight.
 - 1. Nuts: ASTM A563 heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A36/A36M carbon steel.
 - 3. Washers: ASTM F436 Type 1, hardened carbon steel.
- E. Threaded Rods: ASTM A36/A36M.
 - 1. Nuts: ASTM A563 heavy-hex carbon steel.
 - 2. Washers: ASTM A36/A36M carbon steel.
- F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A108, Grade 1035.

- G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1030.

2.05 PRIMER

- A. Primer for non-exposed structural steel: SSPC-Paint 23, latex primer.
- B. Primer for non-exposed structural steel: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- C. Primer for Architecturally Exposed Structural Steel: Comply with Section 051213- "Architecturally Exposed Structural Steel Framing."

2.06 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.07 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360:
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A6/A6M and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required

to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

- F. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches O.C. unless otherwise indicated.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.08 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.09 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
 - 6. Surfaces enclosed in interior construction.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."

3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 5. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting non-exposed structural steel: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.
- E. Painting Architecturally Exposed Structural Steel: Comply with Section 051213- "Architecturally Exposed Structural Steel Framing".

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
1. Liquid Penetrant Inspection: ASTM E165.
 2. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 3. Ultrasonic Inspection: ASTM E164.
 4. Radiographic Inspection: ASTM E94.
- D. Prepare test and inspection reports.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.03 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates, Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other

surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by the Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.04 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint specified.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work:
1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 "Code of Standard Practice for Steel Buildings and Bridges," for mill material.
 4. Treatment of welds for Architecturally Exposed Structural Steel: Comply with Section 051213- "Architecturally Exposed Structural Steel Framing".

3.05 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections in accordance with Chapter 17 of the International Building Code, 2012 with Connecticut State Building Code Amendments.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94.

- E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.06 REPAIRS AND PROTECTION

- A. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.07 TEMPORARY WORK

- A. In addition to OSHA-required protections, provide temporary cover of the vertical openings along the length of the pedestrian bridge immediately upon erection over the railroad. The temporary cover shall be, at a minimum, nominal 1/2" thick exterior grade plywood sheathing sufficiently affixed or braced to the inside of the structural steel framing to prevent the material from tipping or falling from its vertical position; this shall be accomplished without damage to the steel or its coating.

END OF SECTION

SECTION 051213 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Metro-North Railroad regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the Notices to Contractor and other specifications in the Contract.

1.2 SUMMARY

- A. Section includes architecturally exposed structural-steel (AESS).
 - 1. Requirements in Section 051200 "Structural Steel Framing" also apply to AESS.
 - 2. AESS shall be Category 1, as defined in ANSI/AISC 303-16, for all structural steel framing.
- B. Related Requirements:
 - 1. Section 051200 - "Structural Steel Framing" for additional requirements applicable to AESS.
 - 2. Section 055000 - "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
 - 3. Section 099600 - "High-Performance Coatings" for surface preparation and priming requirements.

1.3 DEFINITIONS

- A. AESS: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Submit the following in accordance with Article 1.20-1.05.02 in Form 817 and the special provisions.
- B. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation of bolt heads.
 - 5. Indicate exposed surfaces and edges and surface preparation being used.
 - 6. Indicate special tolerances and erection requirements.
- C. Samples: Submit Samples of AESS to set quality standards for exposed welds.
 - 1. Two steel plates, 3/8 by 8 by 4 inches, with long edges joined by a groove weld.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Article 1.20-1.05.02 in Form 817 and the special provisions.
- B. Qualification Data: For Installer and fabricator.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.8 FIELD CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 BUY AMERICA COMPLIANCE

- A. Not applicable to this Contract.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain.

2.3 FILLER

- A. Filler: Polyester filler intended for use in repairing dents in automobile bodies.

2.4 PRIMER

- A. Primer: Comply with Section 099600 "High-Performance Coatings."

2.5 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
- B. In addition to special care used to handle and fabricate AESS, comply with the following:
 - 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
 - 2. Grind sheared, punched, and flame-cut edges of AESS to remove burrs and provide smooth surfaces and edges.
 - 3. Fabricate AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
 - 4. Fabricate AESS with exposed surfaces free of seams to maximum extent possible.
 - 5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
 - 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.

7. Fabricate AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 8. Seal-weld open ends of hollow structural sections with 3/8-inch closure plates for AESS.
- C. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet under any lighting conditions.
 2. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch.
- D. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch with a tolerance of 1/32 inch for AESS.
- E. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened unless noted as slip critical.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
 2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
 3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where AESS is exposed to weather.
 4. Provide continuous welds of uniform size and profile where AESS is welded.
 5. Grind butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch for AESS.
 6. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for AESS.
 7. At locations where welding on the far side of an exposed connection of AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.

