TABLE OF CONTENTS OF SPECIAL PROVISIONS

Note: This Table of Contents has been prepared for the convenience of those using this contract with the sole express purpose of locating quickly the information contained herein; and no claims shall arise due to omissions, additions, deletions, etc., as this Table of Contents shall not be considered part of the contract.

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June 15, 2016
FEDERAL AID PROJECT NO. N/A
STATE PROJECT NO. 300-178

Network Infrastructure Upgrade for Security New Haven Line Phase 2

Towns of Stratford, Fairfield and Westport
City of Bridgeport
Federal Aid Project No. N/A

The State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges and Incidental Construction, Form 816, 2004, as revised by the Supplemental Specifications dated July 2015 (otherwise referred to collectively as "ConnDOT Form 816") is hereby made part of this contract, as modified by the Special Provisions contained herein. . The State of Connecticut Department of Transportation's "Construction Contract Bidding and Award Manual" ("Manual"), October 1, 2015 edition or latest issue, is hereby made part of this contract. If the provisions of this Manual conflict with provisions of other Department documents (not including statutes or regulations), the provisions of the Manual will govern. The Manual is available upon request from the Transportation Manager of Contracts. The Special Provisions relate in particular to the Network Infrastructure Upgrade for Security – New Haven Line Phase 2 in the Towns of Stratford, Fairfield and Westport; and the City of Bridgeport.

CONTRACT TIME AND LIQUIDATED DAMAGES

Six Hundred Seventy-Two (672) calendar days will be allowed for completion of the work on this project and the liquidated damages charge to apply will be Four Thousand Five Hundred Dollars ($4,500.00) per calendar day.

All Submittals must be submitted and approved within sixty (60) calendar days from the Notice to Proceed.

No track outages will be approved by Metro North Railroad until cable routing plan and all submittals are approved and necessary material procured.

NOTICE TO CONTRACTOR – GENERAL REQUIREMENTS AND COVENANTS OF THE CONTRACT

Division 1 of the document entitled "State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 816, 2004" including the Division 1 Supplemental Specifications, shall collectively be known as the "General Requirements and Covenants of the Contract."

The Contractor is hereby advised of the potential for conflicts between provisions contained within Section 1.20 of the Form 816 with other Division 1 Sections of the Form 816. Where the aforementioned conflicts occur, Section 1.20 shall govern.

NOTICE TO CONTRACTOR – GROUNDING AND BONDING SYSTEMS

The work of this section consists of furnishing and installing the grounding and bonding systems as shown on the plans and specified herein. The grounding and bonding systems shall meet the requirements of National Electrical Code and the technical and safety recommendations of ANSI and IEEE.

The Contractor shall provide grounding and bonding for all new facilities.

Grounding and Electrical Protection

1. The Contractor shall design and provide the lightning and surge protection on AC power circuits that meets the following minimum requirements unless specified otherwise elsewhere:

    a. Rated for maximum surge current value in accordance with Contractor's approved Ground Plan, to be no less than 120 kA.
    b. Provides protection between line to neutral, line to ground, line to line and neutral to ground.
    c. Visual and audible status and alarm indications.
    d. Thermal fusing and short circuit protection rated 200 kA.
    e. UL 1449 listed.
    f. Meet or exceed the requirements of ANSI/IEEE C62.45 and ANSI/IEEE C62.41.

2. The Contractor shall design and provide extensive grounding and bonding within each equipment cabinet in strict accordance with the following practices and standards:

    a. NEC - ANSI/NFPA 70 National Electrical Code. Including, but not limited to, Chapter 8 - Communications Systems and Article 250 - Grounding.
    b. ANSI-J-STD-607-A-2002; Joint Standard Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
    c. ANSI-T1.313-2003 - American National Standard for Telecommunications - Electrical Protection for Telecommunications Central offices and Similar Type Facilities.
    d. ANSI/IEEE Std. 1100-1992 Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems (also known as the IEEE Emerald Book).

3. Each cabinet and rack shall be equipped with a copper ground bus bar. Each device within the rack or cabinet, if so equipped and required by the OEM, shall be grounded by a home run ground wire from the device connected directly to the rack ground bus. No "daisy chaining" of any kind shall be permitted. Device ground wire size and type shall be as recommended by the OEM or standards referenced herein. The ends of each home run ground wire shall be connected to the rack ground bus using the provisioned ground terminal blocks or using a "ring eyelet" crimped to the wire with a Metro-North-approved ratchet-type eyelet tool. No hand crimping of eyelets shall be permitted.

4. Each equipment rack shall be bonded to its adjacent equipment rack on both sides, where applicable. Bonding between racks shall be accomplished with green insulated #6 AWG THHN jacket wire and all manufacturer instructions and recommendations. The ends of each inter-rack bond ground wire shall be complete with a "ring eyelet" crimped to the wire with a Metro-North-approved ratchet-type eyelet tool. No hand crimping of eyelets shall be permitted. Based upon the method used for inter-rack bonding, the contactor shall ensure that paint or any other insulating material is removed to ensure a solid connection and a low resistance bond among racks.

5. Each ground bus in each rack shall be connected directly to the room ground bus, external to the racks, also referred to as the Telecommunications Grounding Busbar (TGB). Rack vertical ground busses shall be connected to the TGB with green insulated #6 AWG stranded wire. The ends of each home run ground wire shall be complete with a "ring eyelet" crimped to the wire with a Metro-North-approved ratchet-type eyelet tool. No hand crimping of eyelets shall be permitted.

6. CCTV Cabinets (including remote CCTV cabinets): Ground using a #4 AWG copper cable to station ground plane at stations; or structural steel at PECK Bridge.

   CCTV Poles: Ground using a #4 AWG copper cable to station ground plane at stations; or structural steel at PECK Bridge.

   New 8' Chain Link Fence and Gate: Bond new fencing and gate to track 3 buried counterpoise (if found) at 50' maximum intervals with 4/0 copper.

   If no counterpoise is located bond new fencing and gate to 10 ft. ground rods installed at 50' maximum intervals or as directed by the Engineer. Such ground rods will be paid under Item #1015021A –3/4" x 10' Ground Rod. (Each).

   Equipment Racks: Ground to ground bus in equipment room as described herein. Bond equipment rack to any adjacent racks.

   Vault Covers, Frames, Hardware, etc. – 3/4" x 10' ground rods. All metal components of the vault shall be bonded together. Bond ground rod to adjacent track counterpoise (if found).

Demarcation Box: Ground to ground bus in substation control house or other approved ground point using #4 AWG copper cable.

Conduits and Equipment Grounding Conductors: Conduits shall be bonded and grounded per NEC and NESC requirements. Provide copper equipment grounding conductor in accordance with contract drawings and NEC requirements. Raceways for power conductors shall not be used as the sole equipment ground. The ends of all conduits projecting into boxes and equipment enclosures shall be provided with insulated grounding bushings. Boxes shall be bonded to conduits. All bushings in any box or enclosure shall be bonded together with No. 8 AWG bare copper wire. All non-current carrying metal parts shall be bonded together and grounded.

Messengers: Messengers shall be grounded as shown in the Plans.

7. At stations, the Contractor shall verify the existing ground plane is in place, intact, and properly grounded. Measure, record, and report the resistance to earth of each portion of the grounding system. The required ground resistance is 5 ohms or less. Resistance-to-earth tests shall be coordinated with and witnessed by the Engineer, and the written results of these tests shall be submitted to the engineer for evaluation and instructions regarding any corrective action which may be deemed necessary.

8. If ground plane is found to be damaged or missing, immediately notify the Engineer before starting work. Metro-North, Connecticut DOT, and the Contractor will survey the area and provide a grounding plan for the station. At the direction of the Engineer, the Contractor shall install a new and/or fix the existing ground plane. Refer to Metro-North standard drawing NH-G-000 (Station Bonding and Grounding, New Haven Line, Typical) for typical requirements.

   The main ground bus shall be 4/0 bare copper (ASTM B8, Class B stranded annealed copper) installed in 3/4" PVC coated conduit, or as otherwise directed by the Engineer. Access points to the main bus shall be provided as directed by the Engineer.

   Where directed by the Engineer, the contractor shall bond all metal station fixtures using a #4 AWG wire (ASTM B8, Class B stranded annealed copper). Bonding wire and associated connections to the main bus for new equipment (CCTV poles, cabinets, fencing, vaults, etc.) shall be considered part the respective Bid Item for the equipment being grounded and will not be paid separately.

   Ground rods shall be provided as directed by the Engineer as part of the grounding plan.

   Such work shall be paid under the following items:

   Item #1015025A – 4/0 Bare Copper Ground Wire (Linear Feet)
   Item #1015013A – #4 AWG Copper Ground Wire (Linear Feet)

Item #1015021A – ¾" x 10' Ground Rod (Each)
Item #1008183A – ¾" PVC Coated Conduit (Linear Foot)

These items shall include all terminations, attachments, materials, tools, equipment, labor, and work incidental thereto and only performed at the direction of the Engineer.

Submittals

Test Reports: Reports of all field tests shall be submitted to the Engineer as required by these specifications and referenced standards.

Certified copies of the test results on cables and other materials, supplied under this section, as per relevant standards.

The Contractor shall submit product data for all components in this section, which shall include shop/working drawings, material/procurement specifications and other related information for each component. Component, small part steel or assembly drawings shall be prepared using AutoCAD. Files shall be saved in AutoCAD version format approved for use by MNR.

Materials

All components shall conform to or be interchangeable with the Railroad's standard components.

Conductors for grounding and bonding shall be ASTM B8, Class B stranded annealed copper, and sized as indicated on the plans.

Connectors and Clamps: Bolts, washers and stop nuts shall be a high copper alloy, such as Everdur, Durium, Duronze or silicone bronze. Ferrous hardware will not be acceptable. Buried ground connections shall be exothermic welded.

Ground rods shall be copper, or copper-clad steel, not less than ¾ inch in diameter, and in ten foot lengths, threaded at one or both ends as required for extension.

Ground wire imbedded in foundations and aerial ground wire shall be 4/0 AWG HD stranded copper conductor.

Construction Methods

Ground rods shall be driven vertically to the depth of ten feet. Rod points shall be provided with a steel alloy cone and the driven end provided with a steel alloy cone and the driven end provided with removable driving stud. Ground rods shall be separated from adjacent buried metallic structure or pipe by a minimum of two feet.

The size and type of the buried ground conductor shall be as indicated on the plans. Conductor connections shall be made as shown on the plans.

Finish welds shall be cleaned and coated with an approved cold applied bituminous resin compound. Primer shall be as recommended by the coating manufacturer.

The work shall be arranged in such a manner that each part of the grounding system which is laid below finish grade shall be completed and inspected before backfilling is done. All precautions shall be taken to assure that no damage is done to the grounding and bonding conductors or connections during backfilling, compacting and concreting operations. Testing for ground resistance shall be performed in accordance with the requirements of this specification before any finish surfacing is laid above the grounding and bonding conductors.

Ground tap connections from the equipment to the grounded structural members shall be provided, as required. All paint, scale, rust, oxidation, or other foreign material shall be thoroughly removed from the points of contact on all metal surfaces before any ground connections are made.

Any shortfall in the existing ground conductors, when connected to the new structures, shall be dealt with by splicing additional ground wire.

Bond all non-energized connections to structures so that there are no neutral or floating components (i.e., strap across any pin or clevis connection).

Field testing shall be thorough, continuing throughout the installation, and fully documented, with the following as a minimum and as applicable.

Electrical resistance tests shall be made during installation to verify continuity of the grounding system.

Measure, record, and report the ground resistance at each location, while disconnected from the MNR ground grid, where grounding system is installed. The required ground resistance is 5 ohms or less. Corrective measures shall be taken by the Contractor to achieve the specified ground resistance.

Resistance to earth tests shall be witnessed by the Engineer and written results of these tests shall be submitted to the Engineer for evaluation.

Payment:

Payment for this work will be under the appropriate pay item where noted. The cost for all material, labor, equipment, tools, testing, and work incidental hereto for bonding and grounding new equipment (CCTV poles, cabinets, fencing, etc.) as described shall be included in the respective bid price for the equipment being grounded, unless specifically noted otherwise. The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – MEASUREMENT AND PAYMENT

This Project is being bid with both lump sum and unit price items. 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 as indicated in the Bid Proposal Form.

Standard Form 816 Items are referenced by their standard item numbers. Refer to the applicable article of Form 816 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, is included in the unit prices or other lump sum items listed in the Bid Proposal Form. Any work that is outside the limits stated under "Method of Measurement" and "Basis of Payment" for a specific item, but is shown on the Contract Plans or described in the Contract Specifications, is included in the unit price or lump sum items. 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 unit price or lump sum items.

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 (CDOT's) Contractor.

The following table may not be all inclusive and does not relieve the Contractor from its responsibility to furnish and complete the work as shown in 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 its various subcontractors. The Contractor shall coordinate his operations with Metro-North Railroad 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 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.

Description	Contractor	Metro-North
Station and PECK Bridge Work		
Procure and Install Cameras, Poles, Conduits and Cable	X	
Procure and Install Camera Communication Cable	X	
Terminate Camera Communication Cable	X	
Procure and Install Camera Poles	X	
Procure and Install Conduits	X	
Procure and Install Electrical Cable	X	
Terminate Electrical Conductors	X	
Connect to Electrical Panels	X	
Procure and Install Security Cabinets	X	
Procure and Install Platform Security Cabinets	X	
Procure and Install Network Equipment	X	
Position Cameras	X	
Approve Camera Positioning and Views		X
Procure, Install, and Configure Workstations including Software	X	
Provide Final Workstation Locations		X
Procure and Install Fiber Patch Panels	X	
Right of Way (ROW) Fiber Procurement and Installation		
Procure Cable and Aerial Duct	X	
Verify Locations and Procure Rubber Grade Crossing Materials	X	
Install Rubber Grade Crossings		X
Procure and Install Aerial Figure 8 Duct	X	
Procure and Install Catenary Attachments	X	
Procure and Install Fiber Cable and Snow Shoes	X	
Procure Fiber Splice Enclosures	X	
Procure Fiber Splicing Materials and Terminations	X	
Install Fiber Splice Enclosures		X
Splice Fiber Cables		X
Terminate Fiber Cable		X
Test Fiber Cable	X (1)	X
CCO Shop		
Power to Racks (Cable and Conduit from Power Panel to Rack)		X
Procure and Install Racks for Head-End Equipment		X
Power for Equipment (PDU, Cable, Terminations, etc.)	X	
Procure and Install Conduit and Cables	X	
Procure and Install Servers and Server Storage Arrays	X	
Procure and Configure Video Management System	X	
Procure Software Licenses for Network Management	X	
Install and Configure Network Management		X
T&E Building		
Power to Racks (Cable and Conduit from Power Panel to Rack)		X
Procure and Install Racks for Head-End Equipment	X	
Power for Equipment (PDU, Cable, Terminations, etc.)	X	
Procure and Install Conduit and Cables	X	
Procure and Install Servers and Server Storage Arrays	X	
Procure and Configure Video Management System	X	
Node Houses		
Procure, Configure, and Commission Backbone Network Equipment	X	

Install Backbone Network Equipment		X
Procure Cisco Professional Services for Network Configuration and Commissioning	X	
Install Conduit and Cables		X
Install Fiber Cabling to Node House from ROW	X	
Procure Fiber Splicing Materials and Terminations	X	
Terminate Fiber Cable		X
Test Fiber Cable	X (1)	X
Procure Patch Panels for Node Houses	X	
Install Patch Panels in Node Houses		X
Power for Equipment (Cable, Conduit, Terminations, etc.)	X	
Procure Power Upgrade Equipment	X	
Install Power Upgrade Equipment		X

(1) See equipment specifications for responsibilities of Contractor and coordination with MNR.

NOTES:

Ancillary and miscellaneous items required to implement a complete system as described in the plans and specifications should be considered included in the items listed above.

NOTICE TO CONTRACTOR – PRE-BID QUESTIONS AND ANSWERS

Questions pertaining to DOT advertised construction projects must be presented through the CTDOT Pre-Bid Q and A Website. The Department cannot guarantee that all questions will be answered prior to the bid date. **PLEASE NOTE - at 12:01 am, the day before the bid, the subject project(s) being bid will be removed from the Q and A Website, Projects Advertised Section, at which time questions can no longer be submitted through the Q and A Website. At this time, the Q and A for those projects will be considered final, unless otherwise stated and/or the bid is postponed to a future date and time to allow for further questions and answers to be posted.**

If a question needs to be asked the day before the bid date, please contact the Contracts Unit staff and email your question to dotcontracts@ct.gov immediately.

Contractors must identify their company name, contact person, contact email address and phone number when asking a question. The email address and phone number will not be made public.

The questions and answers (if any) located on the Q and A Website are hereby made part of the bid/contract solicitation documents (located on the State Contracting Portal), and resulting contract for the subject project(s). It is the bidder's responsibility to monitor, review, and become familiar with the questions and answers, as with all bid requirements and contract documents, prior to bidding. By signing the bid proposal and resulting contract, the bidder acknowledges receipt of, and agrees to the incorporation of the final list of Q and A, into the contract document.

Contractors will not be permitted to file a future claim based on lack of receipt, or knowledge of the questions and answers associated with a project. All bidding requirements and project information, including but not limited to contract plans, specifications, addenda, Q and A, Notice to Contractors, etc., are made public on the State Contracting Portal and/or the CTDOT website.

NOTICE TO CONTRACTOR – OFF-SITE STAGING AND STORAGE

The Contractor is hereby advised that due to the restrictive Project Limits and other operational constraints identified in the Contract, off-site staging and storage of materials and equipment may be required. Arrangement for off-site staging and storage of materials and equipment shall be the responsibility of the Contractor. Payment for off-site staging and storage of materials and equipment shall be in accordance with Form 816 Article 1.09.06. The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – OPERATION AND MAINTENANCE MANUALS

Prepare and submit System Operation and Maintenance Manuals. If standard manufacturer's reference manuals are to be utilized, they shall be enhanced with a site specific introduction and detailed narratives preceding each section to explain how individual section contents relate to the System as installed and configured for operation as Work of this Contract. These manuals shall be made available and utilized during the Factory Acceptance Testing as a means of checking their accuracy and completeness.

There shall be separate Operations and Maintenance Manuals prepared. Manuals shall include all existing functionality of the System to provide a comprehensive manual.

Submit four copies of each manual to the Engineer, in both printed and electronic format on disc. Electronic format shall be both PDF and native formats to allow the Department to modify the contents in the future. The PDF versions shall be created electronically and not scanned from a printed copy. The Engineer and Office of Rails will review the manuals for conformance to the Contract. The manuals will be processed in accordance with Form 816 Article 1.20-1.05.02, with three being forwarded to Office of Rails and one copy being sent to the Engineer.

Equipment and Systems Maintenance Manuals: The Contractor shall provide complete information in the equipment and systems manual on products specified in the following Contract provisions:

1. Ethernet Switch – Cisco IE4000
2. Video Encoder
3. Fiber Optic Patch Panel – 72 Position
4. Fiber Optic Patch Panel – 144 Position
5. Backbone Communication Network – Cisco M6
6. Backbone Communication Network – Power Upgrades
7. Network Management System
8. Workstations
9. Video Management System
10. Infrared Illuminator
11. PTZ Dome Camera
12 Fixed Mount Dome Camera
13 CCTV Cabinet – Base Mounted
14. CCTV Cabinet – PECK Bridge
15. Remote CCTV Cabinet
16. 60W PoE Injector
17. PTZ Power Supply
18. PoE Surge Protection Chassis – Rack Mount
19. PoE Surge Protection Chassis – Wall Mount
20. PoE Surge Protection Module
21. IR Illuminator Power Supply – Rack Mount

22. Modification of Existing Rack
23. Elevator Demarcation Box and Elevator Modifications

The above list may not be all inclusive and does not relieve the Contractor from its responsibility to provide maintenance manuals that are required under other Contract provisions.

Operations Manual: The Operations Manual shall contain custom test, photographs, and drawings for the installed System, with detailed instructions on how to perform day-to-day operational tasks. Include, at a minimum:

1. Overview of installed system architecture
2. Detailed description of normal system operation
3. Error and Alarm Handling Procedures
4. System Start up and Shutdown Procedures
5. Changing Camera Options
6. Viewing of both live and recorded video
7. Description of Operating Procedures
8. Administration terminal and Operator Workstation screenshots
9. All other operator functions of the Video Management System

Video Management System Administrator's Manual shall contain the same information as the Operator's Manual with expanded, specific information for System Administrators. Include, at a minimum:

1. Password assignment and modification
2. Operator assignment and modification
3. Point disable/enable
4. Terminal and data segregation/modification
5. Sequence of operation and flowcharts
6. Modification of control programs and databases
7. Add/delete/modify data points
8. Modification of maps
9. All other system administrator functions of the Video Management System

Maintenance Manual: The Maintenance Manual shall contain custom text, photographs, and drawings for the installed, with detailed instruction on how to perform diagnostics, regular preventive maintenance and replacement on all components. Include:

1. Detailed description of installed system architecture.
2. Hardware description, including description of all equipment and nameplate data. Include catalog cuts.
3. Drawings showing all equipment locations.
4. Photographs of typical equipment locations with individual rack or enclosure identified.
5. Functional block diagrams.
6. Drawings showing interconnection of all equipment.

7. Operating Procedures.
8. System start-up and shut-down procedures.
9. Diagnostic and test procedures for system and all hardware.
10. System back-up and restoration procedures.
11. Comprehensive factory service manuals shall be provided for individual equipment types showing theory of operation, wiring diagrams, voltages, parts lists including diagnostics, and adjustment and configuration procedures.
12. Recommended service and test procedures including hardware replacement, card replacement, adjustments, and preventive maintenance procedures and materials, routine operations, guide to troubleshooting, description of sequence of operation. Include manufacturer's product data with each sheet annotated to clearly identify the data applicable to the installation and deleted references to inapplicable information.
13. Recommended routine maintenance procedures and schedules (e.g. daily, weekly, monthly, etc.)
14. Special maintenance requirements (if any)
15. Hardware configuration information, including device naming, model numbers and serial number of equipment, MAC addresses, IP addresses, and port assignments.
16. Special configuration requirements
17. Include copy of each manufacturer's warranty and give information sheet for proper procedures in the event of failure and instances, which may affect the validity of warranties.

NOTICE TO CONTRACTOR – PROJECT DESCRIPTION

The Project consists of an upgrade to network infrastructure to support a new CCTV System at passenger stations and movable bridge in Stratford, Bridgeport, Fairfield, and Westport. The new CCTV equipment shall be integrated into the existing Verint Nextiva System at the CCO Shop and T&E Building in the New Haven Rail Yard in New Haven, CT.

The new CCTV cameras will be located at five (5) passenger stations and one movable bridge along the Metro North Railroad New Haven Line. These five stations are Stratford, Bridgeport, Fairfield Metro, Fairfield, and Southport and the movable bridge is PECK Bridge in Bridgeport over the Pequonnock River.

The Project will construct a Fiber Optic Communication Aerial Backbone on both sides of the right-of-way supported on existing catenary poles or installed in rigid metal conduit mounted on walls or below grade along the railroad right-of-way from Bridgeport Station (Mile Post 55.50) to Greens Farms Node House in Westport (Mile Post 47.38). Additional fiber work will be required at Stratford Station, PECK Bridge, and Bridgeport Node House. Reconfiguration of the existing network will also be required at Devon Node House, Woodmont Node House, and New Haven Node House to insert the new locations into the existing fiber network.

NOTICE TO CONTRACTOR – SOLE SOURCE PRODUCTS

For operational purposes, the Department has determined the need to sole source products specified in the following Contract provisions:

1. Item #1108659A – NetBoss Integration
2. Item #1108671A – Ethernet Switch – Cisco IE4000
3. Item #1108672A – Cisco Professional Services
4. Item #1108721A – Video Encoder
5. Item #1108869A – Backbone Communications Network – Power Upgrades
6. Item #1108870A – Backbone Communications Network
7. Item #1108868A – CCTV Workstation Software Licenses
8. Item #1108881A – Video Management System Software Licenses
9. Item #1112226A – PTZ Camera Dome
10. Item #1112227A – Fixed Mount Camera Dome
11. Item #1108882A – Video Management System Support Services
12. Encoder contained in Item #1113916A – Elevator Demarcation Box
13. Corresponding spares for items listed above as part of Item #0090693A – Spare Parts

No "Or Equals" will be permitted except as provided within each Item. Said products shall be installed only by their factory-authorized installer or service representative. The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – STANDARD SPECIFICATIONS

Whenever and wherever "CTDOT Form 816", "Form 816", "Standard Specifications" are referenced herein, this shall mean and refer to "State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges and Incidental Construction, Form 816" including the Supplemental Specifications.

NOTICE TO CONTRACTOR – TRAINING

The Contractor shall provide training on products specified in the following Contract provisions:

1. Ethernet Switch – Cisco IE4000
2. Backbone Communications Network
3. Video Encoder
4. Workstation
5. Video Management System
6. Infrared Illuminator
7. PTZ Camera Dome
8. Fixed Mount Camera Dome
9. CCTV Cabinet – Base Mounted
10. CCTV Cabinet – PECK Bridge
11. Remote CCTV Cabinet
12 60W PoE Power Injector
13 PTZ Power Supply
14. PoE Surge Protection Chassis – Rack Mount
15. PoE Surge Protection Chassis – Wall Mount
16. PoE Surge Protection Module
17. IR Illuminator Power Supply – Rack Mount
18. Elevator Demarcation Box/Elevator Modifications
19. Modification of Existing Rack

The above list may not be all inclusive and does not relieve the Contractor from his responsibility to provide training for all system elements or training that is required under other Contract provisions.

In addition to overall system training, the Contractor shall provide Verint Certification courses for Metro-North personnel as described in Item #1108882A – Video Management System Support Services; and Cisco Training as described in Item #1108870A – Backbone Communications Network. Such training shall be paid under those respective Bid Items.

Training Program General Requirements:

A Training Program shall be provided by the Contractor in order to provide initial and ongoing training for all users of the CCTV System. The Contractor shall provide videos on DVD of all Contractor-provided training sessions to facilitate the ongoing training. Training shall include ALL components of the CCTV system including (but not limited to) head-end, cameras, field panels and equipment, communications network, encoders, and IR illuminators and shall include site-specific information. The training shall be tailored to the functions and configuration of the final system as furnished by the Contractor.

Submit Training Plan for approval by the Engineer. After approval of the Training Plan, the

Contractor shall conduct the specified training. The training program shall be implemented through the use of formal classroom training and/or other forms of presentation as recommended by the Contractor. The curriculum shall be designed so that each group of trainees shall be trained in the full repertoire of system commands which they may have to use in the course of performing their designated functions. Students shall be provided with complete sets of training materials and operating manuals during the training sessions, which they shall retain for use on the job at the completion of training. Formal training shall also include a comprehensive student testing program for determining that the intended training has been successfully imparted.

Contractor shall develop and implement a training database configuration to train staff on the use of the system. This training configuration should address the functions and operation of the CCTV System, in real-time simulation of typical alarm events. To support this project, a test database shall be created which shall remain available for centralized training after the system is in operation. The test database configuration shall not degrade the performance of the CCTV System.

Contractor shall conduct the required training at the facility, at the scheduled times and location designated by the Engineer consistent with the approved Training Plan. The full complement of training courses shall be conducted over time to accommodate shift personnel, vacations, and make-up sessions. A detailed schedule for the delivery of all training shall be included in the Project Plan and Schedule and reported on during the regularly scheduled status meetings. All training shall be completed no later than 14 calendar days prior to commencement of the 31-day operational test unless otherwise coordinated with the Engineer. The training shall include, but not be limited to the following groupings of staff:

1. Operator training shall include a simulation of actual site conditions at each facility and shall be provided for three groups of 15 students per course/per facility. Each group shall be trained for the equivalent of two eight hour instructional classes (training must be flexible to accommodate shift workers). Training shall include, but not be limited to: sequence of operation review; sign-on/sign-off; selection of all displays and reports: commanding of points, English and graphic mode; modifying English text; selection of all alarm functions; temporarily modifying resolution and frame rate for viewing; reviews of all topics presented in the Operator's Manual. Training shall also provide site-specific information about the newly installed components and demonstration of the new system with particular emphasis of components or settings that are different from previous phases.

2. System Administrator Training shall include, in addition to subjects addressed in the operator training classes, training for two groups of six DOT or MNR supervisors per facility. Each group shall be trained for two, eight hour instructional classes to be held on two separate days. Training shall include, but not be limited to: communications system instruction; use of operator terminal; program upload, download modification; password assignment and modification; operator assignment and modification; point disable/enable; terminal and data segregation/modification; sequence of operation and flowcharts; modification of control programs and

databases; add/delete/modify data points; review of all topics presented in the System Administrator's Manual. Training shall also provide site-specific information about the newly installed components and demonstration of the new system with particular emphasis of components or settings that are different from previous phases.

3. Maintenance Training shall include training for two groups of six students per course, per facility. Each group shall be trained for four, eight hour instructional classes to be held on four separate days. System maintenance training shall include all functions required to maintain the System and to prepare maintenance personnel to make minor adjustments to the System, troubleshoot the System at the board level, replace defective components and field devices, and perform other maintenance functions normally associated with board-level maintenance activities. This shall include, at a minimum, component overview, safety, troubleshooting, programming, adjustments, and maintenance requirements of the following:
    a. Overall system and architecture
    b. System components
    c. CCTV cabinets
    d. CCTV cameras
    e. Head-end systems
    f. IR illuminators
    g. Power supplies and power injectors
    h. Network architecture and network equipment

    Training shall include symptom recognition, shut down and start-up procedures, replacement of all devices and subcomponents including cameras, lenses, housings, power supplies, switches, illuminators, etc.

    Training shall also provide site-specific information about the newly installed components and demonstration of the new system with particular emphasis of components or settings that are different from previous phases.

Upon completion of each training program, the Contractor shall prepare and deliver a training report which shall summarize the results of the training program, including a list of attendees, course evaluation form, and recommendations for follow-up training or modification to the curriculum.

The Contractor shall furnish electronic copies (both native and PDF formats) of all materials used during the training. The PDF versions shall be created electronically and not scanned from a printed copy. Furnish to the Engineer five (5) file sets each of the User Manual slides, coursework, and training aids in addition to providing an appropriate manual for each person attending the classes.

System Training, other than Cisco Training and Verint Certification training specified elsewhere, shall be included as part of Item #1108871A – Video Management System. The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – WARRANTIES

Submit four copies of written warranties, including special warranties to the Engineer. The Designer and Office of Rails will review the warranties for conformance to the Contract. The warranties will be processed in accordance with Connecticut Standard Specifications Form 816, Article 1.20-1.05.02, with three (3) copies being forwarded to Office of Rails and one copy being sent to the Engineer.

This Section does not relieve the Contractor from its responsibility to provide warranties that are required under other Contract provisions.

Furnish a minimum one (1) year replacement warranty for all devices and equipment. All devices shall have a warranty against defects in materials and workmanship for a one-year period commencing on the Base Date. The Base Date shall be defined as the day of the Engineer's acceptance of the successful completion and acceptance of the 31-day Operational Testing specified herein. The warranty shall cover all components, parts, installations, and assemblies. The warranty shall cover labor to troubleshoot, repair, reprogram, replace defective components, and travel to and from the location where the equipment resides. Warranty response shall be within 72 hours of being notified of the condition at no additional cost to the Department.

NOTICE TO CONTRACTOR – ACCEPTANCE TESTING

General Requirements:

The Contractor shall verify that the complete System, installed and configured, meets all requirements set forth in the specifications and plans to the satisfaction of the Engineer. The contractor shall provide test, inspection, and documented test results sufficient to verify design, ensure proper performance, safety and reliability, and demonstrate compliance with the specifications. All systems, components, installation, and any associated workmanship or materials are required to be reviewed, tested, and accepted prior to turnover to MNR. The Contractor shall test all functional requirements set forth in the specification have been met by the System.

The Contractor shall submit test procedures for the approval of the Engineer, showing in complete detail the manner in which they propose to perform each test. The Contractor shall provide full documentation and certifications of all tests performed. Six (6) copies of a test report that includes test instrumentation, description, calibration, certification data, test methods, test results, and other pertinent information shall be submitted to the Engineer for review and approval.

An Acceptance Testing Plan and all Test Procedures shall be prepared by the Contractor. The Contractor shall give 20 days' advance notice when the Contractor is ready to perform acceptance testing. Actual date and time of testing will be determined by the Engineer.

The Engineer or his representative will witness all tests. The Contractor shall be responsible for retesting of any items as necessary at no additional cost. As defined herein, the Contractor, in the presence of the Engineer, shall inspect the installation for conformity with the approved design and drawings and as recommended by the manufacturers. The Contractor shall provide all facilities, labor and equipment and shall be responsible for the satisfactory completion of the inspections and reports thereof. This shall apply to both Contractor and Railroad furnished equipment.

Additional requirements for specific Items may be listed in other Specifications. The absence of specific test requirements in another section does not relieve the Contractor from performing testing for those items. Likewise, listing specific requirements elsewhere does not relieve the Contractor from complying with requirements listed herein.

Applicable Standards:

Pertinent provisions of the following latest standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of this Specification to the extent required.