8. Make fillet welds for AESS oversize and grind to uniform profile with smooth face and transition.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.

3.3 ERECTION

- A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 1. Erect AESS to the tolerances specified in AISC 303 for steel that is designated AESS.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened unless noted as slip critical.
 2. Orient bolt heads in same direction for each connection and to maximum extent possible in same direction for similar connections.
- B. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.

1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for AESS.
2. Remove erection bolts in AESS, fill holes, and grind smooth.
3. Fill weld access holes in AESS and grind smooth.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

3.6 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 099600 - "High Performance Coatings."

END OF SECTION

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817 – 2016, and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Metro-North Railroad regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the Notices to Contractor and other specifications in the Contract.

1.02 SUMMARY

- A. Section includes surface preparation, shop application and field touch up of high-performance coating systems on the following substrates:
 - 1. Exterior Substrates:
 - a. Cast-In-Place Concrete
 - b. Concrete Topping
 - c. Structural Steel
- B. The adverse conditions dictated by work along a operating railroad necessitate the following conditions:
 - 1. All high performance coatings will be shop-applied.
 - 2. Areas that require field touch-up will be limited to connections and minor abrasions due to erection. Field touch-up is to be applied by the Painting Contractor, certified by the Manufacturer.
- C. Related Sections:
 - 1. Section 055000 “Metal Fabrications” for loose steel lintels.
 - 2. Section 055213 “Pipe and Tube Railings”.
 - 3. Section 081113 “Hollow Metal Doors”

1.03 DEFINITIONS

- A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- B. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.04 ACTION SUBMITTALS

- A. Submit the following in accordance with Article 1.20-1.05.02 in Form 817 and the special provisions.

- B. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- C. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 - 3. VOC content.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Applicator Qualifications: Engage an experienced applicator who has completed high-performance coating system applications similar in material and extent to those indicated for Project and whose work has a record of successful in-service performance.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.07 FIELD CONDITIONS

- A. Apply field touch-up of coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Carboline Company (Carboline).
 - 2. DuPont Company, High Performance Coatings (DuPont).
 - 3. International Protective Coatings; Courtaulds Coatings (International).
 - 4. Tnemec Company, Inc. (Tnemec).

2.02 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
 - 3. Provide products of same manufacturer for each coat in a coating system.
- C. Colors: Custom color as indicated in the finish schedule on the drawings.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

2.03 EPOXY COATINGS

- A. Epoxy Deck Coating (Slip-Resistant): MPI #82.
 - 1. Basis-of-Design: Epoxoline Series FC22, by Tnemec Company Inc., or approved equal.

2.04 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches.
 - 2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."

2.05 SCHEDULE OF FINISHES

- A. The Steel Fabricator shall finish structural steel components for high-performance coatings as specified below:
 - 1. Exterior Exposed Structural Steel including the following components and systems are to receive a 3-coat finishing system per Section 099600 – High Performance Coatings.
 - a. Platform, canopy, stair/elevator towers: All steel members including columns, beams, purlins, roof framing components and accessories including base plates. Refer to Specification Section 051200 – Structural Steel for additional details.
 - b. Exterior platform railings and incorporated systems, stairs, gates, sign frames, brackets and fasteners, unless specified as galvanized and to remain unfinished and exposed to view (gratings). Refer to Specifications Section 055213 – Pipe and Tube Railings, 055000 - Metal Fabrications, and 055110 - Metal Stairs, for additional details.
 - c. Exposed tube steel framing and connected miscellaneous steel, including guardrails/railing systems etc.
 - 2. The following items are hot-dipped galvanized:
 - a. Guardrails.
 - b. Surfaces embedded in concrete or mortar.
 - c. Any remaining exterior exposed to weather steel as depicted in the contract drawings.

2.06 EXTERIOR HIGH-PERFORMANCE COATING SYSTEMS

- A. Steel Substrates: (Basis of Design) System specified is based upon a 3-coat priming and finishing system as manufactured by Tnemec, as follows:
 - 1. Severe Environment (High-Gloss Finish): One finish coat over one intermediate coat and a primer.
 - a. Primer: Tnemec Series 90-97 Zinc @ 2.0-3.5 mils dry. Coordinate with steel fabricator for application, and Section 05120 – Structural Steel for priming and steel preparation.

- b. 2nd Coat: Tnemec Series 27 Typoxy (color) @ 3.0-5.0 mils dry.
 - c. 3rd Coat: Tnemec Series 73 Endura Shield (color) @ 1.5-3.0 mils dry.
2. Acceptable Systems:
- a. Primer: Epoxy primer applied at spreading rate recommended by manufacturer.
 - 1) Carboline: Carbozinc 859 Organic Zinc-Rich Epoxy Primer.
 - 2) DuPont: 25P High Solids Epoxy Mastic.
 - 3) International: Intergard 251 Thin- Film Polyamide Epoxy Rust Inhibitive Primer.
 - b. 2nd Intermediate Coat: Epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 3.0 to 8.0 mils.
 - 1) Carboline: Carboguard 635 Epoxy Polymeric Amine.
 - 2) DuPont: 25P High Solids Epoxy Mastic.
 - 3) International: Intergard 345 DTM Semi-Gloss Epoxy.
 - c. 3rd Coat: Aliphatic polyurethane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.
 - 1) Carboline: Carbothane 134 HG Aliphatic Acrylic Polyurethane.
 - 2) DuPont: Imron 333 High Gloss Polyurethane Enamel.
 - 3) International: Interthane 990 Low VOC Thin Film Polyurethane.

B. Concrete Substrates, Horizontal Surfaces:

- 1. Epoxy Slip-Resistant Deck Coating System:
 - a. Topcoat: Epoxy deck coating (slip-resistant), MPI #82.

2.07 SOURCE QUALITY CONTROL

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site,

pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches.
 - 2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" for Exterior platform railings and incorporated systems, stairs, gates, sign frames, brackets and fasteners.
 - 2. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning." For platform, canopy, stair/elevator towers - all steel members including columns,

beams, purlins, roof framing components and accessories including base plates.

- E. Galvanized Steel Substrates: Galvanizing requires a roughened surface for optimum adhesion/performance of high build epoxies. Remove any contaminants per SSPC-SP1; ensure there are no chemical treatments that may interfere with adhesion; and abrade the surface to establish a suitable roughness (typically 1 mil). SSPC-SP16 or SSPC-SP7 are acceptable methods.

3.03 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.
- E. Application Procedures: Apply coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
- F. Brush Application: Use brushes best suited for material applied and of appropriate size for the surface or item being coated.
 - 1. Apply primers and first coats by brush unless manufacturer's written instructions permit using roller or mechanical applicators.
 - 2. Brush out and work brush coats into surfaces in an even film.
 - 3. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.
 - 4. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for the material and texture required.

5. Spray Equipment: Use mechanical methods to apply coating if permitted by manufacturer's written instructions and governing regulations.
 - a. Use spray equipment with orifice size recommended by manufacturer for material and texture required.
 - b. Apply each coat to provide the equivalent hiding of brush-applied coats.
 - c. Do not double back with spray equipment building-up film thickness of two coats in one pass, unless recommended by manufacturer.

- G. Minimum Coating Thickness: Apply each material no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.

- H. Field Connections: Areas adjacent steel field connections to be delivered to jobsite with primer coat only.
 1. Shop-apply primer coat to entire component.
 2. Mask-off areas around field connections after erection and final torque of connection bolts.
 3. Touch-up areas of primer coat that have been damaged.
 4. Apply finish coats to components, allowing proper feathering of surfaces to obtain a consistent finish.

- I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by manufacturer, to material required to be coated or finished that has not been prime coated by others.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Recoat primed and sealed substrates if there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn-through or other defects caused by insufficient sealing.

- J. Completed Work: Match approved Samples for color, texture, and coverage. Remove, refinish, or recoat work that does not comply with specified requirements.

3.04 QUALITY CONTROL

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

3.05 FIELD PAINTING

- A. Summary: Field painting will be limited to connections and minor abrasions from delivery or erection. All other painting is shop-applied.
- B. Restrictions: Train schedules and site conditions may necessitate railroad track outages, railroad flagmen, and nighttime work periods for field painting. The Contractor shall pay special attention to the Notice to Contractor – Work on Railroad Property and other Metro-North Railroad Specifications in the General Provisions.
- C. Comply with the provisions of Article M.07 of Form 817 except as otherwise stated specified.
 - 1. Clean all steel soon after erection of dirt, mud, lubricant or other foreign matter that may have accumulated.
 - 2. Mask off adjacent painted areas that have already been painted, allowing approximately 1” overlap for feathering.
 - 3. Prime and Spot paint all field bolts, field welds, and abrasions to the shop coat with the same material used for the shop coat. Use a heavy field coat of bituminous paint on those portions of columns to be embedded in masonry or concrete in the exterior walls, and on interior columns through the slab on grade to be encased in concrete.
- D. The ambient air and surface temperature shall be at least 5⁰F above the dew point prior to and during coating applications.

3.06 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

END OF SECTION 099600

SECTION 263353 - STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 – GENERAL

1.01 SUMMARY:

- A. Drawings and general provisions of the Contract, including State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817 – 2016, and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Metro-North Railroad regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the Notices to Contractor and other specifications in the Contract.
- C. This Section includes the furnishing and installing of a three-phase, on-line, static-type, UPS installations, complete with transient voltage surge suppression, input harmonics reduction, rectifier-charger, battery, battery disconnect device, inverter, static bypass transfer switch and all accessories. UPS systems shall be installed for the station and platform lighting, VSS and communication racks.