Organization	Number	Title
ANSI	C2	National Electrical Safety Code
ANSI/IEEE	829	Standard for Software and System Test Documentation
NFPA	70	National Electrical Code

Materials:

All measuring instruments shall be of the precision type and shall have a valid calibration certificate at the time of test. The Contractor shall be responsible for furnishing all test personnel, test instruments, inspection vehicle, and other equipment/materials necessary for performing and recording field inspections and tests.

Submittals:

Test Plan:

The Contractor shall submit for approval by the Engineer a Test Plan outlining all testing to be performed. At a minimum, the Contractor's Acceptance Test Plans shall conform to the requirements of ANSI/IEEE Standard 829. The Test Plan shall contain but not be limited to the following:

1. A list and schedule of all testing and inspection activities (duration, order, prerequisites) including flow diagram of inspections and tests.
2. A description of the overall test environment including: test equipment details; test equipment configuration sketches and diagrams including cabling requirements; and hardware and software required for the test including the number and type of devices to be used during the test and/or the method of simulation.
3. A summary statement of each test phase.
4. A narrative presenting the Contractor's plan for achieving all testing requirements.
5. Safety program defining general precautions to be taken, notices, signs and barriers to be posted concerning the safety of the public, work personnel and equipment. The program will define precautionary measures to be taken prior to, during and following the inspection and test until such time as normal work is resumed.
3. Samples of test forms to be used during testing.
4. Preliminary test procedures for all tests. Test Procedures shall be fully developed after approval of the Test Plan.
5. The Contractor shall apply these requirements to all Tests described herein.

Test Procedures:

The Contractor shall develop Test Procedures for all tests and inspections. The Contractor shall sufficiently document test procedures to ensure that each test is comprehensive, representative of the functions to be exercised, and repeatable in whole or in part if so desired. The Contractor shall submit to the Engineer for approval the final versions of all Test Procedures at least four (4) weeks before the start of testing. The Engineer will approve test procedures only if they are inclusive and thoroughly test each device and, where applicable, each subassembly both individually and when connected to external devices.

The Contractor shall minimally include the following information in the test procedures:

1. Test Schedule.
2. Responsibilities of Contractor and Railroad personnel.
3. Record keeping assignments, procedures and forms.
4. Copies of any certified test data to be supplied by the Contractor.
5. List of all documentation to be used during the test.
6. A description of test equipment or data to be supplied by the Contractor.
7. Block diagram of each hardware test configuration(s) including equipment to be supplied by the Railroad.
8. Techniques and equipment used to simulate, or substitute for, devices not available during factory testing.
9. Problem resolution and procedure for handling variances
10. Provisions for retest.

The Contractor shall include in the test procedures the following specific information for each test:

1. The purpose of each test and the functions to be tested.
2. The detailed procedures to be followed. Test procedures shall be written step-by-step such that someone not familiar with the system would be able to perform the test.
3. The test set-up and test conditions.
4. All inputs and outputs.
5. Test firmware/software descriptions and listings.
6. Expected results.
7. Acceptance criteria.

All tests may be witnessed and accepted or rejected by the Engineer or Metro-North Railroad.

Test Records:

The Contractor shall maintain a complete record of all test results. The Contractor shall make the test records available to the Engineer at all times and shall submit the test records to the Engineer upon completion of all testing. The Contractor shall key the test records to the test procedures.

The Contractor shall include the following in test records, as a minimum:

1. Summary of test, including equipment tested and description of test.
2. The signatures of the Contractor and the Railroad personnel witnessing each of the tests and re-tests.
3. List of test equipment used and calibration date.
4. Any special test conditions or actions taken.
5. Test results, including plots/graphs.
6. Test date and time.
7. Software versions of associated software.
8. All serial numbers of associated hardware.
9. Space for comments by the witnesses.

The Contractor shall prepare and include a variance report in the test record each time a deviation from Contract Document requirements is detected. The variance report shall include a complete description of the variance, and indicate whether the variance is to be corrected immediately, at the end of the current test session, or at some identified point in the future.

Once corrected, the Contractor shall document corrective actions taken to eliminate each variance by providing sufficient information to enable the Engineer to determine the need for re-testing the equipment, for testing interactions with any previously tested equipment, and for updating documentation as a result of the corrective action. The variance is eliminated when the Contractor and the Engineer have acknowledged, by signature, correction of the variance.

Before any testing begins, the Contractor shall submit a copy of their Acceptance Testing Plan and Acceptance Test Procedures, tables, and all forms to be used for recording all results of the inspections and tests, to the Engineer.

All Test Records shall be submitted no later than 30 days after the completion of the test.

Construction Methods:

The Contractor shall not proceed to the next phase of testing without approval of the Engineer. Conditional approvals to proceed to the next phase shall be addressed and verified as soon as possible in the next testing phase.

Prior to gaining approval to conduct witnessed Acceptance Testing, the Contractor shall provide the Engineer with a preliminary test report enumerating each component of each system tested and showing satisfactory results.

The Contractor shall be fully responsible for site safety and the satisfactory completion of inspection and tests as per the Acceptance Testing Plan. The Contractor shall prepare a detailed site safety plan following the guidelines included in the Acceptance Test Plan. The Contractor shall provide personnel to enforce the site safety plan. If tests and/or inspections are repeated due to discrepancies, defects in the installations and/or the equipment, the Contractor shall bear all costs pertaining to the retest.

The Contractor shall promptly correct any defects in the materials or installations. Any visible defect on the Railroad furnished equipment shall be considered the Contractor's responsibility unless previously documented and submitted to the Engineer. Defects noted at time of delivery shall be resolved prior to acceptance testing. Functional failure of Railroad furnished equipment shall be resolved by the Railroad. Any retesting caused by Railroad furnished equipment failures will be the responsibility of the Railroad unless specifically noted otherwise.

Acceptance of test results by the Engineer shall not relieve the Contractor of the responsibility for the installed system to meet the specifications as set forth herein and other sections of the Specifications.

Pre-Installation (Factory) Testing:

Pre-installation/factory testing shall be performed by the Contractor and include inspection of all System equipment prior to delivery to any work site. The contractor shall inspect and test all system equipment for the following:

1. Damage to equipment
2. Missing components and parts
3. Correct power and communication connections
4. Correct positioning and mounting
5. Conformance to the configuration plan
6. Completeness
7. All installed equipment shall be energized, exercised, and tested for function and operation.
8. All installed equipment communication ports shall be subject to testing that shall confirm proper data exchange.
9. Compatibility with associated equipment (including camera compatibility with the existing Verint Nextiva System). The Contractor shall test all software and hardware components individually and as an integrated system to ensure that they perform according to the Specifications as set forth herein.

Items manufactured by the Contractor, such as CCTV cabinets and remote switch cabinets shall be manufactured in a controlled facility and be fully tested prior to delivery to the site. Such items may be inspected by the Engineer or Railroad personnel at any time.

Field Installation Testing

Field Installation Testing shall be performed by the Contractor and be performed following the equipment installation and configuration. The Test Procedures shall require sufficient testing to determine that no shipment or installation problems have occurred and that all devices are installed and operate as intended.

Field Installation Testing should take place locally at each location in order to effectively troubleshoot the devices and ensure each location is properly configured prior to an integrated system-wide test. Testing submittals shall be in the same general format as the Pre-Installation (Factory) Test documentation. Because the Field Installation Testing will be on the installed equipment, properly connected, configured, and interfaced to the actual field devices, the test procedures shall be in correspondingly greater detail than the Pre-Installation Test and shall demonstrate the full and complete local system functionality and compliance with all Contract Requirements. At a minimum, Field Installation Testing shall include:

a. General inspections – Verify no damage has occurred
b. Verification of wiring – Ensure no sharp bend exist, verify cable sizes and quantities, verify cable management in place and cabling is dressed and secured, verify labeling, verify ground is in place, verify correct circuit breakers
c. Verification of grounding – Verify all items are properly grounded and bonded
d. Verification of installation – Verify installation locations and details against approved shop drawings. Verify all items to be installed are present. Test procedures shall list all equipment and devices along with quantities and specific configurations for verification
e. Verification of labeling – For all wiring, devices, panels, breakers, etc.
f. Power on test – verify cabinet voltage, device power and voltage (both inputs and outputs), ensure no breakers trip, verify all equipment is operational as intended, verify voltage drop
g. Functional testing - verify command, control, and monitoring of all devices locally.
h. Field of views – Verify field of views against approved views. Camera views shall be tested during both daytime and nighttime hours for verification of low light operations. Any repairs, construction, or modifications as required to comply with this Item shall be performed at the Contractor's expense. Camera view and IR illumination adjustments shall be adjusted under the direction of the Engineer to obtain the optimal fields of view and illumination levels.
i. Other requirements specified elsewhere in the Contract Documents.

Preliminary marked-up shop drawings shall be available during the tests and their accuracy shall be verified as part of the Field Installation Testing.

Integrated System Testing

After Field Installation Testing and agreement by the Engineer to initiate Integrated System Testing, the System shall be tested as a complete integrated System. Integrated System Testing shall be conducted with all devices and components installed, integrated as a system.

Integrated System Testing shall be in the same general format as previous testing. Integrated System Testing shall include:

1. Verify Video Management System parameters such as IP addresses, recording rates, user access, device locations, maps, failover, dual recording, etc.

2. Command, control, and monitoring of all field interface equipment both locally and over the network where required by the Contract Documents. Verify Video Management System functions as described in other sections.
3. Verification of all existing functionality and configurations of the System prior to modifications under this Contract remain unless specifically removed by this Contract.
4. Verify Network Monitoring System – ensure all devices are configured for monitoring and verify configuration. Tests such as loss of video input, loss of IP camera network link, network link failure, power supply failure, shall be tested.
5. Verify network failover – In cooperation with Metro-North personnel, verify in the event of network link failure, network traffic is re-routed.
6. Other requirements specified elsewhere in the Contract Documents.

During the Integrated System Testing, the Contractor shall perform any recalibration, reconfiguration, or reprogramming of the System hardware and software required as part of the normal operational configuration and to correct any system bug or errors encountered to ensure that the system performs in accordance with the Specifications and required sequences of operation. Such changes shall include field device adjustments such as cameras and IR illuminators. Field of views (including IR illumination) shall be further verified to ensure installation is secure and has not rotated out of position.

After completion of installation and prior to witnessed testing, a factory trained technician shall test and certify the system's operation. Test shall also certify that equipment is installed in accordance with approved factory means and methods.

The existing CCTV system shall remain operational throughout testing unless specifically authorized otherwise by Metro-North.

31 Day Operational Acceptance Testing

Prior to the commencement of Operational Acceptance Testing the Contractor shall furnish one complete set of the approved equipment shop drawings, wiring diagrams, and maintenance and operations manuals for use by the Engineer during the test process.

Operational Acceptance Testing shall commence following notification by the Engineer that the results of the Integrated System Test are satisfactory. The Operational Acceptance Test shall be performed by the Contractor. The Contractor shall provide test procedures to periodically verify all functionality is operating as intended, with full functionality verified at least once per week and spot checks at least once per day.

During the Operational Test period, the Engineer (or designated official) may operate the system as specified using the fully configured software and hardware and all applicable manuals, printed guides, and procedures submitted by the Contractor. The Contractor shall correct any major failure or malfunction of material significance during the period as it occurs. Said malfunctions include, but are not limited to, equipment failure or failure of the System to comply with any

requirement. Major failure is defined for this purpose as any failure of any item of the equipment or software, or both, that prevents the Engineer from performing meaningful work based upon the Railroad's business needs.

During the Operational Acceptance Testing, the Contractor shall perform any re-calibration, reconfiguration, or re-programming of the System hardware and software required as part of the normal operational configuration and to correct any system bug or errors encountered to ensure that the system performs in accordance with the Specifications and required sequences of operation. Such changes shall include field device adjustments such as cameras and IR illuminators. All changes performed during Operational Acceptance Testing shall be fully documented by the Contractor and shall not be implemented without prior approval by the Engineer.

All malfunctions encountered during Operational Acceptance Testing shall be corrected by the Contractor at their expense. After correction, the Operational Acceptance Test shall restart at day one, and shall continue until the results meet the conditions and terms of the performance period and the System has operated continuously for 31 consecutive days without error or malfunction.

Upon completion of the testing, prior to final acceptance, thoroughly clean (internally and externally) all equipment furnished and/or installed in accordance with manufacturer recommended cleaning methods.

Testing shall not be considered complete until all Test Records have been submitted with passing results and accepted by the Engineer. Contractor shall allow a minimum of 21 days for review of Test Records by the Engineer.

Failure to Complete Acceptance Testing Successfully

In the event the system is deemed not to have successfully completed Operational Acceptance Testing within ninety (90) days of the scheduled completion, the Engineer may, at its sole discretion, elect one of the following options, the election of which shall be effective upon written notification to the Contractor by the Engineer:

1. Engineer may require the Contractor to install, within such time period as may be mutually agreed in writing by the Engineer and the Contractor, a direct substitute of equipment or components. Contractor shall use due care in the removal and substitution of such equipment or components. Such substitutions shall be subject to all testing as provided in this section and, in the event such substitute component fails to successfully complete all the testing by the agreed-upon date, the provisions of this paragraph shall again be applicable.
2. The Engineer may permit the Contractor to continue to attempt to successfully complete the Acceptance Testing required by this Section; however, the Engineer may revoke its election of this alternative at any time upon not less than five (5) days prior written notice to the Contractor, in which event the Engineer may, in its sole discretion, elect any one of the other options specified in this paragraph, the further election of which shall be effective upon written notification of the

Contractor by the Engineer.

3. The Engineer may pursue any other remedy hereunder or available at law or in equity or seek to enforce any damages, in addition to those provided under the Contract.

Exchange and Expansion Equipment during Factory, Field and Acceptance Testing

Contractor shall certify in writing to the Engineer when exchange or expansion equipment, devices, or components are installed and ready for use. For the purpose of this section, "expansion" is used to denote equipment which is not specified in the approved final design Bill of Materials. If this occurs during the 31 Day Operational Test, the operational test must re-start.

Payment

Testing shall be included in the price of each item. No additional payments will be made. The Contractor shall bid the Project accordingly. If, in the opinion of the Engineer, the Contractor does not fulfill the requirements of this section, payments for items not fully tested may be withheld.

NOTICE TO CONTRACTOR – WORK ON RAILROAD PROPERTY

The Contractor acknowledges that work to be accomplished under this Contract is to be performed on Railroad territory, which consists of territory operated by Metro North Railroad. The Contractor's work must be accomplished simultaneously with ongoing daily Railroad operations. Such operations include, but are not limited to, the passage of trains, storage of trains, flagging, inspection, repair, construction, reconstruction, and maintenance of the railroad right-of-way and facilities.

The Contractor is advised that the Railroad controls all activities in the respective right-of-way, and the Department expects that these conditions may cause delays and possibly a complete suspension of construction activity. The Contractor shall consider normal Railroad operations and associated impacts to the construction schedule. The Contractor shall not be entitled to time extensions for delays associated with normal Railroad operations. If the Contractor is delayed or suspended in the completion of the work by atypical railroad operations including, but not limited to, activities associated with a derailment, major track failure, or extended power outage, the Contractor will be entitled to a time extension for every day that he can demonstrate that the delays affected the completion date of the Contract. This extension of time will be considered non-compensable and the Contractor will not be entitled to any additional compensation for damages incurred for all direct and indirect costs including, but not limited to, all delay and impact costs, and inefficiencies.

The Contractor shall be responsible for the coordination of the work of its various subcontractors. The Contractor shall coordinate its operations with Metro North Railroad operations associated with Railroad force account work.

The Contractor's employees and the employees of all subcontractors, who will be entering the jobsite within the Railroad territory, must undergo an approximate one hour Railroad safety training class that is offered by Metro North Railroad. The Engineer will arrange for the class; however, the Contractor is responsible for insuring that all employees on the jobsite have been trained. No additional compensation will be allowed to the Contractor for employee’s time for attending these classes. Refer to Form 816 Article 1.05.06 entitled "Cooperation with Utilities (Including Railroads)".

The Contractor must make its own arrangements with Metro North Railroad for the use of Railroad equipment or changes in Railroad facilities made solely to facilitate the Contractor's operations. No additional compensation will be allowed to the Contractor for making such arrangements.

Contractor Requirements for Work Affecting the Railroad

The Contractor shall be governed by the General Requirements and Covenants of the Contract with the following additions:

1. All matters requiring Railroad Company approval or coordination shall be directed to:

Mr. David Willard
Assistant Director - Capital Projects
Metro North Railroad Company
525 Water Street, 3rd Floor
Bridgeport, CT 06601

2. 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.

Where the availability of four track outages are indicated, one of the four tracks will not be available to the Contractor and will remain in train service. The track to remain in train service will be the platform track for each of the passenger stations affected by the outage. During these outages all four tracks will have the catenary de-energized and diesel train service will be operational through the outage area.

2(a) Allowable track outages are as follows:

a. Single track outages 00:30 to 05:00 daily
b. Two-track outages 01:30 to 05:00 daily when required for specific work that cannot be performed under single track outages. Two-track outages will be limited to those situations deemed necessary by the Engineer.
c. No continuous track outages will be allowed.

2 (b) Installation and Removal of Bridge Plates:

Use of bridge plates are not allowed for this project.

2 (c) Power Outages:

i. Catenary Power Outages – A catenary power outage must be scheduled concurrently with a track outage for the track and is restricted to the same periods as specified in the plans and specifications.

ii. Metro North Railroad Power and Signal Distribution Feeder Outages – Outages for feeders can be allowed only during off-peak hours. These outages should be requested at a weekly Railroad Coordination meeting held early in the week for the following two weeks (Monday through Friday). One set of power and signal feeder either on the north or south side must be maintained (energized) at all times.

iii. During peak (5:00 am to 10:00 am and 3:30 pm to 10:00 pm, Monday through Friday) hours of Railroad traffic, both sets (north and south) of power and signal feeders must be energized.

2 (d) Additional Outage Notes:

i. The above outages are not guaranteed at all times.

ii. No full track and/or power outages will be permitted on weekends either immediately before or after major holidays, nor any weekend between Thanksgiving and New Years day.

3. 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.

4. Daily single-track outages will be considered as requests are submitted. Additional track outages will be considered for approval as requested by the Contractor for the completion of work.

5. 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 and/or power outages. Further, outages are granted on the basis of what is deemed necessary for construction, not merely for the Contractor's convenience.

6. 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. In addition, if power outages are also required, time should be allowed for de-energizing and re-energizing power facilities.

7. Off-Peak day time foul time will be allowed during the day for camera and conduit installations at platforms.

8. The Contractor shall assume that the wires and rails of the Railroad will be energized at all times. The Contractor shall require all of its employees, subcontractors, and others, to sign the following form or similar form, and furnish the Railroad with one original copy.

9. General Insurance Information for the New Haven Line Between Stratford and Westport Area:

i. Normal speed of passenger trains is **70 mph** in the area of the work. Normal speed of freight is **40 mph** in the area of the work.

ii. In the Stratford to Greens Farms area, there are in a 24 hour weekday period:

(118)	Scheduled Metro North Passenger Trains
(4)	Extra Trains
(36)	Amtrak Trains
(2)	Freight Trains

WARNING OF DANGER FROM ELECTRIFIED WIRES AND STRUCTURES
TO ALL PERSONS COMING NEAR ELECTRIFIED WIRES AND STRUCTURES

Notice is hereby given that contact, direct or indirect, with any of the electrified wires or structures of this Company is apt to result in serious injury or death and you are warned to avoid all such contact.

Dated

Job
AFE No.
Title

RECEIPT

I have this day received and carefully read the warning or danger from electrified wires and structures issued by you, which was attached to this receipt.

Signed _____

Occupation _____

Date _____

In the presence of

Witness _____

Job
AFE No.

NOTICE TO CONTRACTOR – EARLY SUBMITTALS

The Contractor is hereby advised that the Department has identified the potential need to order certain materials and equipment, and thereby submit certain submittals for approval early in the construction process to insure the Project is completed within the allowable Contract Time. Submittals shall be in accordance with Form 816 Article 1.20-1.05.02. The following items have been identified as possibly requiring early ordering thereby requiring early submission of shop drawings and product data, including color selection charts and samples:

Backbone Communications Network – Power Upgrade
Cable Routing Plan
Video Management System Support Services
PTZ Dome Cameras
Fixed Mount Dome Cameras

The following items have been identified as possibly requiring early submission for purposes of project coordination and project work scheduling:

Selection of the Project Coordinator
Baseline Critical Path Schedule
Contractor's Submittal Schedule
Health and Safety Plan

The lists above are not intended to be all-inclusive and do not relieve the Contractor from coordinating the activities of its subcontractors and suppliers. The Contractor will not be permitted to perform any physical work on the Project without the approval of the required submittals. Failure to properly plan for long lead items within the Contract schedule will not be justification for additional construction time.

It is recommended that the Contractor identify early in the construction sequencing process the subcontractors and suppliers associated with long lead-time items and submit the appropriate shop drawings and supporting data, including color selection charts and samples, for review upon Notice to Proceed.

NOTICE TO CONTRACTOR – LIMITATION OF CONTRACTOR OPERATIONS

The Contractor shall repair at its own expense any and all damage caused by construction operations to existing buildings unless said damage is scheduled as part of the Project work.

During all times that the Project Site is occupied by the Engineer and Department personnel, the Contractor shall maintain the following utilities and services to the extent described to permit Department operations:

1. Electrical Service: The Contractor shall be responsible for paying all monthly electrical usage utility costs related to their construction field office.

2. Telephone Service: The Contractor shall be responsible for paying all monthly telephone utility usage costs related to their construction field office.

3. Sanitary Facilities: The Contractor is responsible for emptying the sanitary facilities at its expense.

The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – PHOTO IDENTIFICATION

The Contractor is hereby notified that all employees, including subcontractors, who will work on the Project will be required to carry personal photo identification, such as a valid driver's license.

NOTICE TO CONTRACTOR – RAILROAD SAFETY TRAINING

All individuals employed by the Contractor and its subcontractors shall attend Safety Orientation for Contract Employees Working on Metro-North Property produced by the Safety Engineer of Metro-North prior to entering onto the Railroad's property or coming within twenty-five (25) feet of the centerline of the track or energized wires. It is the Contractor's responsibility to arrange this Safety Training.

NOTICE TO CONTRACTOR – SPECIAL ELECTRICAL CATENARY WORK

The Contractor is hereby advised that the Project includes electrical work on the existing catenary structures. The Contractor's personnel working near or at catenary structures must be Blue Sticker Certified by MNR. The Contractor shall assume any and all cost associated with obtaining this certification. The Contractor shall strictly adhere to all requirements as specified within the Contract in the performance of this Project work.

NOTICE TO CONTRACTOR – SUBMITTALS

Transmittal of Submittals: Unless otherwise stipulated, all submittals requiring review for conformance with the Contract shall be transmitted by letter and hand delivered or sent by mail directly to STV Incorporated, 185 Plains Rd, Suite 208E, Milford, CT 06461.

A transmittal letter shall be sent to Mr. Jayantha Mather, Office of Rail, Connecticut Department of Transportation, 2800 Berlin Turnpike, P.O. Box 317546, Newington, CT 06131-7546, Attention: Mr. Yure Kuljis.

Copies of the transmittal letter shall be sent to the Robert P. Pettinicchi, Office of Rail Construction, 50 Union Ave, 3rd Floor West, New Haven, CT 06519, Attention: Rodney Armstrong.

Copies of the transmittal letter shall be sent to Metro-North Railroad, 525 Water Street, 3rd Floor, Bridgeport, CT 06604, Attention: Mr. David Willard, P.E.

Submittals requiring review for conformance with the Contract that shall be submitted directly to the District Engineer in lieu of the Designer are listed below. Copies of the transmittal letters shall be sent to the Manager of State Design.

Concrete Mix Design Certifications
Asphalt Mix Design Certifications
Erosion Control Plan and Materials
Demolition Plan
Certified Concrete Cylinder Test Results
Certified Mill Certificates for Reinforcing Steel
Mill Certificates for Structural Steel

Submittals requiring review for conformance with the Environmental Contract work that shall be shall be transmitted by letter and hand delivered or sent by mail directly to Manager of Environmental Compliance, Bureau of Engineering and Highway Operations, Connecticut Department of Transportation, 2800 Berlin Turnpike, P.O. Box 317546, Newington, CT 06131-7546, Room 3127. Copies of the transmittal letters shall be sent to the Manager of State Design and to the District Engineer.

Health and Safety Plan.

Submittal Preparation and Processing: The Contractor shall provide the Designer with complete submittal packages (Product Data, Shop Drawings, Samples, and Quality Assurance Submittals, as applicable) for individual elements of Project work for a concurrent review of all information. Incomplete submittal packages will be returned to the Contractor without being reviewed.

The Contractor shall submit six printed copies and one electronic copy in PDF format of each required submittal for the Designer's review in accordance with Form 816. The PDF versions shall be created electronically and not scanned from a printed copy.

Samples: Where Samples are for selection of color, pattern, texture or similar characteristics from a range of choices, submit 2 full sets of the standard and custom choices for the material or product. Where Samples illustrate assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit 1 sample (or set, if applicable).

Designer's Action: The Designer will return 3 copies marked with action taken and corrections or modifications required. Retain complete copies of submittals on Project site. Use only final action submittals that are marked with "No Exceptions Taken" or "Exceptions as Noted" notation from the Engineer's action stamp. One set of submittals shall be maintained as a "Record Document".

Samples: The Designer will return one set of samples marked with the action taken. The set of samples shall be maintained at the Project site when returned.

The Contractor shall not proceed with procurement, manufacture, or fabrication of items submitted for review, until such submittals have been designated by the Engineer as "No Exceptions Taken" or "Exceptions as Noted," unless specifically authorized to do so by the Engineer. The Contractor shall notify the Engineer within ten (10) days if any correction indicated on submittals constitutes a change of the Contract requirements.

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

Submittals to be Re-submitted

If corrections to the submittals are required, returned copies will be marked "Revise and Resubmit", "Rejected", or other similar notation. One copy will be returned to the Contractor for corrections. The Contractor shall resubmit the corrected material in the same quantity originally submitted within twenty-one (21) days after receipt by the Contractor of the returned submittal.

NOTICE TO CONTRACTOR – UTILITY SERVICE CONNECTIONS

The electric, water and sewer services to the Project Site require service connections to the applicable utility company's facilities. Utility service connections and installations to the point of the utility service are included as shown and described within the Contract.

The Contractor is responsible for notifying the utility company prior to the need for the utility connection, and for coordinating the service connection and/or relocation requirements with the utility company. The Contractor shall coordinate with the following utility companies:

Electric:	United Illuminating (UI)
Water:	Aquarion Water Company of Connecticut
Sewer:	City of Bridgeport Water Pollution Control Authority

Where known, utility company representatives are identified elsewhere within the Contract.

NOTICE TO CONTRACTOR – BASIC ELECTRICAL MATERIALS AND METHODS

Description:

The work of this Section consists of furnishing and installing basic electrical materials applicable to the electrical work specified in other sections as modified to those sections.

Applicable Standards:

Pertinent provisions of the following listed standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made part of this Specification to the extent required:

Organization	Number	Title
ANSI	C78.1	Fluorescent Lamps – Rapid Start Types
ANSI	C82.1	Specifications for Fluorescent Lamp Ballasts
ASTM	A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM	A386	Specification for Zinc Coating (Hot-Dip) on Assembled Steel Products
ASTM	B3	Soft or Annealed Cooper Wire
ASTM	B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM	B187	Copper Bus Bar, Rod and Shapes
ASTM	B633	Specification for Electro-Deposited Coatings of Zinc on Iron or Steel
ASTM	D149	Tests of Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM	D570	Test for Water Absorption of Plastics
ASTM	D635	Test for Rate of Burning and/or Extent and Time of Burning of Self-supporting Plastics in a Horizontal Position
ASTM	D638	Test for Tensile Properties of Plastics
ASTM	D648	Tests for Deflection Temperature of Plastics
ASTM	D695	Test of Compressive Properties of Rigid Plastics

ASTM	D790	Tests for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM	D2240	Test for Rubber Property-Durometer Hardness
NEMA	PB1	Panelboards
NEMA	TC2	Electric Plastic Tubing (EPT) and Conduit
NEMA	TC3	PVC Fittings for Use With Rigid PVC Conduit and Tubing
NEMA	WC5	Thermoplastic-Insulated Wire and Cable
NEMA	WC7	Cross-Linked-Thermosetting-Polyethylene Insulated Wire and Cable
NEMA	WC8	Ethylene-Propylene-Rubber-Insulated Wire and Cable
NEMA	WD1	General Purpose Wiring Devices
NFPA	70	National Electrical Code (NEC)
UL	6	Rigid Metal Conduit
UL	67	Panel Boards
UL	83	Thermoplastic-Insulated Wires and Cables
UL	467	Grounding and Bonding Equipment
UL	489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures
UL	498	Attachment Plugs and Receptacles
UL	542	Lamp holders, Starters, and Starter Holders for Fluorescent Lamps
UL	506	Specialty Transformers
UL	651	Schedule 40 and 80 Rigid PVC Conduit
UL	870	Wire ways, Auxiliary Gutters and Associated Fittings
UL	935	Fluorescent Lamp Ballasts
UL	1008	Automatic Transfer Switches
UL	1059	Terminal Blocks
UL	1570	Fluorescent Lighting Fixtures

Submittals: Submit the following:

Manufacturer's description, shop/working drawings, material/procurement specifications, installation instructions, technical data and certificates for all materials and items supplied under this Section. List of special tools and associated catalog cuts.

Equipment interconnection diagrams, wiring, and circuit schedules. Indicate locations of power panels used. Include information for all existing circuit breakers (including trip, AIC, and voltage ratings), description of the loads attached to the existing circuit breakers, panel ratings and electrical service, and locations for new circuit breakers where applicable. Contractor shall show ratings of circuit breakers to be used have been coordinated with the electrical loads to be attached. Submit voltage drop calculations based on actual cable/conduit routing. Voltage drops shall be shown at full current draw of the attached equipment, as well as the full operating capacity of the breaker (80% of the breaker rating).

Design and production test plan, test procedures and certified test reports.

Materials:

Materials furnished shall be standard products of manufacturers regularly engaged in the production of materials specified.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

Exposed Conduits – Unless specifically noted otherwise noted on the Plans, conduits outdoors at stations and PECK Bridge shall be PVC coated RGS. Risers on catenary structures at node houses shall be PVC. Risers on catenary structures at substations shall be RGS. All other conduits shall be rigid galvanized steel unless otherwise noted.

PVC Conduits and Fittings – Conduits shall comply with NEMA TC2 and UL651, schedule 80 as required, and have the following properties:

Flammabilty – ASTM D635, self-extinguishing

Tensile Strength – ASTM D638, 6,000 psi at 78 degrees F.

Flexural Strength – ASTM D790, 12,500 psi.

Compressive Strength – ASTM D695, 4000 psi.

Hardness – ASTM D2240 (Durometer D), 77.

Water Absorption – ASTM D570, 0.03 percent maximum, in 24 hours at 72 degrees F.

Dielectric Strength – ASTM D149, 1,100V per mil.

Thermal Conductivity – I.3 BTU per house per square foot per degrees F per inch.

Conduit Cement – As recommended by conduit manufacturer.

Fittings – NEMA TC3.

Spacers – Styrene, interlocking type.

Rigid Galvanized Steel (RGS) Conduits and Fittings – Conduits, couplings, elbows, bends and nipples shall meet the requirements of NEC, UL 6, ANSI 80.1, NEMA RN-1 (includes PVC coated RGS). Refer to Special Provisions for additional requirements for PVC coated RGS.

One-hole conduit straps shall be hot-dip galvanized malleable iron. Where used with PVC coated conduit, one-hole conduit strap shall be PVC coated malleable iron. All one-hole straps shall be used with backstrap of the same type. All other hardware shall be 316 stainless steel unless otherwise shown on the Plans. Refer to Special Provisions for additional requirements for PVC coated RGS.

Strut channel shall be 1-5/8" x 1-5/8" 12 gauge, ASTM A240, 316 stainless steel, unless otherwise shown on the Plans. Depth shall be as required to satisfy the load requirements including the safety factor and designed to accept special spring-held nuts for securing hanger rods and other attachments. Nuts and clamps shall be compatible with the channel. All nuts and clamps shall be steel and finished similar to the hanger rods. All hardware shall be 316 stainless steel unless otherwise shown on the Plans. Hangers shall be capable of supporting a load equal to the sum of the weights of the conduits, cable trays, or equipment and wires, and the weight of the hangers, plus an additional 200 pounds minimum.

All materials shall be of same material and finish compatible with each other to form a complete conduit support system in accordance with manufacturer instructions.

Suitable conduit sealing bushings shall be provided for all conduits as required. All empty conduits shall be sealed with blank conduit sealing bushings. All conduit penetrations in floors/walls shall be provided with required number of conduit seals.

Hangers and Supports

Hanger Rods – ASTM A193 or A320, B8M Class 2, 316 stainless steel unless otherwise noted on Plans. Provide hanger rods not smaller than 1/2-inch diameter, threaded either full length or for a sufficient distance at each end to permit at least 1-1/2 inch of adjustment. All rods shall be continuous.