1.02 DEFINITIONS:

- A. EMI: Electromagnetic interference.
- B. LCD: Liquid-crystal display.
- C. LED: Light-emitting diode.
- D. THD: Total harmonic distortion.
- E. UPS: Uninterruptible power supply.

1.03 SUBMITTALS:

- A. Submit the following in accordance with Article 1.20-1.05.02 in Form 817 and the special provisions.
- B. Product Data: Include data on features, components, ratings, and performance for each uninterruptible power supply component indicated.
- C. Shop Drawings: Detail assemblies of equipment indicating dimensions, weights, components, and location and identification of each field connection. Show access,

workspace, and clearance requirements; details of control panels; and battery arrangement.

1. Wiring Diagrams: Detail internal and interconnecting wiring; and power, signal, and control wiring. Differentiate between field-installed and factory-installed wiring and components.
- D. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- F. Factory Test Reports: Comply with specified requirements.
- G. Field Test Reports: Indicate test results compared with specified performance requirements, and provide justification and resolution of differences if values do not agree.
- H. Maintenance Data: For UPS units to include in maintenance manuals. Include the following:
 1. Lists of spare parts and replacement components recommended being stored at Project site for ready access.
 2. Detailed operating instructions covering operation under both normal and abnormal conditions.
- I. Warranties: Special warranties specified in this Section.

1.04 CLOSOUT SUBMITTALS:

- A. Submit closeout submittals in accordance with Article 1.20-1.05.02 in Form 817 and the special provisions, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.05 QUALITY ASSURANCE:

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01
- B. Installer Qualifications: An experienced installer who is an authorized representative of UPS manufacturer for both installation and maintenance of units required for this Project.
- C. Power Quality Consultant Qualifications: A registered professional electrical engineer or engineering technician, currently certified by the National Institute for Certification in Engineering Technologies, NICET level 4, minimum, experienced in functional performance testing UPS installations and in performing power quality surveys similar to that required in Part 3 "Functional Performance Testing" Article.

- D. **Manufacturer Qualifications:** A firm who maintains a service center capable of providing training, parts, and emergency maintenance and repairs for equipment at Project site with eight hours' maximum response time.
- E. **Testing Agency Qualifications:** An independent testing agency with experience and capability to conduct testing indicated without delaying the Work, as documented according to OSHA criteria for accreditation of testing laboratories, 29 CFR 1910.7; or a full member company of the International Electrical Testing Association.
 - 1. **Testing Agency's Field Supervisor:** Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- F. **Source Limitations:** Obtain the UPS and associated components specified in this Section from a single manufacturer with responsibility for entire UPS installation.
- G. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70-2014, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 1. **UPS Power Units: Listed and labeled under UL 1778**
 - 2. **UPS Emergency Lighting Unit: Listed and labeled under UL 924**
 - 3. Mark UPS components as suitable for installation in computer rooms according to NFPA 75.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information
- B. Deliver equipment in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed.
- C. Store equipment in spaces with environments controlled within manufacturers' ambient temperature and humidity tolerances for non-operating equipment.

1.07 WARRANTY:

- A. Refer to Article 1.20-1.06.08 in Form 817 and the special provisions, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS, for additional information
- B. **Warranties, General:** Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

C. Special Battery Warranties: Written warranty, signed by manufacturer and Installer agreeing to replace UPS system storage batteries that fail in materials or workmanship within specified warranty period.

1. Warranted Cycle Life for Sealed Lead-Acid Batteries: Equal to or greater than that represented in manufacturer's published table, including figures corresponding to the following, based on annual average battery temperature of 77 deg F (25 deg C):

DISCHARGE RATE	DISCHARGE DURATION	DISCHARGE END VOLTAGE	CYCLE LIFE
8 hours	8 hours	1.67	6 cycles
30 minutes	30 minutes	1.67	20 cycles
15 minutes	1 minutes	1.67	120 cycles

2. Warranted Cycle Life for Premium Sealed Lead-Acid Batteries: Equal or greater than that represented in manufacturer's published table, including figures corresponding to the following, based on annual average battery temperature of 77 deg F (25 deg C):

DISCHARGE RATE	DISCHARGE DURATION	DISCHARGE END VOLTAGE	CYCLE LIFE
8 hours	8 hours	1.67	40 cycles
30 minutes	30 minutes	1.67	125 cycles
15 minutes	1 minutes	1.67	750 cycles

3. Warranted Cycle Life for Wet-Cell Batteries: Equal to or greater than that represented in manufacturer's published table, including figures corresponding to the following, based on annual average battery temperature of 77 deg F (25 deg C):

DISCHARGE RATE	DISCHARGE DURATION	DISCHARGE END VOLTAGE	CYCLE LIFE
8 hours	8 hours	1.75	40 cycles
1 hour	1 hour	1.75	80 cycles
15 minutes	0 to 30 seconds	1.67	2700 cycles

D. Special UPS Warranties: Written warranties, signed by manufacturer and Installer agreeing to replace components that fail in materials or workmanship within special warranty period.

1. Special Warranty Period: Three years from date of Substantial Completion.

1.08 EXTRA MATERIALS:

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to the client.
 - 1. Fuses: One for every 10 of each type and rating, but not less than 1 of each.
 - 2. Cabinet Ventilation Filters: One complete set.
 - 3. One spare circuit board for each critical circuit.

PART 2 – PRODUCTS

2.01 BUY AMERICA COMPLIANCE

- A. Not applicable to this Contract.

2.02 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton Corporation.
 - 2. Or approved equal.

2.03 FUNCTIONAL DESCRIPTION:

- A. Automatic operation includes the following:
 - 1. Normal Conditions: Supply the load with ac power flowing from the normal ac power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output.
 - 2. Abnormal Supply Conditions: If normal ac supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to maintain constant, regulated inverter ac power output to the load without switching or disturbance.
 - 3. If normal power fails, energy supplied by the battery through the inverter continues supply-regulated ac power to the load without switching or disturbance.
 - 4. When power is restored at the normal supply terminals of the system, controls automatically synchronize the inverter with the external source before transferring the load. The rectifier-charger then supplies power to the load through the inverter and simultaneously recharges the battery.
 - 5. If battery becomes discharged and normal supply is available, the rectifier-charger charges the battery. On reaching full charge, the rectifier-charger automatically shifts to a float-charge mode.
 - 6. If any element of the UPS system fails and power is available at the normal supply terminals of the system, the static bypass transfer switch switches the

load to the normal ac supply circuit without disturbance or interruption of supply.

7. If a fault occurs in the system supplied by the UPS and current flows in excess of the overload rating of the UPS system, the static bypass transfer switch operates to bypass the fault current to the normal ac supply circuit for fault clearing.
8. When the fault has cleared, the static bypass transfer switch returns the load to the UPS system.
9. If battery is disconnected, the UPS continues to supply power to the load with no degradation of its regulation of voltage and frequency of the output bus.

B. Manual operation includes the following:

1. Turning the inverter off causes the load to be transferred by the static bypass transfer switch directly to the normal ac supply circuit without disturbance or interruption.
2. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.

C. Maintenance Bypass/Isolation Switch Operation: Switch is interlocked so it cannot be operated unless static bypass transfer switch is in the bypass mode. Device provides manual selection between the following three conditions without interrupting supply to the load during switching:

1. Full Isolation: Load is supplied, bypassing the UPS. Normal UPS ac input circuit, static bypass transfer switch, and UPS load terminals are completely disconnected from external circuits.
2. Maintenance Bypass: Load is supplied, bypassing the UPS. UPS ac supply terminals are energized to permit operational checking, but system load terminals are isolated from the load.
3. Normal: Normal UPS ac supply terminals are energized and the load is supplied through either the static bypass transfer switch and UPS rectifier-charger and inverter, or the battery and the inverter.

2.04 SERVICE CONDITIONS:

A. Environmental Conditions: UPS shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability, except battery performance.

1. Ambient Temperature for Electronic Components: 32 to 104 deg F (0 to 40 deg C).
2. Ambient Temperature for Battery: 41 to 95 deg F (5 to 35 deg C).
3. Relative Humidity: 0 to 95 percent, noncondensing.
4. Altitude: Sea level to 4000 feet (1220 m).