Trapeze, Multiple Conduit Hangers – Fabricated from two or more hanger rods, a steel channel horizontal member and U-bolts, clamps and other attachments necessary for securing hanger rods and conduits.

Horizontal Member – Continuous metal channel single or double, as required.

Surface Mounted Outlet and Switch Boxes – Cast iron alloy, hub-type with cover gasket in wet locations, complete with painted steel cover plates and complying with ASTM A48.

Dry Locations – Galvanized, 16 MSG minimum, sheet steel with welded seams and screw covers.

Wet Locations – NEMA Type 4, hot-dip galvanized cast iron complying with ASTM A48 and A153.

Insulated Wire, Cable and Accessories – UL Listed for the intended purpose.

Bus Bar – 1¼" extra heavy copper tubular bus, couplings, and connectors shall comply with ASTM B187.

Conductors – Soft or annealed copper conductors shall comply with ASTM B3.

Power Circuits – Minimum wire size shall be No. 12 AWG. All wire shall be ASTM B8, Class B stranded.

Control Circuits – Minimum wire size shall be No. 14 AWG, ASTM B8, Class B stranded.

Fixture Wiring – Minimum wire size shall be No. 16 AWG, ASTM B8, Class C Stranded.

Insulation – Control Circuits (except panel wiring)- NEC Type THW conforming to NEMA WC5, or Type RHW conforming to NEMA WC 8. Power Circuits – NEC Type RHW-2 conforming to NEMA WC 8, or NEC, Type XHHW-2 conforming to NEMA WC 7.

Panel Wiring – NEC Type SIS. Complying with UL 83 flame retardant properties test.

Terminations for 600V Wire and Cable – Terminal connections shall be UL listed and have capacity and insulation voltage ratings of not less than the ratings of the wire or cable terminated.

Terminals for No. 10 and smaller wire – Vinyl-insulated, electro-tin-plated, electrolytic copper locking spade.

Terminals for No. 4/0 and larger wire – Long barrel, tin plated copper, compression – type, with NEMA 2-hole pad, or as shown on drawings.

Terminals for No. 8 to 3/0 wire – Compression, tin-plated copper lugs.

Shielded wires shall be used as applicable.

Wire Identification Markers

Power cable identification marker – Engraved water resistant plastic or brass tag tied to cable with wire tie.

Control wire identification marker – water resistant, factory printed vinyl, with printing protected by clear, permanent overcoat.

Wire ties – Nylon strap with stainless steel locking barb and taper, black, ultraviolet ray resistant.

Wiring Devices

Terminal Blocks – Complying with UL 1059. Terminal blocks shall be of the washer head screw type. Base and inter-terminal barriers shall accommodate terminals for No. 8 AWG and smaller stranded copper wire connectors. Terminal blocks shall be identified and provided with ten percent spare terminals, over those required for circuit wiring. Terminal blocks shall be rack or rail mounted in vertical rows with permanent marker tags.

Switches – Complying with UL 20 and NEMA WD 1. Heavy-duty, AC general use, snap type, toggle operated and rated 20 A, 120-277 V. Switches shall be single pole, double pole, one way or two way, as required.

Receptacles – Complying with UL 498 and NEMA WD 1. Heavy duty, GFCI, general use type, rated 20A, 120-277 V. Receptacles as required to suit specific needs of equipment installed shall also be provided. Where connected to branch circuits less than 20A, 15A rated receptacle may be used.

AC Distribution Panel Boards – AC panel boards shall comply with the requirements of NEMA PB 1 and certified to UL 67 and shall be suitable for three-wire, 120/240V AC distribution service as indicated on the plans. Panel boards shall be equipped with main and branch circuit breakers, rated as required.

Panel boards shall be housed in a NEMA Type 12 enclosure, with hinged front cover, lockable handle, and two-point latch, minimum. Ground lug shall be furnished, welded to enclosure.

Buses shall be electrical grade copper with silver plated contact surfaces. Neutral bus shall have the same rating as the phase bus. Copper ground bus shall be furnished.

Circuit breakers shall comply with UL 489/NEMA AB1, with current ratings as indicated and not less than 10,000 A interrupting rating at 240/120 V. Circuit breakers shall be bolt-on type with quick-make, quick-break action. Contact ON and OFF positions and trip action due to overload or short circuit shall be clearly indicated by the handle position.

Voltage drop for circuits shall not exceed three percent (3%) at full breaker operating capacity (80% of the breaker rating) unless otherwise approved by the Engineer. In no case should the voltage drop exceed 3% at full current draw of the attached equipment.

Manufacturer Testing

Design Tests: All the design tests, per relevant ANSI, NEMA, and UL Standards, shall be, or shall have been, performed on the equipment.

Production Tests: All the production tests, per relevant ANSI, NEMA, and UL Standards, shall be performed on each item of equipment supplied.

Construction Methods:

Installation work shall be in accordance with applicable requirements of NFPA 70 and shall comply with the regulations of NEC, NESC and USC.

The Plans show facilities diagrammatically and do not show offsets, fittings, and accessories that may be required. Investigate carefully the structural and finish conditions affecting the work, and provide such fittings and accessories as required. Control erection tolerance requirements to not impair the strength, safety, serviceability, or appearance of the installations. Determine exact locations of conduit. Route conduits parallel and perpendicular to building lines unless otherwise indicated or approved in the field by the Engineer.

All cabling shall be installed in conduit. Provide a complete end-to-end system.

Conduits fills shall not exceed fill ratios as required by NEC. Communications and fiber conduit fills shall follow the same requirements as power conduits. For purposes of conduit fill, each fiber cable, regardless of the number of fibers contained in the cable, shall be considered one (1) conductor. Conduit sizes shown on Plans are minimal. Contractor shall ensure proper conduit sizing based on the requirements on NFPA 70, Contract Specifications, and actual materials used.

Materials and equipment shall be applied, installed, and connected as recommended by the manufacturer.

<u>Conduits, Fittings, and Accessories</u>

Embedded Conduits – Embedded conduits shall be properly supported and spaced with spacers, prior to backfilling.

The ends of conduits shall be capped or covered prior to backfilling.

Conduits shall be pitched to provide moisture drainage to manholes, if installed.

Conduit expansion fittings, as required, shall be installed to allow for expansion. Expansion fittings shall be designed for use with the type of conduit it's attached to.

The ends of field cut conduits shall be reamed to remove rough edges. The ends of PVC conduits that are to be joined shall be coated with conduit cement for a length equal to the depth of the coupling or other fitting, to ensure a watertight connection.

Conduit runs shall be made with approved couplings and unions. Right angle bends shall be made with factory elbows where possible. Offsets and change-in-direction bends shall be made with factory fittings where possible. Conduit runs shall be straight and true; elbows, offsets, and bends

shall be uniform and symmetrical. Bends shall be made without kinking or deforming the cross-sectional contour of the conduit. The radius of factory bends and elbows shall be greater than the manufacturer recommended minimum for cables being installed. All field conduit bends shall be made in accordance with manufacturer instructions and recommendations.

Conduits entering outlet boxes, pull boxes, panel board enclosures, terminal cabinets, and similar equipment enclosures shall be attached to the box or enclosure with a locknut outside and a locknut inside tightened against the box or enclosure. Conduit shall be provided with end bushings. Conduit shall be provided with grounding bushings with copper jumper to the box or enclosure ground lug or bus. Conduit 1¼" trade size or larger shall be provided with insulating bushings.

To ensure ground continuity, unleaded, conductive anti-seize compound shall be applied to conduit threads, couplings, and hubs before assembly. Provide electrically and mechanically continuous metallic conduits, connected to ground by bonding to the grounding system from point of origin throughout all runs, cabinets, pullboxes, and fittings.

Trapeze hangers or wall mounted metal framing shall be used to support runs of conduit. Conduit clamps shall be used at the end of each run, at each elbow, and on each intermediate hanger to securely fasten each conduit in the group. The required strength of supports, and the size and type of anchors, shall be based on the combined weights of conduits, wires and supports, and stresses incurred during wire pulling. Individual conduit runs may use one-hole strap and backstrap when not run with other conduits and approved by the Engineer.

Locate position of reinforcing steel and other inserts before drilling holes for anchors. Install drilled-in anchors and inserts in accordance with manufacturer's recommendations in accurately and matched tolerance drilled holes of required diameter and depth. If reinforcing steel is encountered during drilling, notify the Engineer. Remove drilling debris and dust from holes before setting anchors. Coordinate drill hole diameters with manufacturer's instructions for anchor diameter. Take all measures to protect the threads from damage during anchor installation. Set anchors with manufacturer's recommended torque, using a torque wrench. Failure to develop the required torque shall be cause for rejection. Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

Conduit runs shall be cleaned and swabbed to remove foreign matter prior to pulling in wire and cable. Cable pulling cord shall be installed in all conduits including spares. Ends of pulling cord shall be tagged with permanent type markers.

Electrical continuity shall be maintained between sections of steel tray by connection to a continuous copper grounding conductor. The grounding conductor shall be connected to local grounding system.

Outlet, Junction and Pull boxes – Install outlet, junction and pull boxes so that covers are accessible after completion of the installation.

Insulated Wire, Cable and Accessories – Wire and cable shall be installed by means of equipment, devices and the methods recommended by the manufacturer. High-voltage cable splices and terminations shall be performed by qualified personnel.

Wiring and cabling shall be terminated and connected by means of connectors, lugs, and other methods specified.

Power Cabling – AC circuits consisting of multiple single conductors shall be grouped and pulled in separate designated raceways. Adequate slack shall be provided at terminations and in pull boxes.

Cables shall be identified by individual engraved tags at each end of circuit and at any intermediate pull box, junction box, hand hole, or manholes.

Control Wiring – Multi-conductor control wiring between equipment panels and cubicles shall be installed in designated conduits and raceways separate from those use for power cables. Multi-conductor cables installed in the same conduit shall be pulled together.

Where possible, control wiring shall be run from end to end without splices. Approval shall be obtained from the Engineer before splicing any control cables. Each multi-conductor cable shall be identified at each end, and at any intermediate pullbox, junction box, by specified markers.

Control cables shall be neatly laid and grouped in cable tray and secured by specified wire ties. Cable entering equipment panels or cubicles shall be supported and secured to prevent tension on terminations. Adequate slack cable shall be provided and each wire terminated shall be double looped.

Wire Terminations – Power wiring shall be terminated with approved connectors. Provide adequate slack wire, one loop minimum, to prevent strain on termination.

Field Touch Up

Galvanized Metal Surfaces – Coat damaged surfaces, to the strength and finish of the original coating, with polystyrene organic rich compound containing not less than 91 percent by weight metallic zinc powder in dried film.

Painted Metal Surfaces – Clean, treat, and coat damaged surfaces with required rush inhibiting undercoating and finish coat paint system in accordance with manufacturer's instructions.

Payment for this work described in this section will be paid under the appropriate pay item.

NOTICE TO CONTRACTOR – COLD WEATHER CONCRETE ACTIVITIES

The Contractor is hereby advised of the potential need for cold weather concrete activities. The Contractor shall strictly adhere to all required cold weather concrete procedures as specified within the Contract and conduct its activities accordingly. The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – RAILROAD SPECIFICATIONS

The contractor is hereby notified that all railroad specifications contained elsewhere herein shall be made a part of this contract, and that the contractor shall be bound to comply with all requirements of such specifications. The requirements and conditions set forth in the subject specifications shall be binding on the contractor just as any other specification would be.

NOTICE TO CONTRACTOR – PROCUREMENT OF MATERIALS

Upon award, the Contractor shall proceed with shop drawings, working drawings, procurement of materials, and all other submittals required to complete the work in accordance with the contract documents.

NOTICE TO CONTRACTOR – WINTER WEATHER

The Contractor is hereby advised of the potential for winter weather during the Contract duration. The Contractor shall be responsible to clear any snow, ice, hail, sleet, etc. to perform their work.

In the event of winter weather during the Contractor's work in the public way (such as platforms, parking lots, etc.), the Contractor shall remove any precipitation (snow, ice, hail, sleet, etc.) and apply approved de-icing materials to all closed surfaces not able to be accessed by station/Railroad snow removal crews due to the work of the Contractor.

The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – LABELING PLAN

Description:

The work of this Section consists of furnishing and installing labeling and identification materials applicable to the electrical and communications work specified in other sections as modified to those sections.

Applicable Standards:

Pertinent provisions of the following listed standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made part of this Specification to the extent required:

The labeling and tagging designed and submitted in the Contractor's Labeling Plan shall comply with the appropriate sections of ANSI/TIA/EIA – 606-A Administration Standards, ANSI/TIA/EIA – 569 Pathway and Spaces, ANSI/TIA/EIA – 568-A Telecommunications Cabling Standard, BICSI Telecommunications Distribution Methods Manual, UL 969, and NFPA 70.

Submittals:

Product Data: Provide submittals for all materials to the Engineer for review and approval prior to delivery and procurement.

Labeling Plan: The Contractor shall submit a Labeling Plan for approval for all work in accordance with this section. Coordinate requirements of other sections.

Samples: Submit sample labels for evaluation including sample text as described herein.

Materials:

Labels shall be suitable for the environment installed.

Power cable identification marker – Engraved water resistant plastic or brass tag tied to cable with wire tie.

Control wire identification marker – water resistant, factory printed vinyl, with printing protected by clear, permanent overcoat.

Outer rack and panel nameplates shall be an engraved, laminated thermo-setting plastic nameplate, minimum 2 inch by 4 inch by 0.062 inch thick (minimum) with edges beveled 0.032x 45 degrees attached in an approved manner. Nameplates shall be black, engraved through to the white core. Text size shall be coordinated with the equipment size, but no less than 0.5 inches unless otherwise approved by the Engineer.

Construction Methods:

All devices, circuits, panels, racks, etc. provided or modified under this Contract shall be labeled. This includes any existing panels modified under this Contract that do not already have permanent labels. Contractor shall update any circuit descriptions contained in the power panels as applicable.

The Contractor shall submit a Labeling Plan so that each of the following are named and labeled:

1. All field devices including cameras and infrared illuminators
2. CCTV panels, remote switch cabinets, racks – and the devices within each.
3. Each end of every cable at both ends, major splice points, and other access locations.
4. System hardware elements such as fiber distribution panels, patch panels, splice trays, network switches, servers, power supplies, etc.
5. Circuit designations on fiber distribution panels, patch panels, trays, and data patch panels
6. Circuit designations on electrical panels, disconnects, and equipment

The Contractor shall submit as part of the Labeling Plan proposed locations for all types of labeling and tagging. At a minimum:

1. The labeling locations for each piece of equipment installed in cabinets shall be on both the front and rear of the device. Labels shall be placed on the device so as not to interfere with any indicators, connectors, and unused ports or slots. Where space is limited, alternative labeling methods may be proposed for approval by the Engineer.

2. Provide a labeling scheme and tags to identify all cameras at each location. Engraved tags shall indicate the camera number at each location, for example “BPT-05”, and shall be mounted by the camera enclosures or pull box. The tags shall be of anodized aluminum, with a thickness of 0.032” (inch). Lettering shall be black on silver background. Text shall be center justified and spaced equally along the span. Tag mounting shall be industrial type adhesive strip, 2.5” x .75”, manufactured by 3M or approved equal. Submit labeling scheme and tags for approval.

3. The labeling locations for cables shall be on each end of each cable within three inches of the termination end of the cable. The label on each end of the cable shall show the full tag nomenclature consistent with overall system design.

Furnish, mark, and install all temporary tags which are required to properly tag all temporary wires and cables used in the Work. Remove temporary tags upon completion of the Work.

Contractor shall furnish a circuit designation card in all power panels modified by this Contract. The circuit designation card shall bear the circuit numbers and other circuit designations as shown on the Contract Drawings and additional information as may be necessary for the positive identification of individual circuits. The cards shall be made of heavy paper of approved quality. The lettering shall be of an approved size and type. A list of the circuit designations shall be submitted for approval before the card is made up. Within panels to be furnished by the Contractor, a directory frame made of brass or oxidized copper, with Lucite cover, shall be mounted on the inside of the panelboard doors.

The Contractor shall complete all fabrication and printing of all labeling and tagging materials in accordance with the approved Labeling Plan before the beginning of Field Testing.

All tagging and labeling shall be permanently affixed in accordance with the approved Labeling Plan.

Payment for this work will be considered incidental to other items. No additional payments will be made. The Contractor shall bid the Project accordingly.

SECTION 1.02 – PROPOSAL REQUIREMENTS AND CONDITIONS

Article 1.02.04 – Examination of Plans, Specifications, Special Provisions and Site of Work:

Replace the third sentence of the last 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.

SECTION 1.03 – AWARD AND EXECUTION OF CONTRACT

Article 1.03.08 - 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".

SECTION 1.05 – CONTROL OF THE WORK

Article 1.05.06—Cooperation with Utilities (Including Railroads) – is supplemented as follows:

Add the following after the last paragraph:

"Special Requirements Regarding Work in Metro-North territory:"

Description:

This section covers authority, definitions, regulatory requirements, traffic regulation and coordination of the Contractor's work schedule with the operation of train service, construction equipment and safety requirements for working within railroad right-of-way, and provisions for storage of materials and equipment and worker safety rules. Subsequent to the Engineer's Pre-construction meeting and prior to commencement to contract activities, a working on the railroad meeting will be held by the Engineer to emphasis these Specifications.

Permission to Enter Upon Railroad Property

Permission is hereby granted to the Contractor to enter property of the State, under the custody and control of the Department and managed by Metro-North Commuter Railroad Company (hereinafter called "Railroad"), a public benefit corporation and subsidiary of Metropolitan Transportation Authority (hereinafter called "MTA"). The purpose of this permission shall be solely for those outlined in this contract and under the following terms and conditions:

I. Location and Access. Permission is hereby granted to the Contractor and its subcontractor(s), if any, to enter the property within the Project Limits identified on the Contract Plans of the New Haven Line, in the vicinity between Mileposts 60.4 (just West of Devon Movable Bridge) and 73.0 (division post in New Haven), in the State of Connecticut (hereinafter called the "Property").

II. Liability. The Contractor covenants and agrees to at all times indemnify, protect and save harmless the "Additional Insureds", as defined under Article V, from and against any and all losses, damages, detriments, suits, claims, demands, costs, and charges which the "Additional Insureds" may directly or indirectly suffer, sustain, or be subjected to by or on account of the Contractors entry upon, occupancy or use of the Property, or the conduct thereon of the Contractor, its subcontractors, officers, employees, agents or invitees, whether such loss or damage be suffered or sustained by the "Additional Insureds" directly or persons (including employees of "Additional Insureds" or Corporations who may seek to hold the "Additional Insureds" liable therefore), and whether attributable to the fault, failure or negligence of the "Additional Insureds" or otherwise.

III. Consideration. The Contractor will pay to the Railroad, the sum of Zero Dollars ($0.00) for

the right to enter upon the Property.

IV. Terms of Permit. The Railroad reserves the right to revoke this permission at any time. Unless subsequently modified, this shall begin with Notice to Proceed and shall end at Contract Completion Date at which time it shall expire automatically. Under no circumstances shall this temporary permission be construed as granting the Contractor any rights, title or interest of any kind or character in, on, or about the land or premises of MTA or Railroad thereafter. The Permittee agrees to notify the Railroad when use of the Property or work is completed.

V. Definitions of Terms and Permissible Abbreviations:

Authority of the Railroad Engineer – This supplements Form 814A, Section 1.05.01 in that all contract work upon or affecting railroad property, right-of-way or facilities, shall also be subject to the approval of the Senior Director, Capital Programs of the Railroad or his duly authorized representative, through coordination with the Engineer.

Additional Insureds – Those individuals or entities appearing under Article 1.03.07, Paragraph 13 of the Specifications.

Conductor/Flagman – A Railroad employee qualified on the Rules of the Operating Department and qualified on the physical characteristics of the portion of the railroad involved. He/she is the contact employee qualified to obtain the use of track. Each conductor/flagman will have the proper flagging equipment, up-to-date Railroad Operating Rules, Timetables and Safety Rules.

Coordination of Work – This supplements Form 814A, Section 1.05.06 in that the Contractor shall be responsible for the coordination of the work of his sub-contractors with respect to the railroad property, right-of-way or facilities.

Groundman – Class "A" employee of the Railroad's Power Department authorized to de-energize/re-energize and ground high tension power lines.

Horizontal Clearance Point – A point 10 feet from the centerline of a track.

Obstruction – An entering of the traffic envelope, also referred to as fouling.

Occupancy – Any use of track other than direct crossing.

On or Adjacent to – shall be interpreted to include space on, above and below the railroad right-of-way operated by the Railroad, as well as space on, above, and below adjacent property which the Railroad determines to affect the safe operations of service.

Qualified Railroad Employee – For the purpose of these specifications, a Qualified Railroad Employee is a Railroad employee qualified to remove track or tracks from service.

Railroad – Whenever the term "Railroad" is used without further qualification, it shall be taken to mean Metro-North Commuter Railroad Company.

Right-of-Way – The limits of railroad property on either side of tracks.

The Safety Rules – All work shall be performed in accordance with rules, regulations, procedures, and safe practices of the Railroad, FRA, OSHA, NESC and all other government agencies having jurisdiction over this project.

Track – The space between the rails plus not less than 4 feet outside each rail.

Traffic Envelope – The area encompassed by the vertical and the horizontal clearance points.

Vertical Clearance Point – A point 22 feet and 6 inches above the top of a running rail unless otherwise authorized by the Railroad.

Use of Track – Obtaining permission from the proper authority of the Railroad for track occupancy.

1 – Requirements for Performing Work on or Adjacent to the Railroad Right-of-Way

(a) General

(1) The Contractor should note that the proposed work involves construction operations on or adjacent to property owned by State and operated by the Railroad. In working near an operating railroad, great care must be exercised and the Railroad's safety rules must be strictly observed.

(2) If while completing the work covered by this contract, the tracks or other facilities of the Railroad are endangered, the Contractor shall immediately do such work as directed by the Railroad through the Engineer to restore safety. Upon failure of the Contractor to carry out such orders immediately, the Railroad may take whatever steps as are necessary to restore safe conditions. The cost and expense to the Railroad of restoring safe conditions, or of any damage to the Railroad's trains, tracks or other facilities caused by the Contractor's or subcontractor's operations, shall be considered a charge against the Contractor and shall be paid for by him, or may be deducted from any monies due or that may become due to him under this contract.

(b) Rules and Regulations

(1) Railroad traffic shall be maintained at all times, and the Contractor shall conduct all of his operations on or adjacent to the Railroad right-of-way fully within the rules, regulations, and requirements of the Railroad. The Contractor shall be responsible for acquainting himself with such requirements as the Railroad may demand. The Contractor shall include in his bid any expenses occasioned by delay or interruption of his work by reason of the operation or maintenance of the Railroad facilities.

(2) The Contractor shall obtain verification of the time and schedule of track occupancy from the Railroad before proceeding with any construction or demolition work on or adjacent to the Railroad right-of-way.

(3) All work to be done on or adjacent to the Railroad right-of-way shall be performed by the Contractor in a manner satisfactory to the Railroad and shall be performed at such times and in such manner as not to interfere with the movement of trains or traffic upon the tracks of the Railroad. The Contractor shall use all necessary care to avoid accidents, damage, delay or interference with the Railroad's trains or property.

(4) If deemed necessary by the Railroad, it may furnish or assign an inspector who will be placed in the work area during the time the Contractor or any subcontractor is performing work under the contract on Railroad property.

(5) Before proceeding with any construction of demolition work on or adjacent to the Railroad Right-of-Way, a pre-construction meeting shall be held at which time the Contractor shall submit for approval of the Railroad, plans, computations, and a detailed description of his method and procedure for accomplishing the specific construction work required under this contract, including methods of protecting Railroad traffic. Such approval shall not serve, in any way, to relieve the Contractor of his responsibility for the adequacy and safety of his methods and procedures for conducting the work.

(6) The Contractor shall conduct his work and handle his equipment and materials in such manner that neither fouls a live track or wire line without the written permission of the Railroad.

(7) Equipment shall be considered to be potentially fouling the track when located in such a position that its failure, with or without load, brings the equipment within the traffic envelope. No equipment shall be placed in this position without prior approval of the Railroad.

(8) Equipment of the Contractor to be used:

(A) Equipment of the Contractor to be used adjacent to the tracks shall be in first-class condition so as to fully prevent failures of defective equipment that might cause delay in the operations of trains or damage to Railroad facilities. His equipment shall not be placed or put into operation adjacent to tracks without first obtaining permission from the Railroad. Under no circumstances shall any equipment or materials be placed or stored within 25 feet from the near rail of a track in operation, unless approved, in advance, by the Railroad.

(B) High rail equipment of the Contractor to be used on the tracks shall be subject to prior approval of the Railroad. The equipment must be inspected and approved in advance at the Railroad's facility by Railroad inspectors. The equipment inspection must be renewed every three months.

(C) On track vehicles shall be equipped with a Railroad approved tow bar and coupler. Multiple vehicles shall move in tandem and coupled when directed by the Railroad. Movement of on track vehicles shall proceed only under the direct supervision of a Qualified Railroad Employee.

(9) Materials and equipment belonging to the Contractor shall not be stored on Railroad property without first having obtained permission from the Engineer and Railroad. Such permission will be on the condition that the Engineer and Railroad will not be liable for damage to such materials and equipment from any cause. The Contractor shall keep the tracks adjacent to the site clear of all refuse and debris that may accumulate from his operations and shall leave the Railroad property in the condition existing before the start of his operations.

(10) The Contractor shall coordinate with the Engineer and the Railroad in order to determine the type of protection required to insure safety and continuity of Railroad traffic incidental to the particular methods of operation and equipment to be used on the work.

(11) The Railroad will require protection during all periods when the Contractor is working on, or over, the right-of-way of the Railroad, or as may be found necessary in the opinion of the Railroad. When protection is required, refer to Paragraph 1(g).

(12) It shall be expressly understood that this contract includes no work for which the Railroad is to be billed by the Contractor, and it shall be further understood that the Contractor is not to bill the Railroad for any work which he may perform, unless the Railroad gives a written request that such work be performed at its expense.

(13) Upon completion of the work, and before final payment is made, the Contractor shall remove from within the limits of the Railroad's right-of-way, all machinery, equipment, surplus materials, falsework, rubbish and temporary buildings, and other property of the Contractor/sub-contractor, and shall leave the right-of-way in a condition satisfactory to the Railroad.

(c) Railroad Protective Services – will be provided in accordance with the Roadway Worker's Protective Act, Title 49, Part 214, Sub-part C. Railroad protective services will also be performed to insure safe operations of trains when construction work would, in the Railroad's opinion, be a hazard to Railroad operations.

(d) Definition of Hazard – the Railroad has furnished the statements quoted below, explaining when they consider a hazard to operations exists:

"Protective services will be required whenever the Contractor is performing work on or adjacent to the Railroad tracks or right-of-way, such as excavating, sheeting, shoring, erection and removal of forms, handling materials, using equipment which by swinging or by failure could foul the track, and when any other type of work being performed, in the opinion of the Railroad, requires such service."

(e) Contractor Requirements for Work Affecting the Railroad

(1) All matters requiring Railroad Company approval or coordination shall be directed to the Engineer or a duly authorized representative thereof, for forwarding to the Railroad Engineer.

(2) Detailed plans and appurtenant data and calculations for any operation which, in the opinion of the Railroad, affect the Railroad, must be submitted to the Engineer or a duly authorized representative thereof, for forwarding to the Railroad Engineer for approval prior to commencement of the work. All plans and calculations submitted must be stamped by a Connecticut registered Professional Engineer.

(3) Permissible Track Outages - are identified in the NOTICE TO CONTRACTOR – WORK ON RAILROAD PROPERTY contained within the Provisions of the Contract. The times identified are the times that the track may be removed from service. **If power outages are required, the de-energizing/re-energizing and grounding of the wires will subtract approximately forty-five minutes from the start and forty-five minutes at the end of the indicated outage period for a total of up to ninety minutes. Where a substation or anchor bridge outage is required, the de-energizing/re-energizing and grounding will subtract an additional thirty minutes from the start and thirty minutes from the end of the indicated outage period for a total of up to one hundred fifty minutes.**

(4) The Contractor shall maintain a minimum of 1 foot level shoulder from ends of ties to maintain lateral track support for all excavations and shall not excavate any slope steeper than 1 (vertical) on 2 (horizontal) from the edge of the shoulder. Sheeting

shall be required on all excavations where the side of the excavation is intercepted by the Railroad live load influence line. The live load influence line is defined as a line originating at the bottom edge of tie and extending downward at a slope of 1 (vertical) on 1½ (horizontal). Such excavations must be designed to withstand, in addition to all common loads such as soil pressure and hydrostatic pressure, a railroad live load of Cooper E-80.

(5) The Contractor shall be required to design and install protective scaffolding over the right-of-way where, at the sole discretion of the Railroad, such scaffolding is necessary to protect the Railroad from possible falling debris; paint or other materials; to protect personnel working about the right-of-way or to provide a platform for personnel, materials and/or equipment. Said scaffolding shall be designed for live load of 200 pounds per square foot applied uniformly over the entire structure and a 2 kips concentrated load placed anywhere on the structure. The two loads are not to be applied simultaneously for design purposes.

(6) All excavation area shall be located by the Contractor and inspected by the Railroad for the purpose of determining conflicts with underground facilities. Exploratory trenches, a minimum of 3 feet deep and 15 inches wide in the form of an "H" with outside dimensions matching and outside of sheeting dimensions are to be hand dug, as directed by the railroad. In some locations, excavations may exceed 3 feet in depth. Specialty excavations such as screw anchors, cat pole foundations, etc will require additional trenching to ensure all possible conflicts are located. These trenches are for exploratory purposes only and are to be backfilled and compacted immediately. All work outlined above must be done in the presence of a Railroad inspector**.**

(7) Cavities adjacent to sheet piling, created by driving of sheet piling, shall be filled with sand and any distributed ballast must be restored and tampered immediately.

(8) Sheet piling shall be cut off at top of tie during construction and at 3 feet below bottom of tie after construction just prior to completion of back filling.

(9) Plans and calculations for sheeting and scaffolding must be submitted to the Engineer for forwarding to the Railroad for approval prior to construction. Further, plans and calculations must be stamped by a Connecticut registered Professional Engineer.

(f) Requirements for Erection, Demolition and Other Rigging Operations On or Adjacent to Railroad Right-of-Way

The Contractor will be required to furnish the following information to the Engineer or a duly authorized representative thereof, for forwarding to the Railroad Engineer for approval prior to the start of any rigging operation over or adjacent to the Railroad right-of-way:

(1) Plan view showing locations of cranes, boom length and rigging operating radii, with delivery or disposal locations shown.

(2) Crane rating sheets showing crane(s) to be adequate for 150% of the lift. Crane and boom nomenclature is to be indicated.

(3) Plans and computations showing weight of pick.

(4) Location plan showing obstructions, indicating that the proposed swing is possible.

(5) Plans showing locations and details of mats, planking or special decking as may be required by the Railroad.

(6) Written statement from crane owner giving the date of last crane condition and safety inspection and the results of said inspection.

(7) Data sheet listing number, type, size and arrangement of slings, spreader bars or other connecting equipment. Include copies of catalog or information sheets of specialized equipment. All such equipment shall be shown adequate to safely carry 150% of the calculated loading.

(8) A complete procedure is to be included, indicating the order of lifts and repositioning or rehitching of the crane or cranes.

(9) Temporary support of any components or intermediate stages is to be shown.

(10) A time schedule of the various stages must be shown, as well as a schedule for the entire lifting procedure.

(11) All erection, demolition and rigging plans and calculations submitted to the Railroad must be stamped by a Connecticut licensed Professional Engineer.

(12) Operations directly on or adjacent to the operating right-of-way will be performed only at times and under conditions specified by the Railroad's representative.

(g) Ordering Protective Personnel

The Railroad will furnish Protective Service Personnel (conductors, flagmen, groundmen, inspectors, maintenance and/or other railroad personnel deemed necessary) to protect the operation of train traffic during the Contractor's construction activities. Railroad Protective Services will also be provided in conformance with the Roadway Worker's Protective Act as stated in Paragraph 1(c). There will be no charge to the Contractor for Railroad Protective Services provided. The providing or failing to provide Protective Services shall not relieve the Contractor from liability or payment for any damage caused by his or his subcontractor's operations conducted in their absence.

(1) The Contractor must obey all instructions from Railroad representatives on the job

site promptly. Failure to follow instructions shall be deemed sufficient cause for closing the job site to the Contractor and its employees.

(2) The Railroad will, at its sole discretion, determine the need for and the availability of protective personnel. The Railroad will provide protective personnel to the extent possible considering its operational and maintenance priorities. The Railroad does not guarantee that protective personnel will be available to meet the Contractor's preferred schedule. Further, no work will commence until the assigned Railroad representative affirmatively advises the Contractor that the necessary protective personnel are stationed and that he may proceed.

(3) The assessment of the need for protective services will be based upon a weekly Railroad Construction Coordination Meeting. At these meetings, the Contractor shall provide a Bi-weekly Schedule that will begin on the following Saturday. Based on that schedule, the Railroad will determine the Protective Services required for the two-week period. Protective Services will be reserved for the following week beginning on the Saturday and ordered for the second week of the schedule. It will be the Contractor's responsibility to perform work in accordance with the submitted schedule. Variations from the submitted schedule may result in additional and unnecessary costs to the Engineer, Railroad and Contractor.

(A) The Contractor shall base his operations on a 5 consecutive day work week. The hours of operation during this time shall remain constant. Multiple shifts may be worked.

(B) The Contractor must demonstrate maximum use of Protective Service Personnel ordered. Failure to do so may result in the inability to consistently obtain services.

(C) The Contractor shall be responsible for forwarding all Protective Service requests from his subcontractors and suppliers in his Bi-weekly schedule submittal.

(4) Requests to cancel construction activities, and subsequently the scheduled Protective Service Personnel, will be also submitted at the weekly Railroad Construction Coordination Meeting. At these meetings, the previously scheduled Protective Services for the week beginning on the following Saturday may be cancelled. This will be the only time for cancellation. Once cancelled, no re-ordering of Protective Services for the following week will be allowed.

(5) Weather conditions will be considered the only basis upon which the Railroad will accept the Contractor's cancellation of scheduled work and will only be recognized on items of work which have been clearly identified and determined to be weather dependent in the Contractor's schedule. Activities not presented on the Bi-weekly schedule at the weekly Railroad Construction Coordination Meeting will not be able to commence until it has been inserted into the schedule and presented at the next

meeting.

(6) Work that requires the support of Railroad personnel shall not be scheduled on the following days, unless the work is of an emergency nature:

Holiday's Observed:	*Independence Day	*Christmas Day
*New Year's Day	*Labor Day	*New Years Eve
*President's Day	*Thanksgiving Day	
*Good Friday	*Day Following Thanksgiving Day	
*Memorial Day	*Christmas Eve	

*The Saturday and Sunday preceding a Monday holiday.
*The Saturday and Sunday following a Friday holiday.
*The Friday and Monday preceding and following a weekend holiday.

(h) Requirements for Requesting Track Outages

Track outages as described in the plans and specifications must be requested at the weekly Railroad Construction Coordination Meeting.

(1) All procedures, material and equipment must be approved and on site prior to the Railroad accepting the track outage request(s). This applies to all track outage requests.

(2) Track outages will be granted based on need for constructability not for convenience.

(3) The Contractor must demonstrate the maximum use of track outages by coordinating his activities and work so that various elements and multiple activities are performed during approved outages. Failure to consistently utilize track outages may cause the inability to gain approval of future requests for outages.

(4) No new track outages may be initiated the weekend preceding or following these holidays:

Thanksgiving, Christmas and New Years Day.

However, long-term continuous outages may extend through these periods.

(i) Catenary and Transmission Systems/Power Outages

(1) Catenary and Transmission Systems - The Contractor shall assume that all the wires on the Railroad Company are energized at all times and must be governed by the restrictions imposed by the Railroad with respect to such electrical circuits. Should it become necessary, in the opinion of the Railroad Engineer to de-energize any wire or wires to insure safety of operation, such wires will be de-energized by the Railroad only during such period that will not interfere with the

Railroad's operation. When the de-energizing and re-energizing of wires is deemed necessary, a representative of the Power Department of the Railroad must be on duty and present to arrange for the same. He will notify the Contractor in writing when the wires have been de-energized and also when said wires are to be re-energized.

(A) The Contractor is advised that the overhead electrification will remain in place for the duration of the entire project, except where called for on the drawings and in the specifications.

(B) Track rails of the Railroad are energized. Particular care must be taken to see that no contact is made between adjoining rails with any material, which is a good conductor of electricity when dry, or material of any nature when wet. Particular care is necessary when any work involving the use of chains, steel rods, cables, pipes, etc., is done. Since the Contractor shall assume the wires and rails of the Railroad will be energized at all times, the Contractor shall require all of his employees, sub-contractors, and others to sign a form similar to the form shown in the NOTICE TO CONTRACTOR – WORK ON RAILROAD PROPERTY contained within the Provisions of the Contract.

(2) Power Outages

(A) Catenary Power Outages - A catenary power outage must be scheduled concurrently with a track outage for the track and is restricted to the same periods as specified in the plans and specifications.

(B) Railroad Power and Signal Distribution Feeder Outages - Outages for feeders can be allowed only during off-peak hours. These outages should be requested at the weekly Railroad Construction Coordination Meeting. One set of power and signal feeders, either the north or south side of the railroad, must remain energized at all times.

NOTE: During peak hours (5:00 a.m. to 10:00 a.m. and 3:30 p.m. to 10:00 p.m., Monday through Friday) of railroad traffic, both the north and south sets of power and signal feeders must be energized.

(j) Safety for Contractor's Employees Working on or Adjacent to the Right-of-Way of the Railroad

(1) Personal Protection Equipment

(A) Approved hard hats, reflectorized vest and clothing must be worn by all Contractor employees while on the Right-of-Way, in yard, shop facilities, and construction and/or work sites. Approved safety eyewear must be worn by all Contractor employees while on Right-of-Way, in yard, shop facilities and

construction and/or work sites and in the operating control cab of a moving locomotive or train. Any exclusion must be jointly approved by Railroad's department head and Director of Safety.

(B) Other protective equipment such as goggles, face shields, safety belts, floatation vests, gloves and respirators shall be issued by the Contractor when required. Protection devices for hearing conservation may be used when determined necessary and safe to do so.

(2) Possession or Use of Intoxicants and Illegal Substances

The use of intoxicants, alcohol, narcotics, marijuana, amphetamines, hallucinogens or other illegal substances while working within the Railroad Right-of-Way, is prohibited and is sufficient cause for immediate removal from the Railroad property. Contractor employees under medication before or while on duty, must be certain that such use will not affect the safe performance of their duties.

(3) Surveying Equipment

(A) Measuring tape must be non-metallic to avoid shunting the signal system electric circuits. This will occur when a metallic object is laid across the top of two rails of any track.

(B) Electrically rated fiberglass elevation rods must be used to avoid injury in the event contact is made with energized catenary or signal/communication lines. Elevations of catenary wires must be obtained by or under direct supervision of a qualified Railroad Groundman.

(4) Conduct On or About Track

(A) Contractor employees must not enter the track envelope unless it is absolutely necessary in performance of their duty. If it is deemed necessary, than the Contractor employees must walk on tracks or cross tracks only when accompanied by or with permission from a Qualified Railroad Employee of the Railroad. Always use approved walkways when available; otherwise identify and take the shortest safe route after looking in both directions. If more than one track is to be crossed, stop and look before crossing each track.

(B) The possession of an umbrella on or about tracks is prohibited.

(C) Do not rest any object on your shoulder while in close proximity to a moving train or high-rail equipment.

(D) Expect equipment to move on any track, in any direction, at any time. Contractor employees must look in both directions and have permission from a Qualified Railroad Employee before:

1. Fouling track
2. Crossing track
3. Going between or around end of equipment or structure
4. Moving out from between or under equipment of structure
5. Getting on or off equipment
6. Performing any other applicable operation

(E) When required by a conductor/flagman or other Qualified Railroad Employee to vacate tracks, the Contractor employees must comply immediately.

(5) Catenary Electric Systems

(A) All overhead wires must be considered energized (LIVE) at all times except when it is known they have been de-energized and properly grounded.

(B) Until the wires are de-energized, properly grounded, and a Groundman has notified that the overhead wires are such, all Contractor employees must not approach within 10 feet of transmission systems wires, catenary system or signal power wires.

(C) At the beginning of each tour of duty, the Groundman will instruct the Contractor foreman and each Contractor employee, in the crew, of the dangers surrounding them, calling their particular attention to any hazards to be avoided in performance of the work.

(D) Whether due to inadequate knowledge of the English language or for any other reason, a Contractor employee who, in the opinion of the Groundman, does not understand the instructions given, shall not be permitted to work or observe.

(E) When clearances have been obtained and the wires, equipment or apparatus properly grounded, the Groundman will indicate to the Contractor foreman and the crew the location of wires, equipment or apparatus from which power has been removed and the location of the grounding devices applied. The Groundman must obtain on standard form, the signature of the Contractor foreman indicating that he and the crew have been so instructed, and will confine their work within the limits as outlined to them by the Groundman.

(F) When the Groundman leaves his crew for any reason, he must notify the Contractor foreman and each person in the crew to stop all work in the vicinity of the wires, personally assuring himself that all persons have moved to a safe distance away from the work area before his departure. The Groundman will obtain the signature of the Contractor foreman on standard form, that he and the crew have been informed that the Groundman is leaving the gang and they will not resume work until advised to do so on return of the Groundman.

(G) When the clearances are to be released, the Groundman will inform the Contractor foreman and each person in the crew and will personally observe that all persons have moved to a safe distance from the wires, equipment or apparatus to be energized, before removing the grounding devices. The Groundman will obtain the signature of the Contractor foreman, on a standard form, stating that he and the gang have been advised that the wires, equipment or apparatus have been energized, and that they will remain at a safe distance from them until informed otherwise by the Groundman.

(H) The Groundman will inform the Contractor foreman if any Contractor employee on the job is unsafe and will not comply with instructions. If trouble is experienced with the Contractor foreman in maintaining safe working conditions, the Groundman will immediately notify his supervisor.

(6) Aerial Catenary Construction by Qualified Contractor Employees

No Catenary Construction is included in State Project No. 300-0178.

(7) Safety Program and Plan

(A) Prior to the commencement of work the Contractor shall submit a "Working on the Railroad Safety Plan" that will include a Program which implements the plan. The submission shall be made to the Engineer or a duly authorized representative and forwarded to the Railroad for compliance with this specification. This plan is separate to the Health and Safety Plan required for other aspects of the project (i.e., lead, excavations, etc.).

(B) Each employee of the Contractor, subcontractor or others on site shall be given an initial Railroad Safety Training session administered by a Railroad Safety Representative prior to being allowed to work on the project. All employees receiving this training will receive a Registered Hard Hat sticker that will identify them as a trained employees. No Contractor employees are permitted on the Railroad Right-of-Way without evidence of this training. Contractor employees shall renew this training annually. The training session will be held on the Railroad Right of Way or conducted at a location mutually agreed upon between the Railroad Safety Representative and the Contractor. At this session the following will be furnished to the employee:

1. Safety Orientation for Contractor Employees Working on Railroad Property produced by the Safety Engineer of the Railroad.
2. Safety Inspection Checklist
3. List of the applicable publications referenced in these specifications with respect to safety and where they are located for review if necessary. The list shall include, but not be limited to, such regulatory standards and mandates, i.e., OSHA, NIOSH, DOL, NFPA, EPA, FRA, MSDS, etc.
4. Copy of the applicable corporate safety plan.

5. Copy of the project Railroad Safety Plan or other project related plans.

NOTE: The employee shall sign the standard form for acknowledgement of the above-noted documents.

(C) All contractor employees entering the railroad right-of-way must attend and acknowledge the daily job briefings prior to commencing any work. The qualified railroad employees will conduct the job briefings.

(D) The Contractor shall hold "TOOL BOX" safety meetings for their employees at least once a week that will be documented and attendees listed.

(E) The Contractor supervisor shall attend a monthly Railroad Safety Meeting.

SECTION 1.06 – CONTROL OF MATERIALS

Article 1.06.07 - Certified Test Reports and Materials Certificates:

Add the following:

1) For the materials in all the contract items with the exception of the following items, a Certified Test Report will be required confirming their conformance to the requirements set forth in these plans or specifications or both. Should the consignee noted on a Certified Test Report be other than the Prime Contractor, then Materials Certificates shall be required to identify the shipment.

2) For the materials in all the contract items with the exception of the following items, a Materials Certificate will be required confirming their conformance to the requirements set forth in these plans or specifications or both.

The following contract items do not require Certified Test Report or Materials Certificates:

0100426A	Water Transportation for Rescue Operations
0969000A	Project Coordinator (Minimum Bid)
0970006A	Traffic Person
0201001	Clearing and Grubbing
1008908A	Clean Existing Conduit/Duct
1108659A	Netboss Integration
1108672A	Cisco Professional Services
1108868A	CCTV Workstation Software Licenses
1108881A	Video Management System Software Licenses
1112244A	Removal, Storage and Transfer of CCTV Equipment
1113912A	Install Existing Fiber Cables through Conduits
1206036A	Remove and Relocate Sign
1108882A	Video Management System Support Services

SECTION 1.07 – LEGAL RELATIONS AND RESPONSIBILITIES

Article 1.07.10 - Contractor's Duty to Indemnify the State against Claims for Injury or Damage:

Add the following after the only paragraph:

"It is further understood and agreed by the parties hereto, that the Contractor shall not use the defense of Sovereign Immunity in the adjustment of claims or in the defense of any suit, including any suit between the State and the Contractor, unless requested to do so by the State."

SECTION 1.08 – PROSECUTION AND PROGRESS

Article 1.08.07 - Determination of Contract Time:

Delete the second, third and fourth paragraphs and replace them with the following:

When the contract time is on a calendar day basis, it shall be the number of consecutive calendar days stated in the contract, INCLUDING the time period from December 1 through March 31 of each year. The contract time will begin on the effective date of the Engineer's order to commence work, and it will be computed on a consecutive day basis, including all Saturdays, Sundays, Holidays, and non-work days.

1.08.08 - Extension of Time:

Delete the last paragraph, "If an approved extension of time…. the following April 1".

Article 1.08.09 - Failure to Complete Work on Time:

Delete the second paragraph, "If the last day...the project is substantially completed" *and replace it with* "Liquidated damages as specified in the Contract shall be assessed against the Contractor per calendar day from that day until the date on which the project is substantially completed.".

SECTION 4.06 BITUMINOUS CONCRETE

Section 4.06 is being deleted in its entirety and replaced with the following:

4.06.01—Description
4.06.02—Materials
4.06.03—Construction Methods
4.06.04—Method of Measurement
4.06.05—Basis of Payment

4.06.01—Description: Work under this section shall include the production, delivery and placement of a non-segregated, smooth and dense bituminous concrete mixture brought to proper grade and cross section. This section shall also include the method and construction of longitudinal joints. The Contractor shall furnish ConnDOT with a Quality Control Plan (QCP) as described in Article 4.06.03.

The terms listed below as used in this specification are defined as:

Bituminous Concrete: A concrete material that uses a bituminous material (typically asphalt) as the binding agent and stone and sand as the principal aggregate components. Bituminous concrete may also contain any of a number of additives engineered to modify specific properties and/or behavior of the concrete material. For the purposes of this Specification, references to bituminous concrete apply to all of its sub-categories, for instance those defined on the basis of production and placement temperatures, such as hot-mix asphalt (HMA) or warm-mix asphalt (WMA), or those defined on the basis of composition, such as those containing polymer-modified asphalt (PMA).

Course: A lift or multiple lifts comprised of the same bituminous concrete mixture placed as part of the pavement structure.

Density Lot: All material placed in a single lift and as defined in Article 4.06.03.

Disintegration: Wearing away or fragmentation of the pavement. Disintegration will be evident in the following forms: Polishing, weathering-oxidizing, scaling, spalling, raveling, potholes or loss of material.

Dispute Resolution: A procedure used to resolve conflicts resulting from discrepancies between the Engineer and the Contractor's density results that may affect payment.

Hot Mix Asphalt (HMA): A bituminous concrete mixture typically produced at 325°F.

Lift: An application of a bituminous concrete mixture placed and compacted to a specified thickness in a single paver pass.

Polymer Modified Asphalt (PMA): A bituminous concrete mixture containing a polymer modified asphalt binder in accordance with contract specifications. All PMA mixtures shall incorporate a qualified warm mix technology.

Production Lot: All material placed during a continuous daily paving operation.

Quality Assurance (QA): All those planned and systematic actions necessary to provide confidence that a product or facility will perform as designed.

Quality Control (QC): The sum total of activities performed by the vendor (Producer, Manufacturer, and Contractor) to ensure that a product meets contract specification requirements.

Superpave: A bituminous concrete mix design used in mixtures designated as "S*" Where "S" indicates Superpave and * indicates the sieve related to the nominal maximum aggregate size of the mix.

Segregation: A non-uniform distribution of a bituminous concrete mixture in terms of gradation, temperature, or volumetric properties.

Warm Mix Asphalt (WMA): A bituminous concrete mixture that can be produced and placed at reduced temperatures than HMA using a qualified additive or technology.

4.06.02—Materials: All materials shall conform to the requirements of Section M.04.

1. Materials Supply: The bituminous concrete mixture must be from one source of supply and originate from one Plant unless authorized by the Engineer. Bituminous Concrete plant QCP requirements are defined in Section M.04.

2. Recycled Materials: Reclaimed Asphalt Pavement (RAP), Crushed Recycled Container Glass (CRCG), Recycled Asphalt Shingles (RAS), or crumb rubber (CR) from recycled tires may be incorporated in bituminous concrete mixtures in accordance with Section M.04 and Project Specifications. CRCG and RAS shall not be used in the surface course.

4.06.03—Construction Methods:

1. Material Documentation: All vendors producing bituminous concrete must have their truck-weighing scales, storage scales, and mixing plant automated to provide a detailed ticket.

Delivery tickets shall include the following information:

a. State of Connecticut printed on ticket.
b. Name of producer, identification of plant, and specific storage bin (silo) if used.
c. Date and time of day.

d. Mixture Designation; Mix type and level Curb mixtures for machine-placed curbing must state "curb mix only".
e. If RAP is used, the plant printouts shall include the RAP dry weight, percentage and daily moisture content.
f. If RAS is used, the plant printouts shall include the RAS dry weight and percentage daily moisture content.
g. The delivery ticket for all mixes produced with Warm Mix Technology must indicate the additive name, and the injection rate (water or additive) incorporated at the HMA plant. The delivery ticket for all mixes produced with pre-blended WMA additive must indicate the name of the WMA Technology.
h. Net weight of mixture loaded into truck (When RAP and/or RAS is used the moisture content shall be excluded from mixture net weight).
i. Gross weight (Either equal to the net weight plus the tare weight or the loaded scale weight).
j. Tare weight of truck – Daily scale weight.
k. Project number, purchase order number, name of Contractor (if Contractor other than Producer).
l. Truck number for specific identification of truck.
m. Individual aggregate, Recycled Materials, and virgin asphalt high/target/low weights. For drum plants and silo loadings, the plant printouts shall be produced at 5 minute intervals maintained by the vendor for a period of three years after the completion of the project.
n. For every mixture designation the running daily total delivered and sequential load number.

The net weight of mixture loaded into the truck must be equal to the cumulative measured weight of its components.

The Contractor must notify the Engineer immediately if, during the production day, there is a malfunction of the weighing or recording system in the automated plant or truck-weighing scales. Manually written tickets containing all required information will be allowed for one hour, but for no longer, provided that each load is weighed on State-approved scales. At the Engineer's sole discretion, trucks may be approved to leave the plant if a State inspector is present to monitor weighing. If such a malfunction is not fixed within forty-eight hours, mixture will not be approved to leave the plant until the system is fixed to the Engineer's satisfaction. No damages will be considered should the State be unable to provide an inspector at the plant.

The State reserves the right to have an inspector present to monitor batching and /or weighing operations.

2. Transportation of Mixture: Trucks with loads of bituminous concrete being delivered to State projects must not exceed the statutory or permitted load limits referred to as gross vehicle weight (GVW). The Contractor shall furnish a list of all vehicles and allowable weights transporting mixture.

The State reserves the right to check the gross and tare weight of any delivery truck. A variation of 0.4 percent or less in the gross or tare weight shown on the delivery ticket and the certified scale weight shall be considered evidence that the weight shown on the delivery ticket is correct. If the gross or tare weight varies from that shown on the delivery ticket by more than 0.4 percent, the Engineer will recalculate the net weight. The Contractor shall take action to correct discrepancy to the satisfaction of the Engineer.

If a truck delivers mixture to the project and the ticket indicates that the truck is overweight, the load will not be rejected but a "Measured Weight Adjustment" will be taken in accordance with Article 4.06.04.

The mixture shall be transported from the mixing plant in trucks that have previously been cleaned of all foreign material and that have no gaps through which mixture might inadvertently escape. The Contractor shall take care in loading trucks uniformly so that segregation is minimized. Loaded trucks shall be tightly covered with waterproof covers acceptable to the Engineer. Mesh covers are prohibited. The front and rear of the cover must be fastened to minimize air infiltration. The Contractor shall assure that all trucks are in conformance with this specification. Trucks found not to be in conformance shall not be allowed to be loaded until re-inspected to the satisfaction of the Engineer.

Truck body coating and cleaning agents must not have a deleterious effect on the transported mixture. The use of solvents or fuel oil, in any concentration, is strictly prohibited for the coating of the inside of truck bodies. When acceptable coating or agents are applied, truck bodies shall be raised immediately prior to loading to remove any excess agent in an environmentally acceptable manner.

3. Paving Equipment: The Contractor shall have the necessary paving and compaction equipment at the project site to perform the work. All equipment shall be in good working order and any equipment that is worn, defective or inadequate for performance of the work shall be repaired or replaced by the Contractor to the satisfaction of the Engineer. During the paving operation, the use of solvents or fuel oil, in any concentration, is strictly prohibited as a release agent or cleaner on any paving equipment (i.e., rollers, pavers, transfer devices, etc.).

Refueling of equipment is prohibited in any location on the paving project where fuel might come in contact with bituminous concrete mixtures already placed or to be placed. Solvents for use in cleaning mechanical equipment or hand tools shall be stored clear of areas paved or to be paved. Before any such equipment and tools are cleaned, they shall be moved off the paved or to be paved area; and they shall not be returned for use until after they have been allowed to dry.

Pavers: Each paver shall have a receiving hopper with sufficient capacity to provide for a uniform spreading operation and a distribution system that places the mix uniformly, without segregation. The paver shall be equipped with and use a vibratory screed system with heaters or burners. The screed system shall be capable of producing a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. Pavers with extendible

screed units as part of the system shall have auger extensions and tunnel extenders as necessary. Automatic screed controls for grade and slope shall be used at all times unless otherwise authorized by the Engineer. The controls shall automatically adjust the screed to compensate for irregularities in the preceding course or existing base. The controls shall maintain the proper transverse slope and be readily adjustable, and shall operate from a fixed or moving reference such as a grade wire or floating beam.

Rollers: All rollers shall be self-propelled and designed for compaction of bituminous concrete. Rollers types shall include steel-wheeled, pneumatic or a combination thereof and may be capable of operating in a static or dynamic mode. Rollers that operate in a dynamic mode shall have drums that use a vibratory or oscillatory system or combination of. The vibratory system achieves compaction through vertical amplitude forces. Rollers with this system shall be equipped with indicators that provide the operator with amplitude, frequency and speed settings/readouts to measure the impacts per foot during the compaction process. The oscillatory system achieves compaction through horizontal shear forces. Rollers with this system shall be equipped with frequency indicators. Rollers can operate in the dynamic mode using the oscillatory system on concrete structures such as bridges and catch basins if at the lowest frequency setting.

Pneumatic tire rollers shall be self-propelled and equipped with wide-tread compaction tires capable of exerting an average contact pressure from 60 to 90 pounds per square inch uniformly over the surface, adjusting ballast and tire inflation pressure as required. The Contractor shall furnish evidence regarding tire size; pressure and loading to confirm that the proper contact pressure is being developed and that the loading and contact pressure is uniform for all wheels.

Lighting: For paving operations, which will be performed during hours of darkness, the paving equipment shall be equipped with lighting fixtures as described below, or with approved lighting fixtures of equivalent light output characteristics. Lighting shall maximize the illumination on each task and minimize glare to passing traffic. The Contractor shall provide generators on rollers and pavers of the type, size, and wattage, to adequately furnish electric power to operate the specified lighting equipment. The lighting options and minimum number of fixtures are listed in Tables 4.06-1 and 4.06-2:

TABLE 4.06-1: Paver Lighting

Option	Fixture Configuration	Fixture Quantity	Requirement
1	Type A	3	Mount over screed area
	Type B (narrow) or Type C (spot)	2	Aim to auger and guideline
	Type B (wide) or Type C (flood)	2	Aim 25 feet behind paving machine
2	Type D Balloon	2	Mount over screed area

TABLE 4.06-2: Roller Lighting

Option	Fixture Configuration*	Fixture Quantity	Requirement
1	Type B (wide)	2	Aim 50 feet in front of and behind roller
	Type B (narrow)	2	Aim 100 feet in front of and behind roller
2	Type C (flood)	2	Aim 50 feet in front of and behind roller
	Type C (spot)	2	Aim 100 feet in front of and behind roller
3	Type D Balloon	1	Mount above the roller

*All fixtures shall be mounted above the roller.

Type A: Fluorescent fixture shall be heavy-duty industrial type. Each fixture shall have a minimum output of 8,000 lumens. The fixtures shall be mounted horizontally, and be designed for continuous row installation.

Type B: Each floodlight fixture shall have a minimum output of 18,000 lumens.

Type C: Each fixture shall have a minimum output of 19,000 lumens.

Type D: Balloon light: Each balloon light fixture shall have a minimum output of 50,000 lumens, and emit light equally in all directions.

Material Transfer Vehicle (MTV): A MTV shall be used when placing a bituminous concrete surface course as indicated in the contract documents. A surface course is defined as the total thickness of the same bituminous concrete mix that extends up to and includes the final wearing surface whether it is placed in a single or multiple lifts, and regardless of any time delays between lifts.

The MTV must be a self-propelled vehicle specifically designed for the purpose of delivering the bituminous concrete mixture from the delivery truck to the paver. The MTV must continuously remix the bituminous concrete mixture throughout the placement process.

The use of a MTV will be subject to the requirements stated in Article 1.07.05- Load Restrictions. The Engineer may limit the use of the vehicle if it is determined that the use of the MTV may damage highway components, utilities, or bridges. The Contractor shall submit to the Engineer at time of pre-construction the following information:

- The make and model of the MTV to be used.
- The individual axle weights and axle spacing for each separate piece of paving equipment (haul vehicle, MTV and paver).
- A working drawing showing the axle spacing in combination with all three pieces of equipment that will comprise the paving echelon.

4. Test Section: The Engineer may require the Contractor to place a test section whenever the requirements of this specification or Section M.04 are not met.

The Contractor shall submit the quantity of mixture to be placed and the location of the test section for review and acceptance by the Engineer. The equipment used in the construction of a passing test section shall be used throughout production.

If a test section fails to meet specifications, the Contractor shall stop production, make necessary adjustments to the job mix formula, plant operations, or procedures for placement and compaction. The Contractor shall construct test sections, as allowed by the Engineer, until all the required specifications are met. All test sections shall also be subject to removal as set forth in Article 1.06.04.

5. Transitions for Roadway Surface: Transitions shall be formed at any point on the roadway where the pavement surface deviates, vertically, from the uniform longitudinal profile as specified on the plans. Whether formed by milling or by bituminous concrete mixture, all transition lengths shall conform to the criteria below unless otherwise specified.

Permanent Transitions: A permanent transition is defined as any transition that remains as a permanent part of the work. All permanent transitions, leading and trailing ends shall meet the following length requirements:

a) Posted speed limit is greater than 35 MPH: 30 feet per inch of vertical change (thickness)
b) Posted speed limit is 35 MPH or less: 15 feet per inch of vertical change (thickness).
c) Bridge Overpass and underpass transition length will be 75 feet either
    (1) Before and after the bridge expansion joint, or
    (2) Before or after the parapet face of the overpass.

In areas where it is impractical to use the above described permanent transition lengths the use of a shorter permanent transition length may be permitted when approved by the Engineer.

Temporary Transitions: A temporary transition is defined as a transition that does not remain a permanent part of the work. All temporary transitions shall meet the following length requirements:

a) Posted speed limit is greater than 50 MPH
    (1) Leading Transitions = 15 feet per inch of vertical change (thickness)
    (2) Trailing Transitions = 6 feet per inch of vertical change (thickness)
b) Posted speed limit is 40, 45, or 50 MPH
    (1) Leading and Trailing = 4 feet per inch of vertical change (thickness)
c) Posted speed limit is 35 MPH or less
    (1) Leading and Trailing = 3 feet per inch of vertical change (thickness)

Note: Any temporary transition to be in-place over the winter shutdown period or during extended periods of inactivity (more than 14 calendar days) shall conform to the greater than 50 MPH requirements shown above.

6. Spreading and Finishing of Mixture: Prior to the placement of the bituminous concrete, the underlying base course shall be brought to the plan grade and cross section within the allowable tolerance. Immediately before placing the mixture, the area to be surfaced shall be cleaned by sweeping or by other means acceptable to the Engineer. The bituminous concrete mixture shall not be placed whenever the surface is wet or frozen. The Engineer will verify the mix temperature by means of a probe or infrared type of thermometer. A probe type thermometer, verified by the Department on an annual basis, must be used in order to reject a load of mixture based on temperatures outside the range stated in the placement QCP.

Placement: The bituminous concrete mixture shall be placed and compacted to provide a smooth, dense surface with a uniform texture and no segregation at the specified thickness and dimensions indicated in the plans and specifications.

When unforeseen weather conditions prevent further placement of the mix, the Engineer is not obligated to accept or place the bituminous concrete mixture that is in transit from the plant.

In advance of paving, traffic control requirements shall be set up daily, maintained throughout placement, and shall not be removed until all associated work including density testing is completed.

The Contractor shall inspect the newly placed pavement for defects in the mixture or placement before rolling is started. Any deviation from standard crown or section shall be immediately remedied by placing additional mixture or removing surplus mixture. Such defects shall be corrected to the satisfaction of the Engineer.

Where it is impractical due to physical limitations to operate the paving equipment, the Engineer may permit the use of other methods or equipment. Where hand spreading is permitted, the mixture shall be placed by means of suitable shovels and other tools, and in a uniformly loose layer at a thickness that will result in a completed pavement meeting the designed grade and elevation.

Placement Tolerances: Each lift of bituminous concrete placed at a uniform specified thickness shall meet the following requirements for thickness and area. Any pavement exceeding these limits shall be subject to an adjustment or removal. Lift tolerances will not relieve the Contractor from meeting the final designed grade. Lifts of specified non-uniform thickness, i.e. wedge or shim course, shall not be subject to thickness and area adjustments.

a) Thickness- Where the total thickness of the lift of mixture exceeds that shown on the plans beyond the tolerances shown in Table 4.06-3, the longitudinal limits of such variation including locations and intervals of the measurements will be documented by the Engineer for use in calculating an adjustment in accordance with Article 4.06.04.

TABLE 4.06-3: Thickness Tolerances

Mixture Designation	Lift Tolerance
S1	+/- ⅜ inch
S0.25, S0.375, S0.5	+/- ¼ inch

Where the thickness of the lift of mixture is less than that shown on the plans beyond the tolerances shown in Table 4.06-3, the Contractor, with the approval of the Engineer, shall take corrective action in accordance with this specification.

b) Area- Where the width of the lift exceeds that shown on the plans by more than the specified thickness of each lift, the longitudinal limits of such variation including locations and intervals of the measurements will be documented by the Engineer for use in calculating the adjustment in Article 4.06.04.

c) Delivered Weight of Mixture - When the delivery ticket shows that the truck exceeds the allowable gross weight for the vehicle type the quantity of tons representing the overweight amount will be documented by the Engineer for use in calculating an adjustment in accordance with Article 4.06.04.

Transverse Joints: All transverse joints shall be formed by saw-cutting a sufficient distance back from the previous run, existing bituminous concrete pavement or bituminous concrete driveways to expose the full thickness of the lift. A brush of tack coat shall be used on any cold joint immediately prior to additional bituminous concrete mixture being placed.

Tack Coat Application: Immediately before application, the area to be tacked shall be cleaned by sweeping or by other means acceptable to the Engineer. A thin uniform coating of tack coat shall be applied to the pavement immediately before overlaying and be allowed sufficient time to break (set) prior to any paving equipment or haul vehicles driving on it. All surfaces in contact with the bituminous concrete that have been in place longer than 3 calendar days shall have an application of tack coat. The tack coat shall be applied by a non-gravity pressurized spray system that results in uniform overlapping coverage at an application rate of 0.03 to 0.05 gallons per square yard for a non-milled surface and an application rate of 0.05 to 0.07 gallons per square yard for a milled surface. For areas where both milled and un-milled surfaces occur, the tack coat shall be an application rate of 0.03 to 0.05 gallons per square yard. The Engineer must approve the equipment and the method of measurement prior to use. The material for tack coat shall not be heated in excess of 160°F and shall not be further diluted.

Compaction: The Contractor shall compact the mixture to meet the density requirements as stated in Article 4.06.03 and eliminate all roller marks without displacement, shoving, cracking, or aggregate breakage.

When placing a lift with a specified thickness less than one and one-half (1 ½) inches, or a wedge course, the Contractor shall provide a minimum rolling pattern as determined by the development of a compaction curve. The procedure to be used shall be documented in the Contractor's QCP for placement and demonstrated on the first day of placement.

The use of the vibratory system on concrete structures is prohibited. When approved by the Engineer, the Contractor may operate a roller using an oscillatory system at the lowest frequency setting.

If the Engineer determines that the use of compaction equipment in the dynamic mode may damage highway components, utilities, or adjacent property, the Contractor shall provide alternate compaction equipment. The Engineer may allow the Contractor to operate rollers in the dynamic mode using the oscillatory system at the lowest frequency setting.

Rollers operating in the dynamic mode shall be shut off when changing directions.