2.05 PERFORMANCE REQUIREMENTS:

- A. UPS shall perform as specified in this Article while supplying rated full-load current, composed of any combination of linear and nonlinear load, up to 100 percent nonlinear load with a load crest factor of 3.0, under the following conditions or combinations of the following conditions:
1. Inverter is switched to battery source.
 2. Steady-state ac input voltage deviates up to plus or minus 10 percent from nominal voltage.
 3. Steady-state input frequency deviates up to plus or minus 5 percent from nominal frequency.
 4. THD of input voltage is 15 percent or more with a minimum crest factor of 3.0, and the largest single harmonic component is a minimum of 5 percent of the fundamental value.
 5. Load is 30 percent unbalanced continuously.
- B. Minimum Duration of Supply: If battery is sole energy source supplying UPS-rated full-output load current at 80 percent power factor, duration of supply is **(4) four hours**, with ambient temperature between 68 to 86 deg F (20-30 deg C).
- C. Input Voltage Tolerance: System steady-state and transient output performance remains within specified tolerances when steady-state ac input voltage varies plus 10, minus 20 percent from nominal voltage.
- D. Overall UPS Efficiency: Equal to or greater than 80 percent at 100 percent load, 80 percent at 75 percent load, and 80 percent at 50 percent load.
- E. Maximum Energizing Inrush Current: Eight times the full-load current.
- F. Maximum AC Output-Voltage Regulation for Loads up to 50 Percent Unbalanced: Plus or minus 2 percent over the full range of battery voltage.
- G. Output Frequency: 60 Hz, plus or minus 0.5 percent over the full range of input voltage, load, and battery voltage.
- H. Limitation of harmonic distortion of input current to the UPS shall be as follows:
1. Description: Either a tuned harmonic filter or an arrangement of rectifier-charger circuits shall limit THD to 5 percent, maximum, at full-rated UPS load current, for power sources with X/R ratio between 2 and 30.
 2. Description: THD is limited to a maximum of 32 percent, at full-rated UPS load current, for power sources with X/R ratio between 2 and 30.
- I. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent RMS total and 3 percent RMS for any single harmonic, for 100 percent rated nonlinear load current with a load crest factor of 3.0.

- J. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent RMS total and 3 percent RMS for any single harmonic for rated full load with THD up to 50 percent, with a load crest factor of 3.0.
- K. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of full-load rating for 10 minutes, and 150 percent for 10 seconds in all operating modes.
- L. Maximum Output-Voltage Transient Excursions from Rated Value: For the following instantaneous load changes, stated as percentages of rated full UPS load, voltage shall remain within stated percentages of rated value and recover to, and remain within, plus or minus 2 percent of that value within 100 ms:
 - 1. 50 Percent: Plus or minus 8 percent.
 - 2. 100 Percent: Plus or minus 10 percent.
 - 3. Loss of AC Input Power: Plus or minus 5 percent.
 - 4. Restoration of AC Input Power: Plus or minus 5 percent.
- M. Input Power Factor: A minimum of 0.85 lagging when supply voltage and current are at nominal rated values and UPS is supplying rated full-load current.
- N. EMI Emissions: Comply with FCC Rules and Regulations, 47 CFR 15 for Class A equipment.

2.06 SYSTEM COMPONENTS, GENERAL:

- A. Electronic Equipment: Solid-state devices using hermetically sealed, semiconductor elements. Devices include rectifier-charger, inverter, static bypass transfer switch, and system controls.
- B. Enclosures: Comply with NEMA 250, Type 1, unless otherwise indicated.
- C. Control Assemblies: Mount on modular plug-ins, readily accessible for maintenance.
- D. Surge Suppression: Protect internal UPS components from surges that enter at each ac power input connection including main disconnect, static bypass transfer switch. Protect rectifier-charger, inverter, controls, and output components.
 - 1. Use factory-installed surge suppressors tested according to IEEE C62.41, Category B.
 - 2. Additional Surge Protection: Protect internal UPS components from low-frequency, high-energy voltage surges described in IEEE C62.41. Design the circuits connecting with external power sources and select circuit elements, conductors, conventional surge suppressors, and rectifier components and controls so input assemblies will have adequate mechanical strength and thermal and current-carrying capacity to withstand stresses imposed by 40-Hz, 180 percent voltage surges described in IEEE C62.41.
- E. Maintainability Features: Mount rectifier-charger and inverter sections and static bypass transfer switch on modular plug-ins, readily accessible for maintenance.

- F. Capacity Upgrade Capability: Arrange wiring, controls, and modular component plug-in provisions to permit future 25 percent increase in UPS capacity.
- G. Seismic-Restraint Design: UPS assemblies, subassemblies, and components; and fastenings and supports, mounting, and anchorage devices for them, shall be designed and fabricated to withstand static and seismic forces in any direction.
- H. UPS Cabinet Ventilation: Redundant fans or blowers draw in ambient air near the bottom of the cabinet and discharge it near the top rear.
- I. Output Circuit Neutral Bus, Conductor, and Terminal Ampacity: Rated phase current times a multiple of 1.73, minimum.

2.07 RECTIFIER-CHARGER:

- A. Capacity: Adequate to supply the inverter during full-rated output load conditions and simultaneously recharge the battery from fully discharged condition to 95 percent of full charge within 10 times the rated discharge time for duration of supply under battery power at full load.
- B. Output Ripple: Limited by output filtration to less than 0.5 percent of rated current, peak to peak.
- C. Rectifier-Charger Control Circuits: Immune to frequency variations within rated frequency ranges of normal and emergency power sources.
 - 1. Response Time: Field adjustable for maximum compatibility with local generator-set power source.
- D. Battery Float-Charging Conditions: Comply with battery manufacturer's written instructions for battery terminal voltage and charging current required for maximum battery life.

2.08 INVERTER:

- A. Description: Pulse-width modulated, with sinusoidal output.