These allowances will not relieve the Contractor from meeting pavement compaction requirements.

Surface Requirements: The pavement surface of any lift shall meet the following requirements for smoothness and uniformity. Any irregularity of the surface exceeding these requirements shall be corrected by the Contractor.

a) Smoothness- Each lift of the surface course shall not vary more than ¼ inch from a Contractor-supplied 10 foot straightedge. For all other lifts of bituminous concrete, the tolerance shall be ⅜ inch. Such tolerance will apply to all paved areas.

b) Uniformity- The paved surface of the mat and joints shall not exhibit segregation, rutting, cracking, disintegration, flushing or vary in composition as determined by the Engineer.

7. Longitudinal Joint Construction Methods: The Contractor shall use Method I- Notched Wedge Joint (see Figure 4.06-1) when constructing longitudinal joints where lift thicknesses are between 1½ and 3 inches, except for S1mixes. Method II Butt Joint (see Figure 4.06-2) shall be used for lifts less than 1½ inches or greater than 3 inches, and S1mixes. During placement of multiple lifts of bituminous concrete, the longitudinal joint shall be constructed in such a manner that it is located at least 6 inches from the joint in the lift immediately below. The joint in the final lift shall be at the centerline or at lane lines. Each longitudinal joint shall maintain a consistent offset from the centerline of the roadway along its entire length. The difference in elevation between the two faces of any completed longitudinal joint shall not exceed ¼ of an inch in any location.

Method I - Notched Wedge Joint:

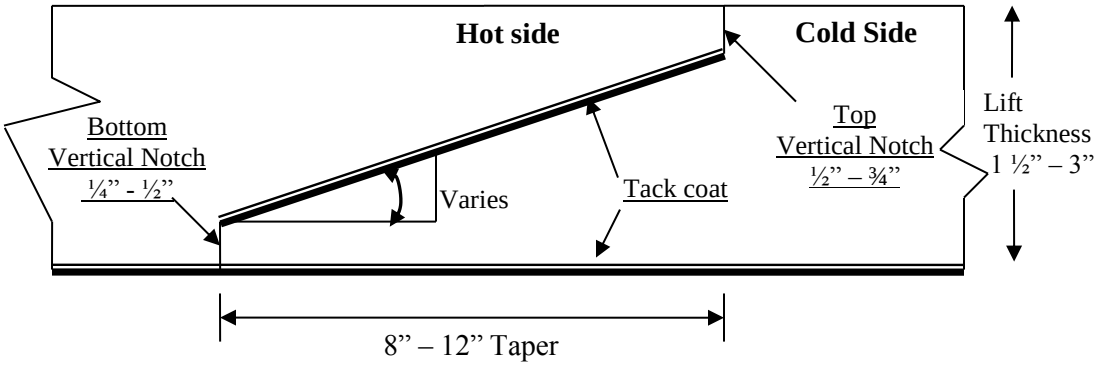

FIGURE 4.06-1: Notched Wedge Joint

A notched wedge joint shall be constructed as shown in Figure 4.06-1 using a device that is attached to the paver screed and is capable of independently adjusting the top and bottom vertical notches. The device shall have an integrated vibratory system.

The taper portion of the wedge joint must be placed over the longitudinal joint in the lift immediately below. The top vertical notch must be located at the centerline or lane line in the final lift. The requirement for paving full width "curb to curb" as described in Method II may be waived if addressed in the QC plan and approved by the Engineer.

The taper portion of the wedge joint shall be evenly compacted using equipment other than the paver or notch wedge joint device.

The taper portion of the wedge joint shall not be exposed to traffic for more than 5 calendar days.

The pavement surface under the wedge joint must have an application of tack coat material. Prior to placing the completing pass (hot side), an application of tack coat must be applied to the exposed surface of the tapered section; regardless of time elapsed between paver passes. The in-place time allowance described in Sub article 4.06.03-7 does not apply to joint construction.

Any exposed wedge joint must be located to allow for the free draining of water from the road surface.

The Engineer reserves the right to define the paving limits when using a wedge joint that will be exposed to traffic.

If Method I, Notched Wedge Joint cannot be used on lifts between 1.5 and 3 inches, Method III Butt Joint may be substituted according to the requirements below for "Method III – Butt Joint with Hot Pour Rubberized Asphalt Treatment."

Method II - Butt Joint:

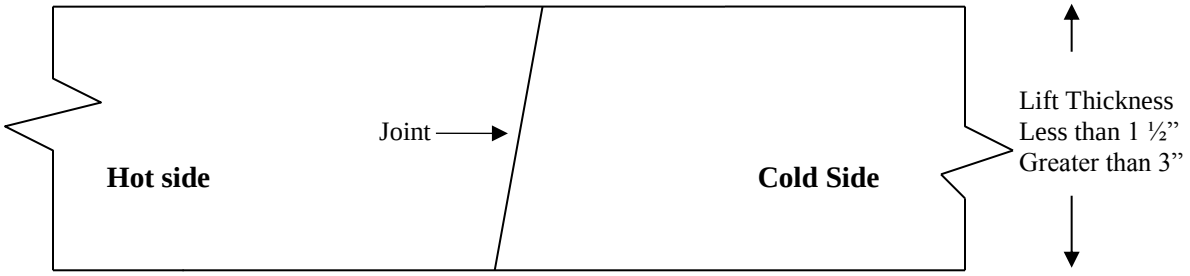

FIGURE 4.06-2: Butt Joint

When adjoining passes are placed, the Contractor shall utilize equipment that creates a near vertical edge (refer to Figure 4.06-2). The completing pass (hot side) shall have sufficient mixture so that the compacted thickness is not less than the previous pass (cold side). The end gate on the paver should be set so there is an overlap onto the cold side of the joint.

The Contractor shall not allow any butt joint to be incomplete at the end of a work shift unless otherwise allowed by the Engineer. When using this method, the Contractor is not allowed to leave a vertical edge exposed at the end of a work shift and must complete paving of the roadway full width "curb to curb."

Method III- Butt Joint with Hot Poured Rubberized Asphalt Treatment: If Method I Wedge Joint cannot be used due to physical constraints in certain limited locations; the contractor may submit a request in writing for approval by the Engineer, to utilize Method III Butt Joint as a substitution in those locations. There shall be no additional measurement or payment made when the Method III Butt Joint is substituted for the Method I Notched Wedge Joint. When required by the contract or approved by the Engineer, Method III (see Figure 4.06-3) shall be used.

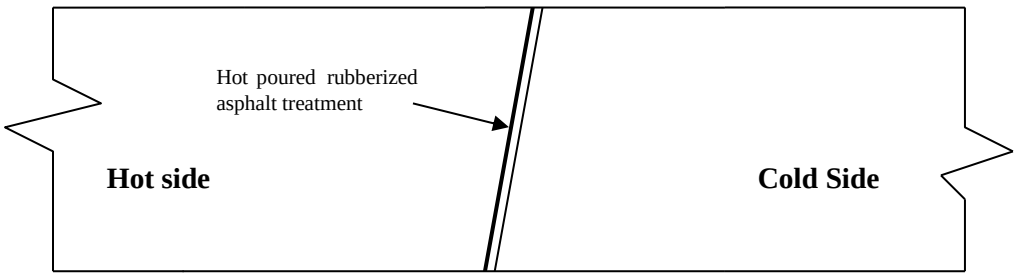

FIGURE 4.06-3: Butt Joint with Hot Poured Rubberized Asphalt Treatment

All of the requirements of Method II must be met with Method III. In addition, the longitudinal vertical edge must be treated with a rubberized joint seal material meeting the requirements of ASTM D 6690, Type 2. The joint sealant shall be placed on the face of the "cold side" of the butt joint as shown above prior to placing the "hot side" of the butt joint. The joint seal material

shall be applied in accordance with the manufacturer's recommendation so as to provide a uniform coverage and avoid excess bleeding onto the newly placed pavement.

8. Contractor Quality Control (QC) Requirements:

The Contractor shall be responsible for maintaining adequate quality control procedures throughout the production and placement operations. Therefore, the Contractor must ensure that the materials, mixture and work provided by Subcontractors, Suppliers and Producers also meet contract specification requirements.

This effort must be documented in Quality Control Plans and address the actions, inspection, or sampling and testing necessary to keep the production and placement operations in control, to determine when an operation has gone out of control and to respond to correct the situation in a timely fashion.

The Standard QCP for production shall consist of the quality control program specific to the production facility.

There are three components to the QCP for placement: a Standard QCP, a Project Summary Sheet that details project specific information, and if applicable a separate Extended Season Paving Plan as required in Section 9 "Temperature and Seasonal Requirements".

The Standard QCP for both production and placement shall be submitted to the Department for approval each calendar year and.at a minimum of 30 days prior to production or placement.

Production or placement shall not occur until all QCP components have been approved by the Engineer.

Each QCP shall include the name and qualifications of a Quality Control Manager (QCM). The QCM shall be responsible for the administration of the QCP, and any modifications that may become necessary. The QCM shall have the ability to direct all Contractor personnel on the project during paving operations. All Contractor sampling, inspection and test reports shall be reviewed and signed by the QCM prior to submittal to the Engineer. The QCPs shall also include the name and qualifications of any outside testing laboratory performing any QC functions on behalf of the Contractor.

Approval of the QCP does not relieve the Contractor of its responsibility to comply with the project specifications. The Contractor may modify the QCPs as work progresses and must document the changes in writing prior to resuming operations. These changes include but are not limited to changes in quality control procedures or personnel. The Department reserves the right to deny significant changes to the QCPs.

QCP for Production: Refer to Section M.04.03-1.

QCP for Placement: The Standard QCP, Project Summary Sheet, and Extended Season Paving Plan shall conform to the format provided by the Engineer. The format is available at http://www.ct.gov/dot/lib/dot/documents/dconstruction/pat/qcp_outline_hma_placement.pdf.

The Contractor shall perform all quality control sampling and testing, provide inspection, and exercise management control to ensure that bituminous concrete placement conforms to the requirements as outlined in its QCP during all phases of the work. The Contractor shall document these activities for each day of placement.

The Contractor shall submit complete field density testing and inspection records to the Engineer within 48 hours in a manner acceptable to the Engineer.

The Contractor may obtain one (1) mat core and one (1) joint core per day for process control, provided this process is detailed in the QCP. The results of these process control cores shall not be used to dispute the Department determinations from the acceptance cores. The Contractor shall submit the location of each process control core to the Engineer for approval prior to taking the core. The core holes shall be filled to the same requirements described in Sub article 4.06.03-10.

9. Temperature and Seasonal Requirements: Paving, including placement of temporary pavements, shall be divided into two seasons, "In-Season" and "Extended-Season". In-Season paving occurs from May 1 – October 14, and Extended Season paving occurs from October 15-April 30. The following requirements shall apply unless otherwise authorized or directed by the Engineer:

- Bituminous concrete mixes shall not be placed when the air or sub base temperature is below 40°F regardless of the season.
- Should paving operations be scheduled during the Extended Season, the Contractor must submit an Extended Season Paving Plan for the project that addresses minimum delivered mix temperature considering WMA, PMA or other additives, maximum paver speed, enhanced rolling patterns and the method to balance mixture delivery and placement operations. Paving during Extended Season shall not commence until the Engineer has approved the plan.

10. Density Testing of Bituminous Concrete Utilizing Core Samples: This procedure describes the frequency and the method the Contractor shall use to obtain pavement cores for acceptance from the project.

Coring shall be performed on each lift specified to a thickness of one and one-half (1 ½) inches or more. All material placed in a lift shall be compacted to the degree specified in Tables 4.06-9 and 4.06-10. The density of each core will be determined using the production lot's average maximum theoretical specific gravity (Gmm) established during the testing of the parent material at the plant. When there was no testing of the parent material or any Gmm exceeds the specified tolerances in the Department's current QA Program for Materials, the Engineer will determine

the maximum theoretical density value to be used for density calculations. Bituminous concrete HMA S1 mixes are excluded from the longitudinal joint density requirements.

The Contractor shall extract cores (4 or 6 inch diameter for S0.25, S0.375 and S0.5 mixes, 6 inch diameter for S1.0 mixtures -wet sawed) from sampling locations determined by the Engineer. The Engineer must witness the extraction and labeling of cores, as well as the filling of the core holes. The cores shall be labeled by the Contractor with the project number, lot number, and sub-lot number on the top surface of the core. When labeling the core lot number, include whether the core is from a mat lot or joint lot by using an "M" for a mat core and "J" for a joint core. For example, a core from the first sub-lot of the first mat lot shall be labeled with "Lot M1 – 1". The first number refers to the lot and the second number refers to the sub-lot. Refer to Figure 4.06-4. The side of the cores shall be labeled with the core lot number and date placed. The project inspector shall fill out a MAT-109 containing the same information to accompany the cores. The Contractor shall deliver the cores and MAT-109 to the Department's Central Testing Lab in a safe manner to ensure no damage occurs to the cores. The Contractor shall use a container approved by the Engineer. In general the container shall consist of an attached lid container made out of plastic capable of being locked shut and tamper proof. The Contractor shall use foam, bubble wrap, or another suitable material to prevent the cores from being damaged during transportation. Once the cores and MAT-109 are in the container the Engineer will secure the lid using a security seal. The security seal's identification number must be documented on the MAT-109. The Central Lab will break the security seal and take possession of the cores upon receipt.

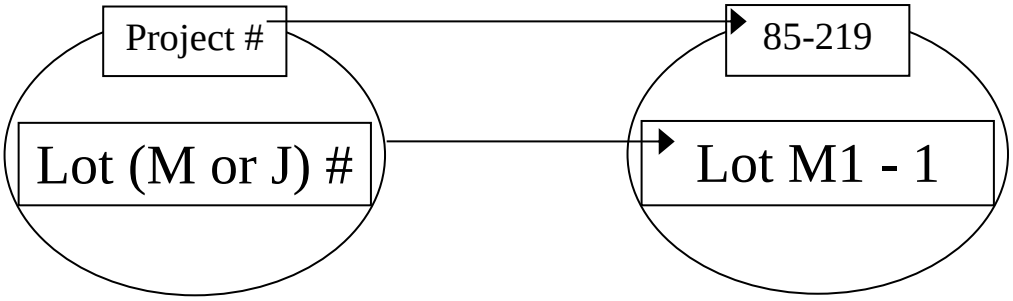

FIGURE 4.06-4: Labeling of Cores

Frequency of sampling is in accordance with the following tables:

TABLE 4.06-4: Testing Requirement for Bridge Density Lot

Length of Each Structure (Feet)	MAT – No. of Cores	JOINT - No. of cores
≤ 500'	See Table 4.06-5(A or B)	See Table 4.06-5(A or B)
501' – 1500'	3	3
1501' – 2500'	4	4
2501' and greater	5	5

All material placed on structures less than or equal to 500 feet in length shall be included as part of a standard lot as follows:

TABLE 4.06-5A: Testing requirement for Density Lots ≥ 500 Tons

<table>
<tr><th>Lot Type</th><th colspan="2">No. of Mat Cores</th><th colspan="2">No. of Joint Cores</th><th>Target Lot Size (Tons)</th></tr>
<tr><td>Lot Without Bridge(1)</td><td colspan="2">4</td><td colspan="2">4</td><td>2000</td></tr>
<tr><td rowspan="2">Lot With Bridge(s)(1)(2)</td><td rowspan="2">4 plus</td><td>1 per structure (≤ 300’)</td><td rowspan="2">4 plus</td><td>1 per structure (≤ 300’)</td><td rowspan="2">2000</td></tr>
<tr><td>2 per structure (301’ – 500’)</td><td>2 per structure (301’ – 500’)</td></tr>
</table>

TABLE 4.06-5B: Testing requirement for Density Lots < 500 Tons

Lot Type	No. of Mat Cores	No. of Joint Cores	Lot Size (Tons)
Lot Without Bridge(1)	3	3	1 per lift
Lot With Bridge(s)(1)(2)	3	3	1 per lift

Notes:
(1) The number of “Required Paver Passes for Full Width” shall be used to determine the sub-lot sizes within the lot. The number of paver passes for full width is determined by the contractor.
(2) If a non-bridge mat or joint core location randomly falls on a structure, the core is to be obtained on the structure in addition to the core(s) required on the structure.

A density lot will be complete when the full designed paving width of the established lot length has been completed and shall include all longitudinal joints that exist between the curb lines regardless of date(s) paved. Quantity of material placed on structures less than or equal to 500 feet long is inclusive of the standard lot. Prior to paving, the total length of the project to be paved shall be split up into lots that contain approximately 2000 tons each. Areas such as highway ramps may be combined to create one lot. In general, combined areas should be set up to target a 2000 ton lot size. One adjustment will apply for each lot. The tons shall be determined using the yield calculation in Article 4.06.04. The last lot shall be the difference between the total payable tons for the project and the sum of the previous lots.
After the compaction process has been completed, the material shall be allowed to cool sufficiently to allow the cutting and removal of the core without damage. The Contractor shall core to a depth that allows extraction so that the uppermost layer being tested for density will not be affected.

A mat core shall not be taken any closer than one foot from the edge of a paver pass. If a random number locates a core less than one foot from any edge, locate the core so that the sample is one foot from the edge.

Method I, Notched Wedge Joint cores shall be taken so that the center of the core is 5 inches from the visible joint on the hot mat side. Refer to Figure 4.06-5.

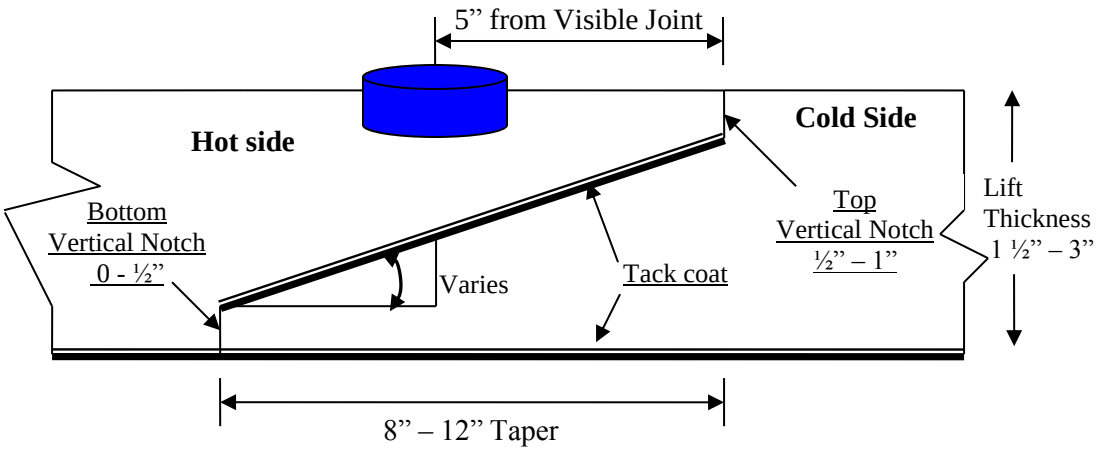

FIGURE 4.06-5: Notched Wedge Joint Cores

When Method III Butt Joint is utilized, cores shall be taken from the hot side so the edge of the core is within 1 inch of the longitudinal joint.

All cores must be cut within 5 calendar days of placement. Any core that is damaged or obviously defective while being obtained will be replaced with a new core from a location within 2 feet measured in a longitudinal direction.

Each core hole shall be filled within four hours upon core extraction. Prior to being filled, the hole shall be prepared by removing any free water and applying tack coat using a brush or other means to uniformly cover the cut surface. The core hole shall be filled using a bituminous concrete mixture at a minimum temperature of 240ºF containing the same or smaller nominal maximum aggregate size and compacted with a hand compactor or other mechanical means to the maximum compaction possible. The bituminous concrete fill shall be compacted to ⅛ inch above the finished pavement.

11. Acceptance Inspection, Sampling and Testing: Inspection, sampling, and testing to be used by the Engineer shall be performed at the minimum frequency specified in Section M.04 and stated herein.

Sampling for acceptance shall be established using ASTM D 3665, or a statistically based procedure of random sampling approved by the Engineer.

Plant Material Acceptance: The Contractor shall provide the required acceptance sampling, testing and inspection during all phases of the work in accordance with Section M.04. The Department will perform verification testing on the Contractor’s acceptance test results. Should binder content, theoretical maximum density (Gmm), or air void results exceed the specified tolerances in the Department’s current QA Program for Materials, Acceptance and Assurance Testing Policies and Procedures, the Department will investigate to determine an assignable cause. Contractor test results for a subject lot or sub lot may be replaced with the Department’s

results for the purpose of assessing adjustments. The verification procedure is included in the Department's current QA Program for Materials.

Density Acceptance: The Engineer will perform all acceptance testing on the cores in accordance with AASHTO T 331.

12. Density Dispute Resolution Process: The Contractor and Engineer will work in partnership to avoid potential conflicts and to resolve any differences that may arise during quality control or acceptance testing for density. Both parties will review their sampling and testing procedures and results and share their findings. If the Contractor disputes the Engineer's test results, the Contractor must submit in writing a request to initiate the Dispute Resolution Process within 7 calendar days of the notification of the test results. No request for dispute resolution will be allowed unless the Contractor provides quality control results within the timeframe described in Sub article 4.06.03-9 supporting its position. No request for Dispute Resolution will be allowed for a Density Lot in which any core was not taken within the required 5 calendar days of placement. Should the dispute not be resolved through evaluation of existing testing data or procedures, the Engineer may authorize the Contractor to obtain a new set of core samples per disputed lot. The core samples must be extracted no later than 14 calendar days from the date of Engineer's authorization.

The number and type (mat, joint, or structure) of the cores taken for dispute resolution must reflect the number and type of the cores taken for acceptance. The location of each core shall be randomly located within the respective original sub lot. All such core samples shall be extracted and filled using the procedure outlined in Article 4.06.03. The results from the dispute resolution cores shall be added to the results from the acceptance cores and averaged for determining the final in-place density value.

13. Corrective Work Procedures: Any portion of the completed pavement that does not meet the requirements of the specification shall be corrected at the expense of the Contractor. Any corrective courses placed as the final wearing surface shall match the specified lift thickness after compaction.

If pavement placed by the Contractor does not meet the specifications, and the Engineer requires its replacement or correction, the Contractor shall:

a) Propose a corrective procedure to the Engineer for review and approval prior to any corrective work commencing. The proposal shall include:
   - Limits of pavement to be replaced or corrected, indicating stationing or other landmarks that are readily distinguishable.
   - Proposed work schedule.
   - Construction method and sequence of operations.
   - Methods of maintenance and protection of traffic.
   - Material sources.
   - Names and telephone numbers of supervising personnel.

b) Perform all corrective work in accordance with the Contract and the approved corrective procedure.

14. Protection of the Work: The Contractor shall protect all sections of the newly finished pavement from damage that may occur as a result of the Contractor's operations for the duration of the Project. Prior to the Engineer's authorization to open the pavement to traffic, the Contractor is responsible to protect the pavement from damage.

15. Cut Bituminous Concrete Pavement: Work under this item shall consist of making a straight-line cut in the bituminous concrete pavement to the lines delineated on the plans or as directed by the Engineer. The cut shall provide a straight, clean, vertical face with no cracking, tearing or breakage along the cut edge.

4.06.04—Method of Measurement:

1. HMA S* or PMA S*: The quantity of bituminous concrete measured for payment will be determined by the documented net weight in tons accepted by the Engineer in accordance with this specification and Section M.04.

2. Adjustments: Adjustments may be applied to bituminous concrete quantities and will be measured for payment using the following formulas:

Yield Factor for Adjustment Calculation = 0.0575 Tons/SY/inch

Actual Area = [(Measured Length (ft)) x (Avg. of width measurements (ft))]

Actual Thickness (t) = Total tons delivered / [Actual Area (SY) x 0.0575 Tons/SY/inch]

a) Area: If the average width exceeds the allowable tolerance, an adjustment will be made using the following formula. The tolerance for width is equal to the specified thickness (in.) of the lift being placed.

Tons Adjusted for Area (T_A) = [(L x W_{adj})/9] x (t) x 0.0575 Tons/SY/inch = (-) Tons

Where: L = Length (ft)
(t) = Actual thickness (inches)
W_{adj} = (Designed width (ft) + tolerance /12) - Measured Width)

b) Thickness: If the actual thickness is less than the allowable tolerance, the Contractor shall submit a repair procedure to the Engineer for approval. If the actual thickness exceeds the allowable tolerance, an adjustment will be made using the following formula:

Tons Adjusted for Thickness (T_T) = A x t_{adj} x 0.0575 = (-) Tons

Where: A = Area = {[L x (Designed width + tolerance (lift thickness)/12)] / 9}
t_{adj} = Adjusted thickness = [(Dt + tolerance) - Actual thickness]
Dt = Designed thickness (inches)

c) Weight: If the quantity of bituminous concrete representing the mixture delivered to the project is in excess of the allowable gross vehicle weight (GVW) for each vehicle, an adjustment will be made using the following formula:

Tons Adjusted for Weight (T_W) = GVW – DGW= (-) Tons

Where: DGW = Delivered gross weight as shown on the delivery ticket or measured on a certified scale.

d) Mixture Adjustment: The quantity of bituminous concrete representing the production lot will be adjusted based on test results and values listed in Tables 4.06-6 and 4.06-7 , . The Department's Division of Material Testing will calculate the daily adjustment value for T_{SD}.

The adjustment values in Table 4.06-6 and 4.06-7 shall be calculated for each sub lot based on the Air Void and Liquid Binder Content test results for that sub lot. The total adjustment for each day's production (lot) will be computed using tables and the following formulas:

Tons Adjusted for Superpave Design (T_{SD}) = $[(AdjAV_t + AdjPB_t) / 100]$ X Tons

Percent Adjustment for Air Voids = $AdjAV_t = [AdjAV_1 + AdjAV_2 + AdjAV_i + \ldots + AdjAV_n)] /n$

Where: $AdjAV_t$ = Total percent air void adjustment value for the lot
$AdjAV_i$ = Adjustment value from Table 4.06-7 resulting from each sub lot or the average of the adjustment values resulting from multiple tests within a sub lot, as approved by the Engineer.
n = number of sub lots based on Table M.04.03-1

TABLE 4.06-6: Adjustment Values for Air Voids

Adjustment Value ($AdjAV_i$) (%)	**S0.25, S0.375, S0.5, S1 Air Voids (AV)**
+2.5	3.8 - 4.2
+3.125*(AV-3)	3.0 - 3.7
-3.125*(AV-5)	4.3 – 5.0
20*(AV-3)	2.3 – 2.9
-20*(AV-5)	5.1 – 5.7
-20.0	$\leq$ 2.2 or $\geq$ 5.8

Positive air void adjustment values will not be calculated for any test that fails to meet gradation or binder content tolerances of the JMF in Table M.04.03– 5.

Percent Adjustment for Liquid Binder = $AdjPB_t = [(AdjPB_1 + AdjPB_2 + AdjPB_i + \ldots + AdjPB_n)] / n$

Where: $AdjPB_t$= Total percent liquid binder adjustment value for the lot
$AdjPB_i$ = Adjustment value from Table 4.06-7 resulting from each sub lot
n = number of binder tests in a production lot

TABLE 4.06-7: Adjustment Values for Binder Content

Adjustment Value ($AdjAV_i$) (%)	**S0.25, S0.375, S0.5, S1 Pb (refer to Table M.04.02-5)**
0.0	Equal to or above the min. liquid content
- 10.0	Below the min. liquid content

e) Density Adjustment: The quantity of bituminous concrete measured for payment in a lift of pavement specified to be 1½ inches or greater may be adjusted for density. Separate density adjustments will be made for each lot and will not be combined to establish one density adjustment. If either the Mat or Joint adjustment value is "remove and replace", the density lot shall be removed and replaced (curb to curb).

No positive adjustment will be applied to a Density Lot in which any core was not taken within the required 5 calendar days of placement.

Tons Adjusted for Density (T_D) = $[\{(PA_M \times .50) + (PA_J \times .50)\} / 100]$ X Density Lot Tons

Where: T_D = Total tons adjusted for density for each lot
PA_M = Mat density percent adjustment from Table 4.06-9
PA_J = Joint density percent adjustment from Table 4.06-10

TABLE 4.06-9: Adjustment Values for Pavement Mat density

Average Core Result Percent Mat Density	**Percent Adjustment (Bridge and Non-Bridge) (1)(2)**
97.1 - 100	-1.667*(ACRPD-98.5)
94.5 – 97.0	+2.5
93.5 – 94.4	+2.5*(ACRPD-93.5)
92.0 – 93.4	0
90.0 – 91.9	-5*(92-ACRPD)
88.0 – 89.9	-10*(91-ACRPD)
87.0 – 87.9	-30
86.9 or less	Remove and Replace (curb to curb)

TABLE 4.06-10: Adjustment Values for Pavement Joint Density

Average Core Result Percent Joint Density	Percent Adjustment (Bridge and Non-Bridge) [(1)(2)]
97.1 – 100	-1.667*(ACRPD-98.5)
93.5 – 97.0	+2.5
92.0 – 93.4	+1.667*(ACRPD-92)
91.0 – 91.9	0
89.0 – 90.9	-7.5*(91-ACRPD)
88.0 – 88.9	-15*(90-ACRPD)
87.0 – 87.9	-30
86.9 or less	Remove and Replace (curb to curb)

[(1)] ACRPD = Average Core Result Percent Density
[(2)] All Percent Adjustments to be rounded to the second decimal place. For example, 1.667 is to be rounded to 1.67.

3. Transitions for Roadway Surface: The installation of permanent transitions shall be measured under the appropriate item used in the formation of the transition.

The quantity of material used for the installation of temporary transitions shall be measured for payment under the appropriate item used in the formation of the transition. The installation and removal of a bond breaker, and the removal and disposal of any temporary transition formed by milling or with bituminous concrete pavement is not measured for payment.

4. Cut Bituminous Concrete Pavement: The quantity of bituminous concrete pavement cut will be measured in accordance with Article 2.02.04.

5. Material for Tack Coat: The quantity of tack coat will be measured for payment by the number of gallons furnished and applied on the Project and approved by the Engineer. No tack coat material shall be included that is placed in excess of the tolerance described in Article 4.06.03.

Method of Measurement:

a. Container Method- Material furnished in a container will be measured to the nearest ½ gallon. The volume will be determined by either measuring the volume in the original container by a method approved by the Engineer or using a separate graduated container capable of measuring the volume to the nearest ½ gallon. The container in which the material is furnished must include the description of material, including lot number or batch number and manufacturer or product source.

b. Truck Method- The Engineer will establish a weight per gallon of the tack coat based on the density at 60ºF for the material furnished. The number of gallons furnished will be determined by weighing the material on scales furnished by and at the expense of the Contractor, or from the automated metering system on the delivery vehicle.

6. Material Transfer Vehicle (MTV): The furnishing and use of a MTV will be measured separately for payment based on the actual number of surface course tons delivered to a paver using the MTV.

4.06.05—Basis of Payment:

1. HMA S* or PMA S*: The furnishing and placing of bituminous concrete will be paid for at the Contract unit price per ton for "HMA S*" or "PMA S*".

- All costs associated with providing illumination of the work area are included in the general cost of the work.
- All costs associated with cleaning the surface to be paved, including mechanical sweeping, are included in the general cost of the work. All costs associated with constructing longitudinal joints are included in the general cost of the work.
- All costs associated with obtaining cores for acceptance testing and dispute resolution are included in the general cost of the work.

2. Bituminous Concrete Adjustment Costs: The adjustment will be calculated using the formulas shown below if all of the measured adjustments in Article 4.06.04 are not equal to zero. A positive or negative adjustment will be applied to monies due the Contractor.

Production Lot: $[T_T + T_A + T_W + (T_{MD} \text{ or } T_{SD})] \times$ Unit Price = Est. (P)

Density Lot: T_D X Unit Price = Est. (D)

Where: Unit Price = Contract unit price per ton per type of mixture

T_* = Total tons of each adjustment calculated in Article 4.06.04

Est. ( ) = Pay Unit represented in dollars representing incentive or disincentive.

The Bituminous Concrete Adjustment Cost item if included in the bid proposal or estimate is not to be altered in any manner by the Contractor. If the Contractor should alter the amount shown, the altered figure will be disregarded and the original estimated cost will be used for the Contract.

3. Transitions for Roadway Surface: The installation of permanent transitions shall be paid under the appropriate item used in the formation of the transition. The quantity of material used for the installation of temporary transitions shall be paid under the appropriate pay item used in the formation of the transition. The installation and removal of a bond breaker, and the removal and disposal of any temporary transition formed by milling or with bituminous concrete pavement is included in the general cost of the work.

4. The cutting of bituminous concrete pavement will be paid in accordance with Article 2.02.05.

5. Material for tack coat will be paid for at the Contract unit price per gallon for "Material for Tack Coat".

6. The Material Transfer Vehicle (MTV) will be paid at the Contract unit price per ton for a "Material Transfer Vehicle".

Pay Item*	Pay Unit*
HMA S*	ton
PMA S*	ton
Bituminous Concrete Adjustment Cost	est.
Material for Tack Coat	gal.
Material Transfer Vehicle	ton

*For contracts administered by the State of Connecticut, Department of Administrative Services, the pay items and pay units are as shown in contract award price schedule.

SECTION M.04 BITUMINOUS CONCRETE

Section M.04 is being deleted in its entirety and replaced with the following:

M.04.01—Bituminous Concrete Materials and Facilities
M.04.02—Mix Design and Job Mix Formula (JMF)
M.04.03—Production Requirements

M.04.01—Bituminous Concrete Materials and Facilities: Each source of material, and facility or plant used to produce and test bituminous concrete must be qualified on an annual basis by the Engineer. Test Procedures and Specifications referenced herein are in accordance with the latest AASHTO and ASTM Standard Test Procedures and Specifications. Such references when noted with an (M) have been modified by the Engineer and are detailed in Table M.04.03-7.

The Contractor shall submit to the Engineer all sources of coarse aggregate, fine aggregate, mineral filler, PG binder, and if applicable any additives such as but not limited to anti-strip, warm mix, and polymer modifiers. The Contractor shall submit a Safety Data Sheet (SDS) for each grade of binder, and additive to be used on the Project. The Contractor shall not change any material sources without prior approval of the Engineer.

An adequate quantity of each size aggregate, mineral filler, bitumen, and additives, shall be maintained at the bituminous concrete plant site at all times while the plant is in operation to ensure that the plant can consistently produce bituminous concrete mixtures that meet the job mix formula (JMF) as specified in Article M.04.02. The quantity of such material shall be reviewed by the Engineer on an individual plant basis and is dependent upon the plant's daily production capacity. A total quantity of any material on site that amounts to less than one day's production capacity may be cause for the job mix formula to be rejected.

1. Coarse Aggregate:

a. Requirements: The coarse aggregate shall consist of clean, hard, tough, durable fragments of crushed stone or crushed gravel of uniform quality. Aggregates from multiple sources of supply must not be mixed or stored in the same stockpile.

b. Basis of Approval: The request for approval of the source of supply shall include a washed sieve analysis in accordance with AASHTO T 27. The Gsa, Gsb, and Pw_a shall be determined in accordance with AASHTO T 85. The coarse aggregate must not contain more than 1% crusher dust, sand, soft disintegrated pieces, mud, dirt, organic and other injurious materials. When tested for abrasion using AASHTO T 96, the aggregate loss must not exceed 40%. When tested for soundness using AASHTO T 104 with a magnesium sulfate solution, the coarse aggregate must not have a loss exceeding 10% at the end of 5 cycles.

For all bituminous mixtures, materials shall also meet the coarse aggregate angularity criteria as specified in Tables M.04.02-2 thru M.04.02-4 for blended aggregates retained

on the #4 sieve when tested according to ASTM D 5821. The amount of aggregate particles of the coarse aggregate blend retained on the #4 sieve that are flat and elongated shall be determined in accordance with ASTM D 4791 and shall not exceed 10% by weight when tested to a 5:1 ratio, as shown in Tables M.04.02-2 thru M.04.02-4.

2. Fine Aggregate:

a. Requirements: The fine aggregate from each source quarry/pit deposit shall consist of clean, hard, tough, rough-surfaced and angular grains of natural sand; manufactured sand prepared from washed stone screenings; stone screenings, slag or gravel; or combinations thereof, after mechanical screening or manufactured by a process approved by the Engineer. The Contractor is prohibited from mixing two or more sources of fine aggregate on the ground for the purpose of feeding into a plant.

All fine aggregate shall meet the listed criteria shown in items #1 thru #7 of Table M.04.01-1. Table M.04.01-1 indicates the quality tests and criteria required for all fine aggregate sources. Individually approved sources of supply shall not be mixed or stored in the same stockpile. The fine aggregates must be free from injurious amounts of clay, loam, and other deleterious materials.

For Superpave mixtures, in addition to the above requirements, the fine aggregate angularity shall be determined by testing the materials passing the #8 sieve in accordance with AASHTO T 304, Method A. Qualification shall be based on the criteria listed in Tables M.04.02-2 thru M.04.02-4. The fine aggregate shall also be tested for clay content as a percentage contained in materials finer than the #8 sieve in accordance with AASHTO T 176.

TABLE M.04.01-1: Fine Aggregate Criteria by Pit/Quarry Source

Item	Title	AASHTO Protocol(s)	Criteria
1	Grading	T 27 & T 11	100% Passing 3/8 inch 95% Passing the #4 min.
2	Absorption	T 84	3% maximum
3	Plasticity limits	T 90	0 or not detectable
4	L.A. Wear	T 96	50% maximum(fine agg. particle size # 8 and above)
5	Soundness by Magnesium Sulfate	T 104	20% maximum @ 5 cycles
6	Clay Lumps and Friable Particles	T 112	3% maximum
7	Deleterious Material	As determined by the Engineer	Organic or inorganic calcite, hematite, shale, clay or clay lumps, friable materials, coal-lignite, shells, loam, mica, clinkers, or organic matter (wood, etc). -Shall not contain more than 3% by mass of any individual listed constituent and not more than 5% by mass in total of all listed constituents.
8	Petrographic Analysis	ASTM C 295	Terms defined in Section M.04.01-2c.

b. Basis of Approval: A Quality Control Plan for Fine Aggregate (QCPFA) provided by the Contractor shall be submitted for review and approval for each new source documenting how conformance to Items 1 through 7 as shown in Table M.04.01-1 is monitored. The QCPFA must be resubmitted any time the process, location or manner of how the fine aggregate (FA) is manufactured changes, or as requested by the Engineer. The QCPFA must include the locations and manufacturing processing methods. The QCPFA for any source may be suspended by the Engineer due to the production of inconsistent material.

The Contractor shall submit all test results to the Engineer for review. The Contractor shall also include a washed sieve analysis in accordance with AASHTO T 27/T 11. Any fine aggregate component or final combined product shall have 100% passing the 3/8 inch sieve and a minimum of 95% passing the # 4. The Gsa, Gsb, and Pw_a shall be determined in accordance with AASHTO T 84.

The Contractor will be notified by the Engineer if any qualified source of supply fails any portion of Table M.04.01-1. One retest will be allowed for the Contractor to make corrections and/or changes to the process. If, upon retest, the material does not meet the requirements of items 1-7, additional testing will be required in accordance with item 8.

The Contractor may provide a Petrographic analysis of the material performed by a third party acceptable to the Engineer at its' own expense. The Contractor shall submit the results of the analysis with recommended changes to the manufacturing process to the Engineer. The Contractor shall submit fine aggregate samples for testing by the Engineer after the recommended changes have been made.

The Contractor may request the use of such fine aggregate on select project(s) for certain applications of bituminous concrete pavement. Such material will be monitored for a period no less than 48 months, at no cost to the State. Terms of any evaluation and suitable application will be determined by the Engineer.

3. Mineral Filler:

a. Requirements: Mineral filler shall consist of finely divided mineral matter such as rock dust, including limestone dust, slag dust, hydrated lime, hydraulic cement, or other accepted mineral matter. At the time of use it shall be freely flowing and devoid of agglomerations. Mineral filler shall be introduced and controlled at all times during production in a manner acceptable to the Engineer.

b. Basis of Approval: The request for approval of the source of supply shall include the location, manufacturing process, handling and storage methods for the material. Mineral filler shall conform to the requirements of AASHTO M 17.

4. Performance Graded Asphalt Binder:

a. General:

i Liquid PG binders shall be uniformly mixed and blended and be free of contaminants such as fuel oils and other solvents. Binders shall be properly heated and stored to prevent damage or separation.

ii. The blending at mixing plants of PG binder from different suppliers is strictly prohibited. Contractors who blend PG binders will be classified as a supplier and will be required to certify the binder in accordance with AASHTO R 26(M). The binder shall meet the requirements of AASHTO M 332 and shall be graded or verified in accordance with AASHTO R 29. The Contractor shall submit a Certified Test Report and bill of lading representing each delivery in accordance with AASHTO R 26(M). The Certified Test Report must also indicate the binder specific gravity at 77ºF; rotational viscosity at 275ºF and 329ºF and the mixing and compaction viscosity-temperature chart for each shipment.

iii. The Contractor shall submit the name(s) of personnel responsible for receipt, inspection, and record keeping of PG binder materials. Contractor plant personnel shall document specific storage tank(s) where binder will be transferred and stored until used, and provide binder samples to the Engineer upon request. The person(s) shall assure that each shipment (tanker truck) is accompanied by a statement certifying that the transport vehicle was inspected before loading and was found acceptable for the material shipped and that the binder will be free of contamination from any residual material, along with two (2) copies of the bill of lading.

iv. Basis of Approval: The request for approval of the source of supply shall list the location where the material will be manufactured, and the handling and storage methods, along with necessary certification in accordance with AASHTO R 26(M). Only suppliers/refineries that have an approved "Quality Control Plan for Performance Graded Binders" formatted in accordance with AASHTO R 26(M) will be allowed to supply PG binders to Department projects.

b. Neat Performance Grade (PG) Binder:

i. PG binder shall be classified by the supplier as a "Neat" binder for each lot and be so labeled on each bill of lading. Neat PG binders shall be free from modification with: fillers, extenders, reinforcing agents, adhesion promoters, thermoplastic polymers, acid modification and other additives such as re-refined motor oil, and shall indicate such information on each bill of lading and certified test report.

ii. The asphalt binder shall be PG 64S-22.

c. Modified Performance Grade (PG) Binder:

Unless otherwise noted, the asphalt binder shall be Performance Grade PG 64E-22 asphalt modified solely with a Styrene-Butadiene-Styrene (SBS) polymer. The polymer modifier shall be added at either the refinery or terminal and delivered to the bituminous concrete production facility as homogenous blend. The stability of the

modified binder shall be verified in accordance with ASTM D7173 using the Dynamic Shear Rheometer (DSR). The DSR G*/sin(δ) results from the top and bottom sections of the ASTM D7173 test shall not differ by more than 10%. The results of ASTM D7173 shall be included on the Certified Test Report. The binder shall meet the requirements of AASHTO M 332 (including Appendix X1) and AASHTO R 29.

d. Warm Mix Additive or Technology:
   i. The warm mix additive or technology must be listed on the NEAUPG Qualified Warm Mix Asphalt (WMA) Technologies List at the time of bid, which may be accessed online at http://www.neaupg.uconn.edu/wma_info.html.
   ii. The warm mix additive shall be blended with the asphalt binder in accordance with the manufacturer's recommendations.
   iii. The blended binder shall meet the requirements of AASHTO M 332 and shall be graded or verified in accordance with AASHTO R 29 for the specified binder grade. The Contractor shall submit a Certified Test Report showing the results of the testing demonstrating the binder grade. In addition, it must include the grade of the virgin binder, the brand name of the warm mix additive, the manufacturer's suggested rate for the WMA additive, the water injection rate (when applicable) and the WMA Technology manufacturer's recommended mixing and compaction temperature ranges.

5. Emulsified Asphalts:

a. General:
   i. Emulsified asphalts shall be homogeneous and be free of contaminants such as fuel oils and other solvents. Emulsions shall be properly stored to prevent damage or separation.
   ii. The blending at mixing plants of emulsified asphalts from different suppliers is strictly prohibited. Contractors who blend emulsified asphalts will be classified as a supplier and will be required to certify the emulsion in accordance with AASHTO PP 71. The emulsified asphalt shall meet the requirements of AASHTO M 140(M) or AASHTO M 208 as applicable.

b. Supplier Approval:
   i. The request for approval of the source of supply shall list the location where the material is manufactured, the handling and storage methods, and certifications in accordance with AASHTO PP 71. Only suppliers that have an approved "Quality Control Plan for Emulsified Asphalt" formatted in accordance with AASHTO PP 71 will be allowed to supply emulsified asphalt to Department projects.
   ii. The supplier shall submit to the Division Chief a Certified Test Report representing each lot in accordance with AASHTO PP 71. The Certified Test Report shall include test results for each specified requirement for the grade delivered and shall also indicate the density at 60ºF. Additionally, once a month one split sample for each emulsified asphalt grade shall be submitted.

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c. Basis of Approval

i. Each shipment of emulsified asphalt delivered to the project site shall be accompanied with the corresponding SDS and Certified Test Report listing Saybolt viscosity, residue by evaporation, penetration of residue, and weight per gallon at 60°F.

ii. Anionic emulsified asphalts shall conform to the requirements of AASHTO M-140(M). Materials used for tack coat shall not be diluted and meet grade RS-1 or RS-1H. When ambient temperatures are 80˚F and rising, grade SS-1 or SS-lH may be substituted if permitted by the Engineer.

iii. Cationic emulsified asphalt shall conform to the requirements of AASHTO M-208. Materials used for tack coat shall not be diluted and meet grade CRS-1. The settlement and demulsibility test will not be performed unless deemed necessary by the Engineer. When ambient temperatures are 80˚F and rising, grade CSS-1 or CSS-lh may be substituted if permitted by the Engineer.

6. Reclaimed Asphalt Pavement (RAP):

a. Requirements: RAP shall consist of asphalt pavement constructed with asphalt and aggregate reclaimed by cold milling or other removal techniques approved by the Engineer. For bituminous concrete mixtures containing RAP, the Contractor shall submit a JMF in accordance with Article M.04.02 to the Engineer for review.

b. Basis of Approval: The RAP material will be accepted on the basis of one of the following criteria:

i. When the source of all RAP material is from pavements previously constructed on Department projects, the Contractor shall provide a materials certificate listing the detailed locations and lengths of those pavements and that the RAP is only from those locations listed.

ii. When the RAP material source or quality is not known, the Contractor shall test the material and provide the following information along with a request for approval to the Engineer at least 30 calendar days prior to the start of the paving operation. The request shall include a material certificate stating that the RAP consists of aggregates that meet the specification requirements of sub articles M.04.01-1 through 3 and that the binder in the RAP is substantially free of solvents, tars and other contaminants. The Contractor is prohibited from using unapproved material on Department projects and shall take necessary action to prevent contamination of approved RAP stockpiles. Stockpiles of unapproved material shall remain separate from all other RAP materials at all times. The request for approval shall include the following:

1. A 50-pound sample of the RAP to be incorporated into the recycled mixture.
2. A 25-pound sample of the extracted aggregate from the RAP.
3. A statement that RAP material has been crushed to 100% passing the ½ inch sieve and remains free from contaminants such as joint compound, wood, plastic, and metals.

7. Crushed Recycled Container Glass (CRCG):

a. Requirements: The Contractor may propose to use clean and environmentally-acceptable CRCG in an amount not greater than 5% by weight of total aggregate.

b. Basis of Approval: The Contractor shall submit to the Engineer a request to use CRCG. The request shall state that the CRCG contains no more than 1% by weight of contaminants such as paper, plastic and metal and conform to the following gradation:

CRCG Grading Requirements	
Sieve Size	Percent Passing
3/8-inch	100
No. 4	35-100
No. 200	0.0-10.0

8. Joint Seal Material:

a. Requirements: Joint seal material shall be a hot-poured rubber compound intended for use in sealing joints and cracks in bituminous concrete pavements. Joint seal material must meet the requirements of ASTM D 6690 – Type 2.

9. Recycled Asphalt Shingles (RAS)

a. Requirements: RAS shall consist of processed asphalt roofing shingles from post-consumer asphalt shingles or from manufactured shingle waste. The RAS material under consideration for use in bituminous concrete mixtures must be certified as being asbestos free and shall be entirely free of whole, intact nails. The RAS material shall meet the requirements of AASHTO MP 23.

The producer shall test the RAS material to determine the asphalt content and the gradation of the RAS material. The producer shall take necessary action to prevent contamination of RAS stockpiles.

10. Plant Requirements:

a. Mixing Plant and Machinery: The mixing plant used in the preparation of the bituminous concrete shall comply with AASHTO M 156/ASTM D 995 for a Batch Plant or a Drum Dryer Mixer Plant, and be approved by the Engineer.

b. Storage Silos: For all mixes, the Contractor may use silos for short-term storage of Superpave mixtures with prior notification and approval of the Engineer. A silo must have heated cones and an unheated silo cylinder if it does not contain a separate internal heating system. Prior approval must be obtained for storage times greater than those indicated. When multiple silos are filled, the Contractor shall discharge one silo at a time. Simultaneous discharge of multiple silos is not permitted.

Type of silo cylinder	Maximum storage time for all classes (hr)	
	HMA	WMA/PMA
Open Surge	4	Mfg Recommendations
Unheated – Non-insulated	8	Mfg Recommendations
Unheated – Insulated	18	Mfg Recommendations
Heated – No inert gas	TBD by the Engineer	

c. Documentation System: The mixing plant documentation system shall include equipment for accurately proportioning the components of the mixture by weight and in the proper order, controlling the cycle sequence and timing the mixing operations. Recording equipment shall monitor the batching sequence of each component of the mixture and produce a printed record of these operations on each delivery ticket, as specified herein. Material feed controls shall be automatically or manually adjustable to provide proportions within the tolerances listed below for any batch size.

An asterisk (*) shall be automatically printed next to any individual batch weight(s) exceeding the tolerances in ASTM D 995 section 8.7.3. The entire batching and mixing interlock cut-off circuits shall interrupt and stop the automatic batching operations when an error exceeding the acceptable tolerance occurs in proportioning.

There must be provisions so that scales are not manually adjusted during the printing process. In addition, the system shall be interlocked to allow printing only when the scale has come to a complete rest. A unique printed character (m) shall automatically be printed on the truck and batch plant printout when the automatic batching sequence is interrupted or switched to auto-manual or full manual during proportioning. For each day's production, each project shall be provided a clear, legible copy of these recordings on each delivery ticket.

d. Aggregates: The Contractor shall ensure that aggregate stockpiles are managed to provide uniform gradation and particle shape, prevent segregation and cross contamination in a manner acceptable to the Engineer. For drum plants only, the Contractor shall determine the percent moisture content at a minimum, prior to production and half way through production.

e. Mixture: The dry and wet mix times shall be sufficient to provide proper coating (minimum 95% as determined by AASHTO T 195(M)) of all particles with bitumen and produce a uniform mixture.

The Contractor shall make necessary adjustments to ensure all types of bituminous concrete mixtures contain no more than 0.5% moisture throughout when tested in accordance with AASHTO T 329.

f. RAP: The Contractor shall indicate the percent of RAP, the moisture content (as a minimum determined twice daily prior to production and halfway through production), and the net dry weight of RAP added to the mixture on each delivery ticket. For each day of production, the production shall conform to the job mix formula and RAP percentage and no change shall be made without the prior approval of the Engineer.

g. Asphalt Binder: The last day of every month, a binder log shall be submitted when the monthly production for the Department exceeds 5000 tons. Blending of PG binders from different suppliers or grades at the bituminous concrete production facility is strictly prohibited.

h. Warm mix additive: For mechanically foamed WMA, the maximum water injection rate shall not exceed 2.0% water by total weight of binder and the water injection rate shall be constantly monitored during production.

i. Field Laboratory: The Contractor shall furnish the Engineer an acceptable field laboratory at the production facility to test bituminous concrete mixtures during production. The field laboratory shall have a minimum of 300 square feet, have a potable water source and drainage in accordance with the CT Department of Public Health Drinking Water Division, and be equipped with all necessary testing equipment as well as with a PC, printer, and telephone with a dedicated hard-wired phone line. In addition, the PC shall have a high speed internet connection with a minimum upstream of 384 Kbps and a functioning web browser with unrestricted access to https://ctmail.ct.gov. This equipment shall be maintained in clean and good working order at all times and be made available for use by the Engineer.

The laboratory shall be equipped with a suitable heating system capable of maintaining a minimum temperature of 65°F. It shall be clean and free of all materials and equipment not associated with the laboratory. Windows shall be installed to provide sufficient light and ventilation. During summer months adequate cooling or ventilation must be provided so the indoor air temperature shall not exceed the ambient outdoor temperature. Light fixtures and outlets shall be installed at convenient locations, and a telephone shall be within audible range of the testing area. The laboratory shall be equipped with an adequate workbench that has a suitable length, width, and sampling tables, and be approved by the Engineer.

The field laboratory testing apparatus, supplies, and safety equipment shall be capable of performing all tests in their entirety that are referenced in AASHTO R 35, *Standard Practice for Superpave Volumetric Design for Hot-Mix Asphalt (HMA)* and AASHTO M 323, *Standard Specification for Superpave Volumetric Mix Design*. In addition, the quantity of all equipment and supplies necessary to perform the tests must be sufficient to

initiate and complete the number of tests identified in Table M.04.03-2 for the quantity of mixture produced at the facility on a daily basis. The Contractor shall ensure that the Laboratory is adequately supplied at all times during the course of the project with all necessary testing materials and equipment.

The Contractor shall maintain a list of laboratory equipment used in the acceptance testing processes including but not limited to, balances, scales, manometer/vacuum gauge, thermometers, gyratory compactor, clearly showing calibration and/or inspection dates, in accordance with AASHTO R 18. The Contractor shall notify the Engineer if any modifications are made to the equipment within the field laboratory. The Contractor shall take immediate action to replace, repair, and/or recalibrate any piece of equipment that is out of calibration, malfunctioning, or not in operation.

M.04.02—Mix Design and Job Mix Formula (JMF)

1. Curb Mix:

a. Requirements: When curb mix is specified, the Contractor shall develop a bituminous concrete mix design that includes a JMF consisting of target values for gradation, binder content and air voids as shown in Table M.04.02-1. The Contractor may use RAP in 5% increments up to a maximum of 30% provided a new JMF is accepted by the Engineer.

b. Basis of Approval: The Contractor shall submit to the Engineer a request for approval of the JMF annually in accordance with one of the methods described herein. Prior to the start of any paving operations, the JMF must be accepted by the Engineer, and the Contractor must demonstrate the ability to meet the accepted JMF. Additionally, the fraction of material retained between any two consecutive sieves shall not be less than 4%.

The Contractor shall test the mixture for compliance with the submitted JMF and Table M.04.02-1. The maximum theoretical density (Gmm) will be determined by AASHTO T 209. If the mixture does not meet the requirements, the JMF shall be adjusted within the ranges shown in Table M.04.02-1 until an acceptable mixture is produced.

An accepted JMF from the previous operating season may be acceptable to the Engineer provided that there are no changes in the sources of supply for the coarse aggregate, fine aggregate, recycled material (if applicable) and the plant operation had been consistently producing acceptable mixture.

The Contractor shall not change sources of supply after a JMF has been accepted. Before a new source of supply for materials is used, a new JMF shall be submitted to the Engineer for approval.

TABLE M.04.02 – 1:
Master Ranges for Curb Mix Mixtures

Notes: (a) Compaction Parameter 50gyration N_{des}. (b) The percent passing the #200 sieve shall not exceed the percentage of bituminous asphalt binder determined by AASHTO T 164 or AASHTO T 308.		
Mix	**Curb Mix**	**Production Tolerances from JMF target**
Grade of PG Binder content %	**PG 64S-22 6.5 - 9.0**	**0.4**
Sieve Size		
# 200	3.0 – 8.0 (b)	2.0
# 50	10 - 30	4
# 30	20 - 40	5
# 8	40 - 70	6
# 4	65 - 87	7
¼"		
3/8 "	95 - 100	8
½ "	100	8
¾"		8
1"		
2"		
Additionally, the fraction of material retained between any two consecutive sieves shall not be less than 4%		
Mixture Temperature		
Binder	325°F maximum	
Aggregate	280-350° F	
Mixtures	265-325° F	
Mixture Properties		
VOIDS %	0 – 4.0 (a)	

2. Superpave Design Method – S0.25, S0.375, S0.5, and S1

a. Requirements: The Contractor or its representative shall design and submit Superpave mix designs annually for approval. The design laboratory developing the mixes shall be approved by the Engineer. The mix design shall be based on the specified Equivalent Single-Axle Loads (ESAL). Each bituminous concrete mix type must meet the requirements shown in Tables M.04.02-2 thru Table M.04.02-5 and in accordance with AASHTO M 323 and AASHTO R 35. The mix design shall include the nominal maximum aggregate size and a JMF consisting of target values for gradation and bitumen content for each bituminous concrete mix type designated for the project.

The contractor shall provide test results with supporting documentation from an AASHTO Materials Reference Laboratory (AMRL) with the use of NETTCP Certified Technicians for the following tests:

1. Aggregate consensus properties for each type & level, as specified in Table M.04.02-3 and the specific gravity data.

2. Extracted aggregates from RAP aggregate, when applicable, consensus properties for each type & level, as specified in Table M.04.02-3 and the specific gravity data.

3. New mixes shall be tested in accordance with AASHTO T 283(M) *Standard Method of Test for Resistance of Compacted Hot-Mix Asphalt (HMA) to Moisture-Induced Damage*, (TSR). The compacted specimens may be fabricated at a bituminous concrete facility and then tested at an AMRL accredited facility.

   The AASHTO T 283(M) test results, specimens, and corresponding JMF sheet (Form MAT-429s) shall be submitted by the Contractor for review.

In addition, minimum binder content values apply to all types of bituminous concrete mixtures, as stated in Table M.04.02-5. For mixtures containing RAP, the virgin production and the anticipated proportion of binder contributed by the RAP cannot be less than the total permitted binder content value for that type nor the JMF minimum binder content.

i. Superpave Mixture (virgin): For bituminous concrete mixtures that contain no recycled material, the limits prescribed in Tables M.04.02-2 thru Table M.04.02-5 apply. The Contractor shall submit a JMF, on a form provided by the Engineer, with the individual fractions of the aggregate expressed as percentages of the total weight of the mix and the source(s) of all materials to the Engineer for approval. The JMF shall indicate the corrected target binder content and applicable binder correction factor (ignition oven or extractor) for each mix type by total weight of mix. The mineral filler (dust) shall be defined as that portion of blended mix that passes the #200 sieve by weight when tested in accordance with AASHTO T 30. The dust-to-effective asphalt (D/Pbe) ratio shall be between 0.6 and 1.2 by weight. The dry/wet mix times and hot bin proportions (batch plants only) for each type shall be included in the JMF.

The percentage of aggregate passing each sieve shall be plotted on a 0.45 power gradation chart and shall be submitted for all bituminous concrete mixtures. This chart shall delineate the percentage of material passing each test sieve size as defined by the JMF. The percentage of aggregate passing each standard sieve shall fall within the specified control points as shown in Tables M.04.02-2 thru Table M.04.02-5. A change in the JMF requires that a new chart be submitted.

ii. Superpave Mixtures with RAP: Use of approved RAP may be allowed with the following conditions:

- RAP amounts up to 15% may be used with no binder grade modification.
- RAP amounts up to 20% may be used provided a new JMF is approved by the Engineer. The JMF submittal shall include the grade of virgin binder added. The JMF shall be accompanied by a blending chart and supporting test results in accordance with AASHTO M 323 Appendix X1, or by test results that show the combined binder (recovered binder from the RAP, virgin binder at the mix design proportions, warm mix asphalt additive and any other modifier if used) meets the requirements of the specified binder grade.
- Two representative samples of RAP shall be obtained. Each sample shall be split and one split sample shall be tested for binder content in accordance with AASHTO T 164 and the other in accordance AASHTO T 308.

Unless approved by the Engineer, RAP material shall not be used with any other recycling option.

iii. Superpave Mixtures with RAS: Use of RAS may be allowed solely in HMA S1 mixtures with the following conditions:

- RAS amounts up to 3% may be used.
- RAS total binder replacement up to 15% may be used with no binder grade modification.
- RAS total binder replacement up to 20% may be used provided a new JMF is approved by the Engineer. The JMF submittal shall include the grade of virgin binder added. The JMF shall be accompanied by a blending chart and supporting test results in accordance to AASHTO M 323 appendix X1 or by test results that show the combined binder (recovered binder from the RAP, virgin binder at the mix design proportions, warm mix asphalt additive and any other modifier if used) meets the requirements of the specified binder grade.
- Superpave Mixtures with RAS shall meet AASHTO PP 78 design considerations. The RAS asphalt binder availability factor (F) used in AASHTO PP 78 Equation 2 shall be 0.85.

iv. Superpave Mixtures with CRCG: In addition to the requirements in M.04.02 – 2 a through c, for bituminous concrete mixtures that contain CRCG, the Contractor shall submit a materials certificate to the Engineer stating that the CRCG complies with requirements stated in Article M.04.01, as applicable. Additionally, 1% hydrated lime, or other accepted non-stripping agent, shall be added to all mixtures containing CRCG. CRCG material shall not be used with any other recycling option.

b. Basis of Approval: On an annual basis, the Contractor shall submit to the Engineer any bituminous concrete mix design, and JMF anticipated for use on Department projects. Prior to the start of any paving operations, the mix design and JMF must be approved by the Engineer. Bituminous concrete mixture supplied to the project without an approved mix design and JMF will be rejected. The following information must be included in the mix design submittal:

i. Gradation, consensus properties and specific gravities of the aggregate, RAP, and RAS.
ii. Average asphalt content of the RAP and RAS by AASHTO T 164.
iii. Source of RAP and RAS and percentage to be used.
iv. Warm mix Technology and manufacturer's recommended additive rate and tolerances.
v. TSR test report, and, if applicable, anti-strip manufacturer and recommended dosage rate.
vi. Mixing and compaction temperature ranges for the mix with and without the warm-mix technology incorporated.
vii. JMF ignition oven correction factor by AASHTO T 308.

The JMF shall be accepted if the Plant mixture and materials meet all criteria as specified in Tables M.04.02-2 thru Table M.04.02-5. If the mixture does not meet the requirements, the contractor shall adjust the JMF within the ranges shown in Tables M.04.02-2 thru Table M.04.02-5 until an acceptable mixture is produced. All equipment, tests, and computations shall conform to the latest AASHTO R 35 and AASHTO M 323.

Any JMF, once approved, shall only be acceptable for use when it is produced by the designated plant, it utilizes the same component aggregates and binder source, and it continues to meet all criteria as specified herein, and component aggregates are maintained within the tolerances shown in Table M.04.02-2.

The Contractor shall not change any component source of supply including consensus properties after a JMF has been accepted. Before a new source of materials is used, a revised JMF shall be submitted to the Engineer for approval. Any approved JMF applies only to the plant for which it was submitted. Only one mix with one JMF will be approved for production at any one time. Switching between approved JMF mixes with different component percentages or sources of supply is prohibited.

c. Mix Status: Each facility will have each type of bituminous concrete mixture evaluated based on the previous year of production, for the next construction paving season, as determined by the Engineer. Based on the rating a type of mixture receives it will determine whether the mixture can be produced without the completion of a PPT. Ratings will be provided to each bituminous concrete producer annually prior to the beginning of the paving season.

The rating criteria are based on compliance with Air Voids and Voids in Mineral Aggregate (VMA) as indicated in Table M.04.03-3: *Superpave Master Range for Bituminous Concrete Mixture Production*, and are as follows:

Criteria A: Based on Air Voids. Percentage of acceptance results with passing air voids.

Criteria B: Based on Air Voids and VMA. The percentage of acceptance results with passing VMA, and the percentage of acceptance results with passing air voids, will be averaged.

The final rating assigned will be the lower of the rating obtained with Criteria A or Criteria B.

Ratings are defined as:

"A" – Approved:
A rating of "A" is assigned to each mixture type from a production facility with a current rating of 70% passing or greater.

"PPT" – Pre-Production Trial:
Rating assigned to each mixture type from a production facility when:

1. there are no passing acceptance production results submitted to the Department from the previous year;
2. there is a source change in one or more aggregate components from the JMF on record by more than 10% by weight;
3. there is a change in RAP percentage;
4. the mixture has a rating of less than 70% from the previous season;
5. a new JMF not previously submitted.

Bituminous concrete mixtures rated with a "PPT" cannot be shipped or used on Department projects. A passing "PPT" test shall be performed with NETTCP certified personnel on that type of mixture by the bituminous concrete producer and meet all specifications (Table M.04.02-2 Table M.04.02-5) before production shipment may be resumed.
Contractors that have mix types rated as "PPT" may use one of the following methods to change the rating to an "A."

Option A: Schedule a day when a Department inspector can be at the facility to witness a passing "PPT" test or,

Option B: When the Contractor or their representative performs a "PPT" test without being witnessed by an inspector, the Contractor shall submit the test results and a split sample including 2 gyratory molds, 5,000 grams of boxed bituminous concrete for binder and gradation determination, and 5,000 grams of cooled loose bituminous concrete for Gmm determination for verification testing and approval. Passing verifications will designate the bituminous concrete type to

be on an "A" status. Failing verifications will require the contractor to submit additional trials.

Option C: When the Contractor or their representative performs a "PPT" test without being witnessed by a Department inspector, the Engineer may verify the mix in the Contractor's laboratory. Passing verifications will designate the bituminous concrete type to be an "A" status. Failing verifications will require the Contractor to submit additional trials.

When Option (A) is used and the "PPT" test meets all specifications, the "PPT" test is considered a passing test and the rating for that mix is changed to "A". When the "PPT" test is not witnessed, the "PPT" Option (B) or (C) procedure must be followed. If the "PPT" Option (B) procedure is followed, the mixtures along with the test results must be delivered to the Materials Testing Lab. The test results must meet the "C" tolerances established by the Engineer. The tolerance Table is included in the Department's current QA Program for Materials, Acceptance and Assurance Testing Policies and Procedures.