2.09 STATIC BYPASS TRANSFER SWITCH:

- A. Description: Solid-state switching device providing uninterrupted transfer. A contactor or electrically operated circuit breaker automatically provides electrical isolation for the switch.
- B. Switch Rating: Continuous duty at the rated full-load current of the UPS, minimum.

2.10 BATTERY:

- A. Description: Sealed, valve-regulated, recombinant, lead-calcium units, factory assembled in an isolated compartment of UPS cabinet, and complete with battery disconnect switch.

- B. Description: Sealed, premium, heavy-duty, valve-regulated, recombinant, lead-calcium units, factory assembled in an isolated compartment or in a separate matching cabinet, complete with battery disconnect switch.
 - 1. Arrange for drawout removal of battery assembly from cabinet for test and inspection.
- C. Description: Wet-cell, lead-calcium, heavy-duty industrial units in styrene acrylonitrile containers mounted on three-tier, acid-resistant, painted steel racks. Assembly includes a battery disconnect switch, intercell connectors, a hydrometer syringe, and a thermometer with specific gravity-correction scales.

2.11 UPS CONTROL AND INDICATION:

- A. Description: Group displays, indications, and basic system controls on a common control panel on front of UPS enclosure.
- B. Minimum displays, indicating devices, and controls include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. Alarms include an audible signal and a visual display.
- C. Indications: Plain-language messages on a digital LCD or LED.
 - 1. Quantitative indications shall include the following:
 - a. Input voltage, each phase, line to line.
 - b. Input current, each phase, line to line.
 - c. Bypass input voltage, each phase, line to line.
 - d. Bypass input frequency.
 - e. System output voltage, each phase, line to line.
 - f. System output current, each phase.
 - g. System output frequency.
 - h. DC bus voltage.
 - i. Battery current and direction (charge/discharge).
 - j. Elapsed time-discharging battery.
 - 2. Basic status condition indications shall include the following:
 - a. Normal operation.
 - b. Load-on bypass.
 - c. Load-on battery.
 - d. Inverter off.
 - e. Alarm condition exists.
 - 3. Alarm indications shall include the following:
 - a. Bypass ac input overvoltage or undervoltage.
 - b. Bypass ac input overfrequency or underfrequency.
 - c. Bypass ac input and inverter out of synchronization.
 - d. Bypass ac input wrong-phase rotation.
 - e. Bypass ac input single-phase condition.

- f. Bypass ac input filter fuse blown.
 - g. Internal frequency standard in use.
 - h. Battery system alarm.
 - i. Control power failure.
 - j. Fan failure.
 - k. UPS overload.
 - l. Battery-charging control faulty.
 - m. Input overvoltage or undervoltage.
 - n. Input transformer overtemperature.
 - o. Input circuit breaker tripped.
 - p. Input wrong-phase rotation.
 - q. Input single-phase condition.
 - r. Approaching end of battery operation.
 - s. Battery undervoltage shutdown.
 - t. Maximum battery voltage.
 - u. Inverter fuse blown.
 - v. Inverter transformer overtemperature.
 - w. Inverter overtemperature.
 - x. Static bypass transfer switch overtemperature.
 - y. Inverter power supply fault.
 - z. Inverter transistors out of saturation.
 - aa. Identification of faulty inverter section/leg.
 - bb. Inverter output overvoltage or undervoltage.
 - cc. UPS overload shutdown.
 - dd. Inverter current sensor fault.
 - ee. Inverter output contactor open.
 - ff. Inverter current limit.
4. Controls shall include the following:
- a. Inverter on-off.
 - b. UPS start.
 - c. Battery test.
 - d. Alarm silence/reset.
 - e. Output-voltage adjustment.

D. Dry-form "C" contacts shall be available for remote indication of the following conditions:

- 1. UPS on battery.
- 2. UPS on-line.
- 3. UPS load-on bypass.
- 4. UPS in alarm condition.
- 5. UPS off (maintenance bypass closed).

2.12 OUTPUT DISTRIBUTION SECTION:

- A. Panelboard: Comply with Section 262416.

2.13 BASIC BATTERY MONITORING:

- A. Battery Ground-Fault Detector: Initiates alarm when resistance to ground of positive or negative bus of battery is less than 5000 ohms.
- B. Battery compartment smoke/high-temperature detector initiates an alarm when smoke or a temperature greater than 75 deg C occurs within the compartment.
- C. Annunciation of Alarms: At UPS control panel.