"U" – No Acceptable Mix Design on File:

Rating assigned to a type of mixture that does not have a JMF submitted, or the JMF submitted has not been approved, or is incomplete. A mix design or JMF must be submitted annually seven (7) days prior in order to obtain an "A," or "PPT" status for that mix. A "U" will be used only to designate the mix status until the mix design has been approved, and is accompanied with all supporting data as specified. Bituminous concrete mixtures rated with a "U" cannot be used on Department projects.

TABLE M.04.02– 2: Superpave Master Range for Bituminous Concrete Mixture Design Criteria

Notes: (1) Minimum Pb as specified in Table M.04.02-5. (2) Voids in Mineral Aggregates shall be computed as specified in AASHTO R 35. (3) Control point range is also defined as the master range for that mix. (4) Dust is considered to be the percent of materials passing the #200 sieve. (5) For WMA, lower minimum aggregate temperature will require Engineer's approval. (6) For WMA and PMA, the mix temperature shall meet manufacturer's recommendations.

	S0.25		**S0.375**		**S0.5**		**S1**	
Sieve	CONTROL POINTS (3)		CONTROL POINTS(3)		CONTROL POINTS(3)		CONTROL POINTS(3)	
inches	Min (%)	Max (%)	Min (%)	Max (%)	Min (%)	Max (%)	Min (%)	Max (%)
2.0	-	-	-	-	-	-	-	-
1.5	-	-	-	-	-	-	100	-
1.0	-	-	-	-	-	-	90	100
3/4	-	-	-	-	100	-	-	90
1/2	100	-	100	-	90	100	-	-
3/8	97	100	90	100	-	90	-	-
#4	-	90	-	90	-	-	-	-
#8	32	67	32	67	28	58	19	45
#16	-	-	-	-	-	-	-	-
#30	-	-	-	-	-	-	-	-
#50	-	-	-	-	-	-	-	-
#100	-	-	-	-	-	-	-	-
#200	2.0	10.0	2.0	10.0	2.0	10.0	1.0	7.0
Pb (1)	-	-	-	-	-	-	-	-
VMA (2) (%)	16.0 ± 1		16.0 ± 1		15.0 ± 1		13.0 ± 1	
VA (%)	4.0 ± 1		4.0 ± 1		4.0 ± 1		4.0 ± 1	
Gse	JMF value		JMF value		JMF value		JMF value	
Gmm	JMF ± 0.030		JMF ± 0.030		JMF ± 0.030		JMF ± 0.030	
Dust/Pbe(4)	0.6 – 1.2		0.6 – 1.2		0.6 – 1.2		0.6 – 1.2	
Agg. Temp(5)	280 – 350°F		280 – 350°F		280 – 350°F		280 – 350°F	
Mix Temp(6)	265 – 325°F		265 – 325°F		265 – 325°F		265 – 325°F	
Design TSR	≥ 80%		≥ 80%		≥ 80%		≥ 80%	
T-283 Stripping	Minimal, as determined by the Engineer							

TABLE M.04.02–3: Superpave Master Range for Consensus Properties of Combined Aggregate Structures

Notes: (1) If less than 25 % of a given layer is within 4 inches of the anticipated top surface, the layer may be considered to be below 4 inches for mixture design purposes.

Traffic Level	Design ESALs (80 kN)	Coarse Aggregate Angularity (1) ASTM D 5821	Fine Aggregate Angularity (7) AASHTO T 304	Flat and Elongated Particles ASTM D 4791	Sand Equivalent AASHTO T 176
-----	(million)			>#4	-----
1*	< 0.3	55/- -	40	10	40
2	0.3 to < 3.0	75/- -	40	10	40
3	≥ 3.0	95/90	45	10	45
	Design ESALs are the anticipated project traffic level expected on the design lane, projected over a 20 year period, regardless of the actual expected design life of the roadway.	Criteria presented as minimum values. 95/90 denotes that a minimum of 95% of the coarse aggregate, by mass, shall have one fractured face and that a minimum of 90% shall have two fractured faces.	Criteria presented as minimum percent air voids in loosely compacted fine aggregate passing the #8 sieve.	Criteria presented as maximum Percent by mass of flat and elongated particles of materials retained on the #4 sieve, determined at 5:1 ratio.	Criteria presented as minimum values for fine aggregate passing the #8 sieve.

*** NOTE: Level 1 for use by Towns and Municipalities ONLY.**

TABLE M.04.02– 4: Superpave Master Range for Traffic Levels and Design Volumetric Properties

Traffic Level	Design ESALs	Number of Gyrations by Superpave Gyratory Compactor			Percent Density of Gmm from HMA/WMA specimen			Voids Filled with Asphalt (VFA) Based on Nominal mix size – inch			
	(million)	Nini	Ndes	Nmax	Nini	Ndes	Nmax	0.25	0.375	0.5	1
1*	< 0.3	6	50	75	≤ 91.5	96.0	≤ 98.0	70 - 80	70 - 80	70 - 80	67 - 80
2	0.3 to < 3.0	7	75	115	≤ 90.5	96.0	≤ 98.0	65 - 78	65 - 78	65 - 78	65 - 78
3	≥ 3.0	8	100	160	≤ 90.0	96.0	≤ 98.0	73 – 76	73 - 76	65 - 75	65 - 75

*** NOTE: Level 1 for use by Towns and Municipalities ONLY.**

TABLE M.04.02– 5:
Superpave Minimum Binder Content by Mix Type and Level

Mix Type	Level	Binder Content Minimum (1)
S0.25	1*	5.6
S0.25	2	5.5
S0.25	3	5.4
S0.375	1*	5.6
S0.375	2	5.5
S0.375	3	5.4
S0.5	1*	5.0
S0.5	2	4.9
S0.5	3	4.8
S1	1*	4.6
S1	2	4.5
S1	3	4.4

*** NOTE: Level 1 for use by Towns and Municipalities ONLY.**

M.04.03— Production Requirements:

1. Standard Quality Control Plan (QCP) for Production:

The QCP for production shall describe the organization and procedures which the Contractor shall use to administer quality control. The QCP shall include the procedures used to control the production process, to determine when immediate changes to the processes are needed, and to implement the required changes. The QCP must detail the inspection, sampling and testing protocols to be used, and the frequency for each.

Control Chart(s) shall be developed and maintained for critical aspect(s) of the production process as determined by the Contractor. The control chart(s) shall identify the material property, applicable upper and lower control limits, and be updated with current test data. As a minimum, the following quality characteristics shall be included in the control charts: percent passing #4 sieve, percent passing #200 sieve, binder content, air voids, Gmm and VMA. The control chart(s) shall be used as part of the quality control system to document variability of the bituminous concrete production process. The control chart(s) shall be submitted to the Engineer the first day of each month.

The QCP shall also include the name and qualifications of a Quality Control Manager. The Quality Control Manager shall be responsible for the administration of the QCP, including compliance with the plan and any plan modifications.

The Contractor shall submit complete production testing records to the Engineer within 24 hours in a manner acceptable to the Engineer.

The QCP shall also include the name and qualifications of any outside testing laboratory performing any QC functions on behalf of the Contractor. The QCP must also include a list of sampling & testing methods and frequencies used during production, and the names of all Quality Control personnel and their duties.

Approval of the QCP does not imply any warranty by the Engineer that adherence to the plan will result in production of bituminous concrete that complies with these specifications. The Contractor shall submit any changes to the QCP as work progresses.

2. Acceptance Sampling & Testing Methods:

i. General:

Acceptance samples of mixtures shall be obtained from the hauling vehicles and tested by the Contractor at the facility during each day's production.

The Contractor shall submit all acceptance tests results to the Engineer within 24 hours or prior to the next day's production. All acceptance test specimens and supporting documentation must be retained by the Contractor. Verification testing will be performed by the Engineer in accordance with the Department's QA Program for Materials. Labeled Acceptance test specimens shall be retained at the production facilities and may be disposed of with the approval of the Engineer. All Quality Control specimens shall be clearly labeled and separated from the Acceptance specimens.

Should the Department be unable to verify the Contractor's acceptance test result(s) due to a failure of the Contractor to retain acceptance test specimens or supporting documentation, the Contractor shall review its quality control plan, determine the cause of the nonconformance and respond in writing within 24 hours to the Engineer describing the corrective action taken at the plant. In addition, the Contractor must provide supporting documentation or test results to validate the subject acceptance test result(s). The Engineer may invalidate any positive adjustments for material corresponding to the acceptance test(s). Failure of the Contractor to adequately address quality control issues at a facility may result in suspension of production for Department projects at that facility.

Contractor personnel performing acceptance sampling and testing must be present at the facility prior to, during, and until completion of production, and be certified as a NETTCP HMA Plant Technician or Interim HMA Plant Technician and be in good standing. Production of material for use on State projects must be suspended by the Contractor if such personnel are not present.

Technicians found by the Engineer to be non-compliant with NETTCP or Department policies may be removed by the Engineer from participating in the acceptance testing process for Department projects until their actions can be reviewed.

Anytime during production that testing equipment becomes inoperable, production can continue for a maximum of 1 hour. The Contractor shall obtain box sample(s) in accordance with Table M.04.03-1 to satisfy the daily acceptance testing requirement for the quantity shipped to the project. The box sample(s) shall be tested once the equipment issue has been resolved to the satisfaction of the Engineer. Production beyond 1 hour may be considered by the Engineer. Production will not be permitted beyond that day until the subject equipment issue has been resolved.

ii. Curb Mix Acceptance Sampling and Testing Procedures:

Curb Mixes shall be tested by the Contractor at a frequency of one test per every 250 tons of cumulative production, regardless of the day of production.

When these mix designs are specified, the following acceptance procedures and AASHTO test methods shall be used:

TABLE M.04.03 – 2: Curb Mix Acceptance Test Procedures

Protocol	Reference	Description
1	**AASHTO T 30(M)**	Mechanical Analysis of Extracted Aggregate
2	**AASHTO T 168**	Sampling of Bituminous Concrete
3	**AASHTO T 308**	Binder content by Ignition Oven method (adjusted for aggregate correction factor)
4	**AASHTO T 209(M)**	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
5	**AASHTO T 312**	Superpave Gyratory molds compacted to N_{des}
6	**AASHTO T 329**	Moisture Content of Hot-Mix Asphalt (HMA) by Oven Method

a. Determination of Off-Test Status:

i. The test results of AASHTO T 308 and T 30(M) will be used to determine if the mixture is within the tolerances shown in Table M.04.02-1. Curb Mixtures are considered “off test" when the test results indicate that any single value for bitumen content or gradation are not within the tolerances shown in Table M.04.02-1 for that mixture. If the mix is “off test”, the Contractor must take immediate actions to correct the deficiency and a new acceptance sample shall be tested on the same day or the following day of production.

ii. When multiple plants and silos are located at one site, mixture supplied to one project is considered as coming from one source for the purpose of applying the “off test” status.

iii. The Engineer may cease supply from the plant when test results from three consecutive samples are not within the JMF tolerances or the test results from two consecutive samples not within the master range indicated in Table M.04.02-1 regardless of production date.

b. JMF Changes

i. If a test indicates that the bitumen content or gradation are outside the tolerances, the Contractor may make a single JMF change as allowed by the Engineer prior to any additional testing. A JMF change shall include the date and name of the Engineer that allowed it. Consecutive test results outside the requirements of Table M.04.02-1 JMF tolerances may result in rejection of the mixture.

ii. Any modification to the JMF shall not exceed 50% of the JMF tolerances indicated in Table M.04.02-1 for any given component of the mixture without approval of the Engineer. When such an adjustment is made to the bitumen, the corresponding production percentage of bitumen shall be revised accordingly.

iii. Superpave Mix Acceptance Sampling and Testing Procedures:

The hauling vehicle from which samples are obtained shall be selected using stratified – random sampling based on the total estimated tons of production in accordance with ASTM D 3665, except that the first test shall be randomly taken from the first 151 tons or as directed by the Engineer. The Engineer may request a second acceptance test within the first sub lot. One acceptance test shall always be performed in the last sub-lot based on actual tons of material produced.

The number of sub lots/acceptance tests is based on the total production per day as indicated in Table M.04.03-1. Quantities of the same type/level mix per plant may be combined daily for multiple state projects to determine the number of sub lots. The Engineer may direct that additional acceptance samples be obtained to represent materials actually being delivered to the project.

The payment adjustment for air voids and liquid binder will be calculated per sub lot as described in Section 4.06.

An acceptance test shall not be performed within 150 tons of production from a previous acceptance test unless approved by the Engineer. Quality Control tests are not subject to this restriction. Unless otherwise tested, a minimum of one (1) acceptance test shall be performed for every four days of production at a facility for each type/level mix (days of production may or may not be consecutive days).

TABLE M.04.03 – 1:
Superpave Acceptance Testing Frequency per Type/Level/Plant

Daily quantity produced in tons (lot)	Number of Sub Lots/Tests
0 to 150	0, Unless requested by the Engineer
151 to 600	1
601 to 1,200	2
1,201 to 1,800	3
1,801 or greater	1 per 600 tons or portions thereof

When the Superpave mix design is specified, the following acceptance and AASHTO test procedures shall be used:

TABLE M.04.03– 3: Superpave Acceptance Testing Procedures

Protocol	Reference	Description
1	AASHTO T 168	Sampling of bituminous concrete
2	AASHTO R 47	Reducing samples to testing size
3	AASHTO T 308	Binder content by Ignition Oven method (adjusted for aggregate correction factor)
4	AASHTO T 30	Gradation of extracted aggregate for bituminous concrete mixture
5	AASHTO T 312	(1)Superpave Gyratory molds compacted to N_{des}
6	AASHTO T 166	(2)Bulk specific gravity of bituminous concrete
7	AASHTO R 35	(2)Air voids, VMA
8	AASHTO T 209(M)	Maximum specific gravity of bituminous concrete (average of two tests)
9	AASHTO T 329	Moisture content of Production bituminous concrete

Notes: **(1)** One set equals two six-inch molds. Molds to be compacted to Nmax for PPTs and to Ndes for production testing. The first sublot of the year will be compacted to N_{max}
(2) Average value of one set of six-inch molds.

If the average corrected Pb content differs by 0.3% or more from the average bituminous concrete facility production delivery ticket in five (5) consecutive tests regardless of the production date (moving average), the Contractor shall immediately investigate, determine an assignable cause and correct the issue. When two consecutive moving average differences are 0.3% or more, the Engineer may require a new aggregate correction factor.

The test specimen must be ready to be placed in an approved ignition furnace for testing in accordance with AASHTO T 308 within thirty minutes of being obtained from the hauling vehicle and the test shall start immediately after.

The Contractor shall perform moisture susceptibility (TSR) testing annually for all design levels of HMA-, WMA-, and PMA- S0.5 plant-produced mixtures, in accordance with the latest version of AASHTO T 283(M).

If any material source changes from the previous year, or during the production season, a mix design TSR as well as a production TSR is required for the new mixture. The AASHTO T 283(M) test shall be performed at an AASHTO Materials Reference Laboratory (AMRL) by NETTCP Certified Technicians. The test results and specimens shall be submitted to the Engineer for review. This shall be completed within 30 days from the start of production. Superpave mixtures that require anti-strip additives (either liquid or mineral) shall continue to meet all requirements specified herein for binder and bituminous concrete. The Contractor shall submit the name, manufacturer, percent used, technical datasheet and SDS for the anti-strip additive (if applicable) to the Engineer. In addition, compaction of samples shall be accomplished utilizing an accepted Superpave Gyratory Compactor (SGC), supplied by the Contractor. The SGC shall be located at the facility supplying mixture to the project.

a. Determination of Off-Test Status:

i. Superpave mixes shall be considered *"off test"* when any Control Point Sieve, VA, VMA, and Gmm values are outside of the limits specified in Table M.04.03-4 and the computed binder content (Pb) established by AASHTO T308 or as documented on the vehicle delivery ticket is below the minimum binder content stated in sub article M.04.02-5. Note that further testing of samples or portions of samples not initially tested for this purpose cannot be used to change the status.

ii. Any time the bituminous concrete mixture is considered Off-test:

1. The Contractor shall notify the Engineer (and project staff) when the plant is *"off test"* for a type of mixture. When multiple plants and silos are located at one site, mixture supplied to one project is considered as coming from one source for the purpose of applying the *"off test"* determination.

2. The Contractor must take immediate actions to correct the deficiency, minimize *"off test"* production to the project, and obtain an additional Process Control (PC) test after any corrective action to verify production is in conformance to the specifications. A PC test will not be used for acceptance and is solely for the use of the Contractor in its quality control process.

b. Cessation of Supply for Superpave Mixtures with no Payment Adjustment: Production of bituminous concrete shall cease for the Project from any plant that consistently fails to produce mixture that meets the JMF and volumetric properties. The quantity of Superpave mixtures shipped to the project that is "off-test" will not be adjusted for deficient mixtures.

A Contractor shall cease to supply mixture from a plant when:

1. Bituminous concrete mixture is "off test" on three (3) consecutive tests for any combination of VMA or Gmm, regardless of date of production.

2. Bituminous concrete mixture is "off test" on two (2) consecutive tests for the Control Point sieves in one day's production.

Following cessation, the Contractor shall immediately make necessary material or process corrections and run a Pre-Production Trial (PPT) for that type of mixture. Use of that type of mixture from that plant will be prohibited on the Project until the Contractor has demonstrated the ability to produce acceptable mixture from that facility. When the Contractor has a passing test and has received approval from the Engineer, the use of that mixture to the Project may resume.

c. Cessation of Supply for Superpave Mixtures with Payment Adjustment: Production of bituminous concrete shall cease for the Project from any plant that consistently fails to produce mixture that meets the Superpave minimum binder content by mix type and level listed in Table M.04.02-5. The quantity of Superpave mixtures shipped to the project that is "off-test" will be adjusted for deficient mixtures in accordance with Section 4.06.

A Contractor shall cease to supply mixture from a plant when:

1. The binder content (Pb) is below the requirements of Table M.04.02-5 on the ignition oven test result after two (2) consecutive tests, regardless of the date of production.

2. The air voids (VA) is outside the requirements of Table M.04.03-4 after three (3) consecutive tests, regardless of the date of production.

Following cessation, the Contractor shall immediately make necessary material or process corrections and run a Pre-Production Trial (PPT) for that type of mixture. Use of that type of mixture from that plant will be prohibited on the Project until the Contractor has demonstrated the ability to produce acceptable mixture from that facility. When the Contractor has a passing test and has received approval from the Engineer, the use of that mixture to the Project may resume.

d. JMF Changes for Superpave Mixture Production: It is understood that a JMF change is effective from the time it was submitted forward and is not retroactive to the previous test or tests. JMF changes are permitted to allow for trends in aggregate and mix properties but every effort shall be employed by the Contractor to minimize this to ensure a uniform

and dense pavement. A revised JMF submittal shall include the date and name of the Engineer that allowed it.

JMF changes are only permitted prior to or after a production shift for all bituminous-concrete types of mixtures and only when they:

i. Are requested in writing and pre-approved by the Engineer.
ii. Are based on a minimum of a two test trend.
iii. Are documented with a promptly submitted revised JMF on the form provided by the Engineer.
iv. A revised JMF submittal shall include the date and name of the Engineer that allowed it.

No change will be made on any aggregate or RAP consensus property or specific gravity unless the test is performed at an AASHTO Materials Reference Laboratory (AMRL) by NETTCP Certified Technicians.

A JMF change shall be submitted every time the plant target RAP and/or bin percentage deviates by more than 5% and/or the plant target binder content deviates by more than 0.15% from the active JMF.

TABLE M.04.03– 4: Superpave Master Range for Bituminous Concrete Mixture Production

Notes: (1) 300°F minimum after October 15. (2) Minimum Pb as specified in Table M.04.02-5 (3) Control point range is also defined as the master range for that mix. (4) JMF tolerances shall be defined as the limits for production compliance. VA & Pb payment is subject to adjustments, as defined in sub-article 4.06.04 - 2. (5) For WMA, lower minimum aggregate temperature will require Engineer's approval. (6) For WMA and/or polymer modified asphalt, the mix temperature shall meet manufacturer's recommendations. In addition, for WMA, the maximum mix temperature shall not exceed 325°F once the WMA technology is incorporated.

	S0.25		**S0.375**		**S0.5**		**S1**		**Tolerances**
Sieve	CONTROL POINTS (4)		CONTROL POINTS (4)		CONTROL POINTS (4)		CONTROL POINTS (4)		**From JMF Targets** (4)
inches	Min(%)	Max(%)	Min(%)	Max(%)	Min(%)	Max(%)	Min(%)	Max(%)	±Tol
1.5	-	-	-	-	-	-	100	-	
1.0	-	-	-	-	-	-	90	100	
3/4	-	-	-	-	100	-	-	90	
1/2	100	-	100	-	90	100	-	-	
3/8	97	100	90	100	-	90	-	-	
#4	-	90	-	90	-	-	-	-	
#8	32	67	32	67	28	58	19	45	
#16	-	-	-	-	-	-	-	-	
#200	2.0	10.0	2.0	10.0	2.0	10.0	1.0	7.0	
Pb(2)	-	-	-	-	-	-	-	-	note (2)
VMA (%)	16.0		16.0		15.0		13.0		1.0
VA (%)	4.0		4.0		4.0		4.0		1.0
Gmm	JMF value		JMF value		JMF value		JMF value		0.030
Agg. Temp (5)	280 – 350F		280 – 350F		280 – 350F		280 – 350F		
Mix Temp (6)	265 – 325 F (1)		265 – 325 F (1)		265 – 325 F (1)		265 – 325 F (1)		
Prod. TSR	N/A		N/A		≥80%		N/A		
T-283 Stripping	N/A		N/A		Minimal as determined by the Engineer		N/A		

TABLE M.04.03– 5:
JMF Tolerances for Application of Positive Adjustments

Notes: (1) Only for S1 mixes.
(2) Only for S0.5 and S1 mixes.

Sieve	Tolerances From JMF Targets
inches	±Tol
3/4	9 (1)
1/2	9 (1)
3/8	9 (2)
#4	8
#8	7
#16	6
#200	3
Pb	0.4

TABLE M.04.03– 6:
Superpave Master Range for Traffic Levels and Design Volumetric Properties

Traffic Level	Design ESALs (million)	Number of Gyrations by Superpave Gyratory Compactor	
		Nini	Ndes
1*	< 0.3	6	50
2	0.3 to < 3.0	7	75
3	≥3.0	8	100

* NOTE: Level 1 for use by Towns and Municipalities ONLY.

TABLE M.04.03-7:
Modifications to Standard AASHTO and ASTM Test Specifications and Procedures

AASHTO Standard Specification	
Reference	**Modification**
M 140	Emulsified Asphalt grade RS-1H shall meet all the requirements of the emulsified asphalt grade RS-1 except for the penetration requirement of the residue that will change from 100 to 200 penetration units (0.1 mm) to 40 to 90 penetration units (0.1 mm).
AASHTO Standard Method of Test	
Reference	**Modification**
T 30	Section 7.2 thru 7.4 Samples are not routinely washed for production testing
T 168	Samples are taken at one point in the pile. Samples from a hauling vehicle are taken from only one point instead of three as specified. Selection of Samples: Sampling is equally important as the testing, and the sampler shall use every precaution to obtain samples that are truly representative of the bituminous mixture. Box Samples: In order to enhance the rate of processing samples taken in the field by construction or maintenance personnel the samples will be tested in the order received and data processed to be determine conformance to material specifications and to prioritize inspections by laboratory personnel.
T 195	Section 4.3 only one truck load of mixture is sampled. Samples are taken from opposite sides of the load.
T 209	Section 7.2 The average of two bowls is used proportionally in order to satisfy minimum mass requirements. 8.3 Omit Pycnometer method.
T 283	When foaming technology is used, the material used for the fabrication of the specimens shall be cooled to room temperature, and then reheated to the manufactures recommended compaction temperature prior to fabrication of the specimens.
T 331	6.1 Cores are dried to a constant mass prior to testing using a core-dry machine.

AASHTO Standard Recommended Practices	
Reference	**Modification**
R 26	Quality Control Plans must be formatted in accordance with AASHTO R 26, certifying suppliers of performance-graded asphalt binders, Section 9.0, Suppliers Quality Control Plan, and "NEAUPG Model PGAB QC Plan." 1. The Department requires that all laboratory technician(s) responsible for testing PG-binders be certified or Interim Qualified by the New England Transportation Technician Certification Program (NETTCP) as a PG Asphalt Binder Lab Technician. 2. Sampling of asphalt binders should be done under the supervision of qualified technician. NECTP "Manual of Practice," Chapter 2 Page 2-4 (Key Issues 1-8). 3. A copy of the Manual of Practice for testing asphalt binders in accordance with the Superpave PG Grading system shall be in the testing laboratory. 4. All laboratories testing binders for the Department are required to be accredited by the AASHTO Materials Reference Laboratory (AMRL). 5. Sources interested in being approved to supply PG-binders to the Department by use of an "in-line blending system," must record properties of blended material, and additives used. 6. Each source of supply of PG-binder must indicate that the binders contain no additives used to modify or enhance their performance properties. Binders that are manufactured using additives, modifiers, extenders etc., shall disclose the type of additive, percentage and any handling specifications/limitations required. 7. All AASHTO M 320 references shall be replaced with AASHTO M 332. 8. Each year, in April and September, the supplier shall submit test results for two BBR testing at two different temperatures in accordance with AASHTO R 29. Suppliers shall provide AASHTO M 332 testing results and split samples at a minimum of once per lot.

ON-THE-JOB TRAINING (OJT) WORKFORCE DEVELOPMENT PILOT

Description

To provide construction industry related job opportunities to minorities, women and economically disadvantaged individuals; and to increase the likelihood of a diverse and inclusive workforce on Connecticut Department of Transportation (ConnDOT) projects.

All contractors (existing and newcomers) will be automatically placed in the Workforce Development Pilot. Standard OJT requirements typically associated with individual projects will no longer be applied at the project level for new projects. Instead, these requirements will be applicable on an annual basis for each contractor performing work on ConnDOT projects.

The OJT Workforce Development Pilot will allow a contractor to train employees on Federal, State and privately funded projects located in Connecticut. However, contractors should give priority to training employees on ConnDOT Federal-Aid funded projects.

Funding

The Department will establish an OJT fund annually from which contractors may bill the Department directly for eligible trainee hours. The funds for payment of trainee hours on federal-aid projects will be allocated from the ½ of 1% provided for OJT funding, and will be based on hours trained, not to exceed a maximum of $25,000.00 per year; per contractor.

Minorities and Women

Developing, training and upgrading of minorities, women and economically disadvantaged individuals toward journeyperson level status is the primary objective of this special training provision. Accordingly, the Contractor shall make every effort to enroll minority, women and economically disadvantaged individuals as trainees to the extent that such persons are available within a reasonable area of recruitment. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training whether a member of a minority group or not.

Assigning Training Goals

The Department, through the OJT Program Coordinator, will assign training goals for a calendar year based on the contractor's past two year's activities and the contractor's anticipated upcoming year's activity with the Department. At the beginning of each year, all contractors eligible will be contacted by the Department to determine the number of trainees that will be assigned for the upcoming calendar year. At that time, the Contractor shall enter into an agreement with the Department to provide a self-imposed on-the-job training program for the calendar year. This agreement will include a specific number of annual training goals agreed to by both parties. The number of training assignments may range from one (1) to six (6) per

contractor per calendar year. Each January, a summary of the trainees required and the OJT Workforce Development Pilot package will be sent to participating contractors. The number of trainees assigned to each contractor in the summary will increase proportionately not to exceed 6, as shown in the following table. This package will also be provided to contractors as they become newly eligible for the OJT Workforce Development Pilot throughout the remainder of the year. Projects awarded after September 30 will be included in the following year's Program.

The dollar thresholds for training assignments are as follows:

$4.5 – 8 million=	1 trainee
$ 9 – 15 million=	2 trainees
$16 – 23 million=	3 trainees
$24 – 30 million=	4 trainees
$31 – 40 million=	5 trainees
$41 – and above=	6 trainees

Training Classifications

Preference shall be given to providing training in the following skilled work classifications. However, the classifications established are not all6inclusive:

Equipment Operators	Electricians
Laborers	Painters
Carpenters	Iron / Reinforcing Steel Workers
Concrete Finishers	Mechanics
Pipe Layers	Welders

The Department has on file common training classifications and their respective training requirements; that may be used by the contractors. Contractors shall submit new classifications for specific job functions that their employees are performing. The Department will review and recommend for acceptance the new classifications proposed by contractors, if applicable. New classifications shall meet the following requirements:

Proposed training classifications are reasonable and realistic based on the job skill classification needs, and the number of training hours specified in the training classification is consistent with common practices and provides enough time for the trainee to obtain journeyman level status.

Where feasible, 25% percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. The number of trainees shall be distributed among the work classifications on the basis of the contractor's needs and the availability of journeymen in the various classifications within a reasonable area of recruitment.

No employee shall be employed as a trainee in any classification in which they have successfully completed a training course leading to journeyman level status or in which they have been employed as a journeyman.

Records and Reports

The Contractor shall maintain enrollment in the program and submit all required reports documenting company compliance under these contract requirements. These documents and any other information shall be submitted to the OJT Program Coordinator as requested.

Upon the trainee's completion and graduation from the program, the Contractor shall provide each trainee with a certification Certificate showing the type and length of training satisfactorily completed.

Trainee Interviews

In order to determine the continued effectiveness of the OJT Program in Connecticut, the department will periodically conduct personal interviews with current trainees and may survey recent graduates of the program. This enables the OJT Program Coordinator to modify and improve the program as necessary. Trainee interviews are generally conducted at the job site to ensure that the trainees' work and training is consistent with the approved training program.

Trainee Wages

Contractors shall compensate trainees on a graduating pay scale based upon a percentage of the prevailing minimum journeyman wages (Davis-Bacon Act). Minimum pay shall be as follows:

60 percent	of the journeyman wage for the first half of the training period
75 percent	of the journeyman wage for the third quarter of the training period
90 percent	of the journeyman wage for the last quarter of the training period

In no case, will the trainee be paid less than the prevailing rate for general laborer as shown in the contract wage decision (must be approved by the Department of Labor).

Achieving or Failing to Meet Training Goals

The Contractor will be credited for each trainee currently enrolled or who becomes enrolled in the approved training program and providing they receive the required training under the specific training program. Trainees will be allowed to be transferred between projects if required by the Contractor's schedule and workload. The OJT Program Coordinator must be notified of transfers within five (5) days of the transfer or reassignments by e-mail (Phylisha.Coles@ct.gov).

Where a contractor does not or cannot achieve its annual training goal with female or minority trainees, they must produce adequate Good Faith Efforts documentation. Good Faith Efforts are those designed to achieve equal opportunity through positive, aggressive, and continuous result-oriented measures. 23 CFR § 230.409(g) (4). Contractors should request minorities and females from unions when minorities and females are under-represented in the contractor's workforce.

Whenever a contractor requests ConnDOT approval of someone other than a minority or female, the contractor must submit documented evidence of its Good Faith Efforts to fill that position with a minority or female. When a non-minority male is accepted, a contractor must continue to attempt to meet its remaining annual training goals with females and minorities.

Where a contractor has neither attained its goal nor submitted adequate Good Faith Efforts documentation, ConnDOT will issue a letter of non-compliance. Within thirty (30) days of receiving the letter of non-compliance, the contractor must submit a written Corrective Action Plan (CAP) outlining the steps that it will take to remedy the non-compliance. The CAP must be approved by ConnDOT. Failure to comply with the CAP may result in your firm being found non-responsive for future projects.

Measurement and Payment

Optional reimbursement will be made to the contractor for providing the required training under this special provision on ConnDOT Federal6Aid funded projects only.

Contractor will be reimbursed at $0.80 for each hour of training given to an employee in accordance with an approved training or apprenticeship program. This reimbursement will be made even though the Contractor receives additional training program funds from other sources, provided such other source does not specifically prohibit the contractor from receiving other reimbursement.

Reimbursement for training is made annually or upon the trainees completion and not on a monthly basis. No payment shall be made to the Contractor if either the failure to provide the required training, or the failure to hire the trainee as a journeyperson, is caused by the Contractor.

Program reimbursements will be made directly to the prime contractor on an annual basis. To request reimbursement, prime contractors must complete the Voucher for OJT Workforce Development Pilot Hourly Reimbursement for each trainee in the OJT Program. This form is included in the OJT Workforce Development Pilot package and is available on the Department's web site at:

www.ct.gov/dot

The completed form must be submitted to the Office of Contract Compliance for approval. The form is due on the 15th day of January for each trainee currently enrolled and for hours worked on ConnDOT Federal6Aid funded projects only.

SMALL CONTRACTOR AND SMALL CONTRACTOR MINORITY BUSINESS ENTERPRISES (SET-ASIDE)

March, 2001

NOTE: Certain of the requirements and procedures stated in this "Special Provision" are applicable prior to the execution of the Contract.

I. GENERAL

A. The Contractor shall cooperate with the Connecticut Department of Transportation (CONNDOT) in implementing the required contract obligations concerning "Small Contractor" and "Small Contractor Minority Business Enterprise" use on this Contract in accordance with Section 4a-60g of the Connecticut General Statutes as revised. References, throughout this "Special Provision", to "Small Contractors" are also implied references to "Small Contractor Minority Business Enterprises" as both relate to Section IIA of these provisions. The Contractor shall also cooperate with CONNDOT in reviewing the Contractor's activities relating to this provision. This "Special Provision" is in addition to all other equal opportunity employment requirements of this Contract.