2.14 BATTERY CYCLE WARRANTY MONITORING:

- A. Description: Electronic device, acceptable to battery manufacturer as a basis for warranty action, for monitoring of charge-discharge cycle history of batteries covered by a cycle-life warranty.
- B. Basic Functional Performance: Automatically measures and records each discharge event, classifies it according to duration category, and totals discharges according to warranty criteria, displaying remaining warranted battery life on integral LCD.
- C. Additional monitoring functions and features shall include the following:
 - 1. Measuring and Recording: Total voltage at battery terminals, providing alarm for excursions outside the proper float voltage level.
 - 2. Monitors: Ambient temperature at battery and initiates an alarm if temperature deviates from normally acceptable range.
 - 3. Keypad on Device Front Panel: Provides access to monitored data using front panel display.
 - 4. Alarm Contacts: Arranged to provide local alarm for abnormal battery voltage or temperature.
 - 5. Memory: Device stores recorded data in nonvolatile electronic memory.
 - 6. RS-232 Port: Permits downloading data to a portable personal computer.
 - 7. Modem: Makes measurements and recorded data accessible to remote personal computer via telephone line. Computer is not specified in this Section.

2.15 SOURCE QUALITY CONTROL:

- A. Factory test complete UPS, including battery, before shipment. Include the following tests:
 - 1. Functional test and demonstration of all functions, controls, indicators, sensors, and protective devices.
 - 2. Full-load test.
 - 3. Transient-load response test.

4. Overload test.
 5. Power failure test.
 6. Efficiency test at 50, 75, and 100 percent of rated full-load current at rated power factor.
- B. Observation of Test: Give 14 day's advance notice of tests and provide opportunity for the client's representative to observe tests at their option.
- C. Report test results. Include the following data:
1. Description of input source and output loads used. Describe actions required to simulate source load variation and various operating conditions and malfunctions.
 2. List of indications, parameter values, and system responses considered satisfactory for each test action. Include tabulation of actual observations during test.
 3. List of instruments and equipment used in factory tests.

PART 3 – EXECUTION

3.01 INSTALLATION:

- A. Install system components on 4-inch- (100-mm-) high concrete bases. Cast-in-place concrete, reinforcing, and formwork are specified in Division 3.
- B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70-2005.
- C. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams, unless otherwise indicated.

3.02 GROUNDING:

- A. Comply with Section 260526 - Grounding for materials and installation requirements.
- B. Separately Derived Systems: If not part of a listed power supply for a data-processing room, comply with NFPA 70-2005 requirements for connecting to grounding electrodes and for bonding to metallic piping near isolation transformer.

3.03 IDENTIFICATION:

- A. Identify components and wiring according to Section 26 - Labeling and Identification.
 1. Identify each battery cell individually.

3.04 BATTERY EQUALIZATION:

- A. Equalize charging of battery cells according to manufacturer's written instructions. Record individual-cell voltages.

3.05 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Service: Engage the services of a factory-authorized service representative to supervise UPS installation, startup, and preliminary testing and adjustment and to participate in final tests, inspections, and adjustments.
- B. Electrical Tests and Inspections: Perform tests and inspections according to manufacturer's written instructions and as listed below to demonstrate condition and performance of each component of the UPS:
 - 1. Inspect interiors of enclosures, including the following:
 - a. Integrity of mechanical and electrical connections.
 - b. Component type and labeling verification.
 - c. Ratings of installed components.
 - 2. Test manual and automatic operational features and system protective and alarm functions.
 - 3. Test communication of status and alarms to remote monitoring equipment.
- C. Electrical Tests and Inspections: Perform tests and inspections listed below by an independent testing agency meeting the qualifications specified in "Quality Assurance" Article according to manufacturer's written instructions and as listed below to demonstrate condition and performance of each UPS:
 - 1. Inspect interiors of enclosures, including the following:
 - a. Integrity of mechanical and electrical connections.
 - b. Component type and labeling verification.
 - c. Ratings of installed components.
 - 2. Load the system using a variable-load bank to simulate kilovolt amperes, kilowatts, and power factor of loads for the unit's rating. Use instruments calibrated, within the previous six months according to NIST standards.
 - a. Simulate malfunctions to verify protective device operation.
 - b. Test duration of supply on emergency, low-battery voltage shutdown, and transfers and restoration due to normal source failure.
 - c. Test harmonic content of input and output current less than 25, 50, and 100 percent of rated loads.
 - d. Test output voltage under specified transient-load conditions.
 - e. Test efficiency at 50, 75, and 100 percent rated loads.
 - f. Test remote status and alarm panel functions.
 - g. Test battery-monitoring system functions.
- D. Seismic-restraint tests and inspections shall include the following: Inspect type, size, quantity, arrangement, and proper installation of mounting or anchorage devices.
- E. Retest: Correct deficiencies and retest until specified requirements are met.

- F. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.

3.06 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train CTDOT/MNR maintenance personnel to adjust, operate and maintain the UPS.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
 - 2. Review data in maintenance manuals.
 - 3. Schedule training with client's personnel, through Architect, with at least seven days advance notice.

END OF SECTION 263353