B. For the purpose of this "Special Provision", the "Small Contractor(s)" and "Minority Business Enterprise(s)" named to satisfy the set-aside requirement must be certified by the Department of Administrative Services, Business Connections/ Set-Aside Unit [(860) 713-5236 www.das.state.ct.us/busopp.htm] as a "Small Contractor" and "Minority Business Enterprises" as defined by Section 4a-60g Subsections (1) and (3) of the Connecticut General Statutes as revised and is subject to approval by CONNDOT to do the work for which it is nominated pursuant to the criteria stipulated in Section IIC-3.

C. Contractors who allow work which they have designated for "Small Contractor" participation in the pre-award submission required under Section IIC to be performed by other than the approved "Small Contractor" organization and prior to concurrence by CONNDOT, will not be paid for the value of the work performed by organizations other than the "Small Contractor" designated.

D. If the Contractor is unable to achieve the specified contract goals for "Small Contractor" participation, the Contractor shall submit written documentation to CONNDOT's Manager of Construction Operations indicating his/her good faith efforts to satisfy goal requirements. Documentation is to include but not be limited to the following:

1. A detailed statement of the efforts made to select additional subcontract opportunities for work to be performed by each "Small Contractor" in order to increase the likelihood of achieving the stated goal.

2. A detailed statement, including documentation of the efforts made to contact and solicit contracts with each "Small Contractor", including the names, addresses, dates and telephone numbers of each "Small Contractor" contacted, and a description of the information provided to each "Small Contractor" regarding the scope of services and anticipated time schedule of items proposed to be subcontracted and the nature of response from firms contacted.

3. For each "Small Contractor" that placed a subcontract quotation which the Contractor considered not to be acceptable, provide a detailed statement of the reasons for this conclusion.

4. Documents to support contacts made with CONNDOT requesting assistance in satisfying the contract specified or adjusted "Small Contractor" dollar requirements.

5. Document other special efforts undertaken by the Contractor to meet the defined goal.

E. Failure of the Contractor to have at least the specified dollar amount of this contract performed by "Small Contractor" as required in Section IIA of this "Special Provision" will result in the reduction in contract payment to the Contractor by an amount equivalent to that determined by subtracting from the specific dollar amount required in Section IIA, the dollar payments for the work actually performed by each "Small Contractor". The deficiency in "Small Contractor" achievement, will therefore, be deducted from the final contract payment. However, in instances where the Contractor can adequately document or substantiate its good faith efforts made to meet the specified or adjusted dollar amount to the satisfaction of CONNDOT, no reduction in payments will be imposed.

F. All records must be retained for a period of three (3) years following completion of the contract and shall be available at reasonable times and places for inspection by authorized representatives of CONNDOT.

G. Nothing contained herein, is intended to relieve any contractor or subcontractor or material supplier or manufacturer from compliance with all applicable Federal and State legislation or provisions concerning equal employment opportunity, affirmative action, nondiscrimination and related subjects during the term of this Contract.

II. **SPECIFIC REQUIREMENTS**

In order to increase the participation of "Small Contractors", CONNDOT requires the following:

A. Not less than 1.0 (%) percent of the **final** value of this Contract shall be subcontracted to and performed by, and/or supplied by, manufactured by and paid to "Small Contractors" and/or "Small Contractors Minority Business Enterprises".

If the above percentage is zero (0%) AND an asterisk (*) has been entered in the adjacent brackets [ ], this Contract is 100% solely set-aside for participation by "Small Contractors" and/or "Small Contractors Minority Business Enterprises".

B. The Contractor shall assure that each "Small Contractor" will have an equitable opportunity to compete under this "Special Provision", particularly by arranging solicitations, time for the preparation of Quotes, Scope of Work, and Delivery Schedules so as to facilitate the participation of each "Small Contractor".

C. The Contractor shall provide to CONNDOT's Manager of Contracts within Seven (7) days after the bid opening the following items:

1. An affidavit (Exhibit I) completed by each named "Small Contractor" subcontractor listing a description of the work and indicating the dollar amount of all contract(s) and/or subcontract(s) that have been awarded to him/her for the current State Fiscal Year (July 1 - June 30) does not exceed the Fiscal Year limit of $10,000,000.00.

2. A certification of work to be subcontracted (Exhibit II) signed by both the Contractor and the "Small Contractor" listing the work items and the dollar value of the items that the nominated "Small Contractor" is to perform on the project to achieve the minimum percentage indicated in Section IIA above.

3. A certification of past experience (Exhibit III) indicating the scope of work the nominated "Small Contractor" has performed on all projects, public and private, for the past two (2) years.

4. In instances where a change from the originally approved named "Small Contractor" (see Section IB) is proposed, the Contractor is required to submit, in a reasonable and expeditious manner, a revised submission, comprised of the documentation required in Section IIC, Paragraphs 1, 2 and 3 and Section E together with documentation to substantiate and

justify the change, (i.e., documentation to provide a basis for the change) to CONNDOT's Manager of Construction Operations for its review and approval prior to the implementation of the change. The Contractor must demonstrate that the originally named "Small Contractor" is unable to perform in conformity to specifications, or unwilling to perform, or is in default of its contract, or is overextended on other jobs. The Contractor's ability to negotiate a more advantageous contract with another "Small Contractor" is not a valid basis for change. Documentation shall include a letter of release from the originally named "Small Contractor" indicating the reason(s) for the release.

D. After the Contractor signs the Contract, the Contractor will be required to meet with CONNDOT's Manager of Construction Operations or his/her designee to review the following:

1. What is expected with respect to the "Small Contractor" set aside requirements.

2. Failure to comply with and meet the requirement can and will result in monetary deductions from payment.

3. Each quarter after the start of the "Small Contractor" the Contractor shall submit a report to CONNDOT's Manager of Construction Operations indicating the work done by, and the dollars paid to each "Small Contractor" to date.

4. What is required when a request to sublet to a "Small Contractor" is submitted.

E. The Contractor shall submit to CONNDOT's Manager of Construction Operations all requests for subcontractor approvals on standard forms provided by the Department.

If the request for approval is for a "Small Contractor" subcontractor for the purpose of meeting the contract required "Small Contractor" percentage stipulated in Section IIA, a copy of the legal contract between the Contractor and the "Small Contractor" subcontractor must also be submitted at the same time. Any subsequent amendments or modifications of the contract between the Contractor and the "Small Contractor" subcontractor must also be submitted to CONNDOT's Manager of Construction Operations with an explanation of the change(s). The contract must show items of work to be performed, unit prices and, if a partial item, the work involved by both parties.

In addition, the following documents are to be attached:

(1) A statement explaining any method or arrangement for renting equipment. If rental is from a Contractor, a copy of Rental Agreement must be submitted.

(2) A statement addressing any special arrangements for manpower.

(3) A statement addressing who will purchase material.

F. Contractors subcontracting with a "Small Contractor" to perform work or services as required by this "Special Provision" shall not terminate such firms without advising CONNDOT, in writing, and providing adequate documentation to substantiate the reasons for termination if the designated "Small Contractor" firm has not started or completed the work or the services for which it has been contracted to perform.

G. Material Suppliers or Manufacturers

If the Contractor elects to utilize a "Small Contractor" supplier or manufacturer to satisfy a portion or all of the specified dollar requirements, the Contractor must provide the Department with:

1. An executed Affidavit Small Contractor (Set-Aside) Connecticut Department of Transportation Affidavit Supplier or Manufacturer (sample attached), and

2. Substantiation of payments made to the supplier or manufacturer for materials used on the project.

Brokers and packagers shall not be regarded as material Suppliers or manufacturer.

H. Non-Manufacturing or Non-Supplier "Small Contractor" Credit

Contractors may count towards its "Small Contractor" goals the following expenditures with "Small Contractor" firms that are not manufacturers or suppliers:

1. Reasonable fees or commissions charged for providing a bona fide service such as professional, technical, consultant or managerial services and assistance in the procurement of essential personnel, facilities, equipment, material or supplies necessary for the performance of the contract provided that the fee or commission is determined by the Department of Transportation to be reasonable and consistent with fees customarily allowed for similar services.

2. The fees charged for delivery of materials and supplies required on a job site (but not the cost of the materials and supplies themselves) when the hauler, trucker, or delivery service is not also the manufacturer of or a regular dealer in the materials and supplies, provided that the fee is determined by the Department of Transportation to be reasonable and not excessive as compared with fees customarily allowed for similar services.

3. The fees or commissions charged for providing any bonds or insurance specifically required for the performance of the Contract, provided that the fee or commission is determined by the Department of Transportation to be reasonable and not excessive as compared with fees customarily allowed for similar services.

III. BROKERING

For the purpose of this "Special Provision", a "Broker" is one who acts as an agent for others in negotiating contracts, purchases, sales, etc., in return for a fee or commission. Brokering of work by a "Small Contractor" is not allowed and is a contract violation.

IV. PRE-AWARD WAIVERS:

If the Contractor's submission of the "Small Contractor" listing, as required by Section IIC indicates that it is unable, by subcontracting to obtain commitments which at least equal the amount required by Section IIA, it may request, in writing, a waiver of up to 50% of the amount required by Section IIA. To obtain such a waiver, the Contractor must submit a completed "Application for Waiver of Small Contractor Minority Business Enterprise Goals" to CONNDOT's Manager of Contracts which must also contain the following documentation:

1. Information described in Section ID.

2. For each "Small Contractor" contacted but unavailable, a statement from each "Small Contractor" confirming its unavailability.

Upon receipt of the submission requesting a waiver, the CONNDOT's Manager of Contracts shall submit the documentation to the Director of the Office of Contract Compliance who shall review it for completeness. After completion of the Director of Contract Compliance's review, she/he should write a narrative of his/her findings of the application for a waiver, which is to include his/her recommendation. The Director of Contract Compliance shall submit the written narrative to the Chairperson of the DBE Screening Committee at least five (5) working days before the scheduled meeting. The Contractor shall be invited to attend the meeting and present his/her position. The DBE Screening Committee shall render a decision on the waiver request within five (5)

working days after the meeting. The DBE Screening Committee's decision shall be final. Waiver applications are available from the CONNDOT Manager of Contracts.

EXHIBIT I Mar. 01

SMALL CONTRACTOR/*MINORITY BUSINESS ENTERPRISE
(* Delete if not Applicable)
SET-ASIDE PROGRAM
(QUALIFICATION AFFIDAVIT)

PROJECT(s) _____
(INCLUDING TOWN & DESCRIPTION)

STATE OF _____CONNECTICUT_____

COUNTY OF_____

I_____,ACTING IN BEHALF
NAME OF PARTY SIGNING AFFIDAVIT
OF_____,DO HEREBY CERTIFY
PERSON FIRM OR ORGANIZATION
AND AFFIRM THAT THE INFORMATION SET FORTH BELOW IS TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE. AS OF THIS DATE_____THE LIST OF SMALL CONTRACTOR SET-ASIDE PROGRAM - CONTRACTS AND/OR SUBCONTRACTS AWARDED DURING THE CURRENT FISCAL YEAR (JULY 1 - JUNE 30) 20_____ IS AS FOLLOWS:

Col. 1 TOWN AND PROJECT NUMBER	Col. 2 STATE AGENCY WHICH AWARDED CONTRACT	Col. 3 CONTRACT AMOUNT AWARDED UNDER THIS PROGRAM	Col. 4 AMOUNT OF WORK SUBCONTRACTED FROM OTHER FIRMS UNDER THIS PROGRAM	Col. 5 TOTAL AMOUNT OF ALL WORK UNDER THIS PROGRAM Col. 3 Plus Col. 4
	TOTALS	$	$	$

_____
NAME OF PERSON, FIRM OR ORGANIZATION

(FIRM SEAL)

_____
SIGNATURE & TITLE OF OFFICIAL

SWORN TO AND SUBSCRIBED BEFORE ME BY_____

WHO IS PERSONALLY KNOWN TO ME, THIS_____DAY OF_____, 20_____

_____
(NOTARY PUBLIC)

MY COMMISSION EXPIRES_____SEAL

PLEASE NOTE THAT ALL THE WORK AWARDED OR SUBCONTRACTED TO YOUR FIRM UNDER THE SET-ASIDE PROGRAM IN A FISCAL YEAR (JULY 1-JUNE 30) INCLUDING THIS PROJECT, CANNOT BE MORE THAN $10,000,000.00

Mar.01

EXHIBIT II

CERTIFICATION OF WORK TO BE SUBCONTRACTED
NOMINATED SMALL CONTRACTOR/*MINORITY BUSINESS ENTERPRISE

* Delete if not applicable

DEPARTMENT OF TRANSPORTATION
CONTRACT DIVISION
2800 BERLIN TURNPIKE
NEWINGTON, CT 06111

PLEASE INCLUDE A COPY OF CERTIFICATION LETTER

CONTRACTOR_____

ADDRESS_____

TOWN_____PROJECT NO._____

DESCRIPTION OF PROJECT_____

_____

CONTRACT BID AMOUNT $_____

DATE_____

Listed below is the Nominated Small Contractor/Minority Business Enterprise for the above project and the requested data:

Name, Address & Tel No. of the Nominated Firm	ITEM(s)NUMBER(s) and Description of the Item(s) to be performed by and paid to the Subcontractor	Quantities (indicate if partial)	Prime's Bid Amount For Item	Dollar Amount Subcontracted	Small Business Set-Aside Dollar Requirement

Signed By _____
Small Contractor/*Minority Business Enterprise
(Subcontractor)

Signed By_____
Contractor

Title_____

Mar.01

EXHIBIT III

CERTIFICATION
PAST CONSTRUCTION EXPERIENCE

SMALL CONTRACTOR / * MINORITY BUSINESS ENTERPRISES

* Delete if not applicable

PLEASE LIST ALL CONSTRUCTION PROJECTS YOUR ORGANIZATION HAS WORKED ON IN THE PAST TWO FISCAL YEARS

PROJECT LOCATION NUMBER AND DESCRIPTION APPLICABLE	CONTRACT AMOUNT	IF WORK PERFORMED AS PRIME GIVE OWNERS NAME IF WORK PERFORMED AS SUBCONTRACTOR GIVE CONTRACTORS NAME	START DATE	ACTUAL OR ESTIMATED COMPLETION DATE	NAME AND PHONE OF OWNER OR PRIME CONTRACTOR AS

SIGNED BY: _____

SMALL BUSINESS CONTRACTOR
*MINORITY BUSINESS ENTERPRISES

D.O.T. PROJECT NO. _____

* Delete if not applicable

MARCH, 2001

SMALL CONTRACTOR/SMALL CONTRACTOR MINORITY BUSINESS ENTERPRISE (MBE) (SET-ASIDE) CONNECTICUT DEPARTMENT OF TRANSPORTATION AFFIDAVIT – SUPPLIER OR MANUFACTURER

This affidavit must be completed by the State Contractor's designated Small Contractor/ Small Contractor Minority Business Enterprise (MBE), notarized and attached to the contractor's request to utilize a Small Contractor/Small Contractor Minority Business Enterprise (MBE) supplier or manufacturer as a credit towards its Small Contractor/Small Contractor Minority Business Enterprise (MBE) contract requirement; failure to do so will result in not receiving credit towards the contract Small Contractor/Small Contractor Minority Business Enterprise (MBE) requirement.

State Project No. _____
Federal Aid Project No. _____
Description of Project _____

I, _____, acting in behalf of _____
(Name of person signing Affidavit) (Small Contractor/Small Contractor MBE contractor person,
_____ of which I am the_____ affirm that _____
firm, association or certify and corporation) (Title of Person) (Small
_____is a certified Small Contractor/Small
Contractor/Small Contractor MBE person, firm, association or corporation)
Contractor Minority Business Enterprise, as defined by Section 4a-60g of the Connecticut General Statutes, as revised.

I further certify and affirm that _____
(Small Contractor/Small Contractor MBE person, firm, association or corporation)
will assume the actual and contractual responsibility for the provision of the materials and/or supplies sought by _____. If a manufacturer, I produce goods from raw
(State Contractor)
materials or substantially alter them before resale, or if a supplier, I perform a commercially useful function in the supply process.

I understand that false statements made herein are punishable at Law (Sec. 53a-157, CGS, as revised).

_____
(Name of Small Contractor/Small Contractor MBE person, firm, association or corporation)

_____
(Signature and Title of Official making the Affidavit)

Subscribed and sworn to before me, the _____ day of _____ 200____.

_____
Notary Public (Commissioner of the Superior Court)

My Commission Expires _____

CERTIFICATE OF CORPORATION

I, _____, certify that I am the _____ (Official) of the Corporation named in the foregoing instrument; that I have been duly authorized to affix the seal of the Corporation to such papers as require the seal; that _____, who signed said instrument on behalf of the Corporation, was then _____ of said corporation; that said instrument was duly signed for and in behalf of said Corporation by authority of its governing body and is within the scope of its corporation powers.

_____

(Signature of Person Certifying) (Date)

(Corporate Seal)

ITEM #0000457A – 600V COPPER WIRE NO. 14 AWG
ITEM #0000459A – 600V COPPER WIRE NO. 12 AWG
ITEM #0000461A – 600V COPPER WIRE NO. 8 AWG
ITEM #0000462A – 600V COPPER WIRE NO. 6 AWG
ITEM #0000463A – 600V COPPER WIRE NO. 4 AWG
ITEM #0000554A – 600V COPPER WIRE NO. 2 AWG

Description:

Work under these items shall include furnishing and installing 600 volt class conductors as shown on the plans and in conformity with these specifications.

The work shall include all materials, equipment and labor incidental for the completion of all work specified.

General:

Regulatory Requirements:

Conform to the requirements of NFPA No. 70 (National Electrical Code) and ANSI C2 (National Electrical Safety Code).

Provide products listed and classified by UL as suitable for the purpose specified and indicated on the plans.

Product Data:

Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

Project Conditions:

Verify that field measurements are as indicated.

Rules:

The installation shall be in accordance with the requirements of the National Electrical Code, the National Electrical Safety Code, all State and local codes, and as shown on the plans.

Coordination:

The plans indicate the extent and the general location and arrangement of the work. The Contractor shall study the plans and details so that the work will be properly located and readily accessible. If conflicts occur necessitating departures from the plans, the Contractor shall submit details of departures and reasons therefore shall be submitted as soon as practicable for written approval of the Engineer. Contractor shall ensure any rerouting required does not affect voltage drop of the circuit.

Substitutions of products and materials of other Sections may affect power circuit and wiring requirements. Contractor shall ensure all substitutions are coordinated with the design and the installation conforms to all Contract requirements and local codes.

Submit shop drawings and voltage drop calculations coordinated with conduit layout shop drawings and all other work for approval prior to performing any installation.

Capacities of materials shall not be less than capacities indicated on the plans.

Workmanship:

General: Materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer, unless otherwise specified. The installation shall be accomplished by workmen skilled in this type of work.

Qualification of Cable Splicers: Before assigning cable splicer work covered by this specification, the Contractor shall provide the Engineer with the names of the cable splicers to be employed with satisfactory proof that each splicer has had at least 3 years' experience in splicing high voltage cables and is experienced with the type and rating of cables to be spliced. In addition, each cable splicer may be required to make an approved dummy splice in the presence of the Engineer in accordance with cable manufacturer's instructions, before the splicer is approved to splice cable covered by this specification. All material for dummy splices shall be furnished by the Contractor.

Materials:

Cable system in conduits shall include 600 volt copper conductors with NEC Type XHHW-2, 90˚C insulation. The size and number of conductors and the number of cables shall be as indicated on the plans. Conductors shall be Class B stranded. Outer diameter shall not exceed those material specifications in the NEC.

Connectors for 600 volt conductors smaller than No. 6 AWG shall be zinc coated, screw on, spring pressure type with vinyl insulating jackets, while conductors No. 6 AWG and larger shall have double bolted or long barrel indent type connectors. Conductors rated above 600 volts shall

have long barrel indent connectors. All below grade splices shall be submersible hot-melt adhesive type.

Lugs for 600 volt conductors smaller than No. 6 AWG shall be compression type with molded nylon insulating sleeves, while conductors No. 6 AWG and larger shall have the two hole NEMA tongue, double bolted or long barrel indent lugs.

Construction Methods:

Insulated cables shall be installed by the Contractor in underground ducts, conduits, pull boxes, manholes, and in above ground aerial ducts and innerducts, risers and conduit as shown on the plans. Prior to pulling cables of this Special Provision, the Contractor shall perform pulling calculations to determine the direction of pull, and maximum expected pulling tensions based on setup, length of pull, number of bends and pull points. The calculations shall be submitted to the Engineer for review at least 45 days prior to intended pull. Deficiencies in the calculation shall be resolved prior to the work being performed.

Care shall be exercised in pulling cables in conduit to avoid kinking, putting undue stress on the cable, compressing, distorting, or otherwise abrading cable insulation. A lubricating compound shall be used while pulling cables. Cable pulling tension and cable sidewall pressure applied during the pulling process shall not exceed the manufacturer's written recommendations. Rollers, jam and quadrant blocks shall be utilized as required to facilitate cable installation.

Wire and cable shall be continuous from power source to equipment. Where splices are required, they shall be made only in approved junction boxes or manholes and shall be subject to approval by the Engineer. Make splices and terminations in outlet, junction, or pull boxes in equipment cabinets. No splices shall be made in panelboards. Splices and terminations shall be made mechanically and electrically secure, using proper splicing and termination kits. Splices shall be insulated to a level equal to that of the cable. All splices shall be accessible per NEC requirements. Splices in CCTV equipment panels shall be made using UL listed terminal blocks. Use splice and terminator installation tools and installation techniques recommended by the manufacturer and follow manufacturer recommendations.

All splicing and terminating materials shall be compatible so that no one material will adversely affect the physical or electrical properties of any other, or of the wire or cable itself. All materials for making splices and terminations shall be specifically designed for use with the type of wire or cable, insulation and installation and operating conditions of the specific application.

Care shall be exercised in preventing access of water and vermin into the cable conduits, junction boxes and manholes by sealing the cable entrances.

Install all cable in conduit. Do not pull wiring into conduit until conduits and outlets have been thoroughly cleaned and swabbed. Prior to pulling wires and cables into underground conduit systems, place a feeding tube approved by the Engineer at the entrance end of such systems.

Provide suitable installation equipment to prevent cutting and abrasion of conduits and wire or cables during the pulling of cables. Use silicone lubricant and installation procedure as recommended by the cable manufacturer. The lubricant shall not be deleterious to the cable.

Terminations of insulated power cables shall be protected from accidental contact, deterioration of coverings, and moisture, by the use of terminating devices and materials. Terminations shall be made using materials and methods as indicated or specified herein, or as designated by the written instruction of the cable manufacturer and termination kit manufacturer. Terminations shall be rated and be capable of withstanding test voltages in accordance with IEEE 48. Terminations of single cables shall include the securing and sealing of the sheath and insulation of the cable conductors, stress relief, and grounding of cable shields of shielded cable. Cables and cable terminations shall be adequately supported so as to avoid any excessive strain on the termination and the conductor connection.

Power conductors and cables shall not be installed in the same raceway as fiber optic cable regardless of voltage.

Each wire and cable shall be identified by its circuit in all cabinets, boxes, manholes, handholes, wireways and other enclosures and access locations, and at all terminal points. The circuit designations and cable tag materials shall be submitted to the Engineer for approval. Tags shall be attached to wires and cables in such a manner as to be readily visible. Tags shall be suitable for the environment installed.

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information.

Testing after Installation:

1. Wiring shall be installed such that when completed, the system shall be free from shorts, crosses, or grounds.

2. All cables shall be tested for insulation as per latest version of ANSI/NETA ATS. The tests shall be performed on each conductor with respect to ground and adjacent conductors. All cables shall be tested with 1000 volts DC. Test duration shall be one minute.

3. The insulation resistance values shall be as per manufacturer's published data. If manufacturer's data is not available, the insulation resistance values shall not be less than that shown in Table 100.1 in ANSI/NETA ATS.

4. The Contractor shall make tests as necessary, including polarity test of the sockets, to demonstrate that the equipment, installed, complies with the Contract requirements. The Contractor shall provide all labor, calibrated instruments, and apparatus required for tests. If any of the equipment fails, under test, to meet the Contract requirements or to function properly, the defects shall be rectified by readjusting, or removing and replacing, the

faulty equipment until, under test, the requirements are met. The Engineer may check the Contractor's instruments or furnish its own instruments.

Method of Measurement:

The work will be measured per linear foot, as applicable, complete in place, tested, and accepted.

Basis of Payment:

The work will be paid for at the respective contract unit price per linear foot. The prices shall include all costs to provide for the completion of all work specified.

Pay Item	**Pay Unit**
600V Copper Wire No. 14 AWG	LF
600V Copper Wire No. 12 AWG	LF
600V Copper Wire No. 8 AWG	LF
600V Copper Wire No. 6 AWG	LF
600V Copper Wire No. 4 AWG	LF
600V Copper Wire No. 2 AWG	LF

ITEM #0090092A – GYPSUM BOARD BOX OUT

Description:

This specification makes provisions for the box out of existing and proposed electrical conduits which pass thru the elevator machine room. Box out dimensions shall be as directed by the Engineer. Possible work involved will be the removal and disposal of the existing gypsum board covering, installation of metal studs and purlins, installation of gypsum board covering, joint finishing and painting the work with a color to match existing adjacent surfaces.

Box out of conduits shall be constructed to provide a 2 hour fire protection rating.

Materials:

1. Gypsum Board
   Gold Bond Brand Fire Shield Wallboard or approved equal.

   Fire Rated Gypsum Board: A gypsum core wall panel with additives to enhance fire resistance of the core and surfaced with paper on front, back and long edges and complying with ASTM C 36 and C 1396, Type X.

   Thickness shall be 5/8 in. with tapered edges.

2. Framing Materials
   Studs shall be 3-5/8 in and C shaped Studs Weighing 692lbs to 707 lbs. per 1000 linear feet. With min base stale of .0255 in. galvanized and complying with ASTM C 645

   Track shall be 1-5/8in., 2-1/2 in., 3-5/8 in., and 6 in U shaped track with 1-1/4 in legs, weighing 278 lbs., 337 lbs., 412., 438., per 1000 Linear ft. with base metal of .0179 in., galvanized and complying with ASTM C 645

   Main Runner Channels shall be 1-1/2 in. cold rolled steel channel weighing 475 lbs. per 1000 linear ft. with min. base steel of .054 in., galvanized or painted.

   Z furring channels shall be 1in., 1-1/2 in., and 2 in., Z shaped channels weighing 201 lbs., 236 lbs., and 268 lbs., per 1000 linear ft. with base steel of .0179 in., galvanized and complying with ASTM C 645.

3. Fasteners

   Metal framing and gypsum board fastening screws shall be “Phillips II Plus” or approved equal.

4. Joint treatment
   Tape shall be 2-1/16 in. wide paper reinforcing tape (proForm brand Joint Tape or approved equal)

   Compound shall be quick drying type pre mixed vinyl based compound (Proform brand all-purpose Joint compound , regular grade and machine grade, Proform Brand Xp Joint compound, Proform brand Multi-use Joint Compound.) or approved equal.

5. Paint
   Paint shall conform to Section M.07, Paint, of the Standard Specifications.

   Finish shall match sheen and color as existing finish.

Submittals:

Submit product data on metal framing, gypsum board types, and joint tapes. Submit Color samples to match existing paint.

Construction Method:

Box out conduit chase shall be constructed utilizing materials described herein this specification fastened securely to existing and adjacent construction. Metal stud screws (Zip Screws) shall be used to join framing members and metal stud screws shall be used to fasten gypsum to framing. Metal framing shall be isolated from concrete work with 15# felt or other approved barrier. Framing and gypsum work shall comply with all appropriate building construction and fire codes.

Method of Measurement:

This work will be measured for payment as a Contract lump sum item.

Basis of Payment:

Gypsum Board Box Out will be paid for at the Contract lump sum price for "Gypsum Board Box Out" which price shall include all materials, labor, equipment, tools, demolition, miscellaneous incidental fasteners and other materials to provide a complete and painted finished unit.

Pay Item	**Pay Unit**
Gypsum Board Box Out	Lump Sum

ITEM #0090693A – SPARE PARTS

Description:

This item consists of furnishing additional quantities of specific items in the Contract to be used as replacement items should one of the installed items fail.

The Contractor shall furnish the additional quantities of each item as indicated in this Specification. It shall be the responsibility of the Contractor to purchase the item, transfer ownership and deliver the items to the Connecticut Department of Transportation (CTDOT) or Metro-North Railroad (MNR), as indicated.

Materials:

Each item furnished shall be new, from the same manufacturer and have the identical model number as each item furnished for installation as described in the Specification for each item.

The Contractor shall deliver the following quantities of each item as a "spare part" for these products specified in the Contract Special Provisions:

	DESCRIPTION	QTY.	Ownership and Delivery
1.	Aerial Fiber Optic Cable Snow Shoes	6	MNR
2.	Fiber Optic Splice Enclosure	6	MNR
3.	CCTV Camera – Fixed Dome	12	MNR
4.	CCTV Camera – PTZ	2	MNR
5.	CCTV IR Light	7	MNR
6.	Video Encoder	1	MNR
7.	IR Power Supply – Rack Mount	1	MNR
8.	60W PoE Injector	3	MNR
9.	PTZ Power Supply	3	MNR
10.	PoE Surge Suppression – Rack Mount	1	MNR
11.	PoE Surge Suppression – Wall Mount	1	MNR
12.	PoE Surge Suppression Module	25*	MNR
13.	Single Encoder as Provided by Elevator Demarcation Box Item	1	MNR
14.	Analog Elevator Camera as Provided by Elevator Demarcation Box Item	1	MNR
15.	Camera Power Supply as Provided by Elevator Demarcation Box Item	1	MNR

*Furnish 5 spare non-PoE surge suppression modules, such as those used to connect workstations. The remainder shall be PoE.

Construction Method:

All provisions outlined in these Contract Documents shall be complied with for each item furnished from the Spare Parts list.

Method of Measurement:

The Contractor shall submit to the Engineer for acceptance a breakdown of its lump sum bid price for this item. If the lump sum bid price is unacceptable to the Engineer, substantiation showing that the submitted price costs are reasonable shall be required.

The lump sum bid price breakdown shall show Contractor costs per spare part. The Contractor shall be reimbursed for the item after it is furnished and the transfer is carried out as outlined in this specification and approved by the Engineer.

Each item furnished under Spare Parts will be held by the Contractor until after the System Acceptance test is complete. After acceptance of the system, the Contractor shall deliver the items to the Connecticut Department of Transportation or Metro North Railroad at a designated site within the State of Connecticut. Transfer of ownership and delivery shall be coordinated with the Engineer.

Basis of Payment:

The quantity to be paid for under this item(s) will be paid as a lump sum for the total number of spare parts turned over to Connecticut Department of Transportation and Metro-North Railroad as described in this Specification.

Pay Item	**Pay Unit**
Spare parts	Lump Sum

ITEM #0090698A – GROUNDING DETAIL G-3
ITEM #0090696A – GROUNDING DETAIL G-1
ITEM #0090694A – ISOLATION DETAIL IS-1
ITEM #0090699A – GROUNDING DETAIL G-4
ITEM #0090700A – GROUNDING DETAIL G-5
ITEM #0090697A – GROUNDING DETAIL G-2
ITEM #0603431A – STEEL (MISCELLANEOUS)

Description:

Work under these items consist of furnishing, fabrication and erection of steel (miscellaneous) for support of Figure 8 aerial duct, down guys, messenger wires, ground wires including their grounding and isolation systems, and galvanized steel wire, fittings and guy safety covers for down guys (guy assemblies), as well as for the installation of guy bracket assemblies, as shown in the plans and listed on Table 1.

Steel (miscellaneous) includes, but is not limited to, the furnishing, fabrication and installation of bracket assemblies, drop post supports, dead end supports, wall mounted brackets, pole extension post connection, cable support 3-bolts clamp assembly and aerial innerduct support.

The work under this item also includes the relocation of existing down guys, the removal of existing down guys, and the installation of aerial guy wires.

The Contractor shall be responsible for coordinating the installation of Steel (miscellaneous) with Railroad and the requirements set forth in the Special Provisions, obtaining necessary outages for conducting work, as well as coordinating necessary power outages with Connecticut Light and Power and United Illuminating.

Attachment	Description
TYPE B-1	Typ. Lattice/Fig.8 Aerial Duct Support
TYPE B-1M	Typ. Lattice/ Offset Fig.8 Aerial Duct Support
TYPE B-2	Typ. Portal Lattice/Fig.8 Aerial Duct Support
TYPE B-2M	Typ. Portal Lattice/ Offset Fig.8 Aerial Duct Support
TYPE B-3	Typ. I-Beam/Fig.8 Aerial Duct Support
TYPE B-4	Typ. A-Frame/Fig.8 Aerial Duct Support
TYPE B-4A	Typ. A-Frame/Fig.8 Aerial Duct Support
TYPE B-5	Typ. Cross-Member/Fig.8 Aerial Duct Support
TYPE B-5A	Typ. Cross-Member/Fig.8 Aerial Duct Support
TYPE B-5B	Typ. Cross-Member/Fig.8 Aerial Duct Support
TYPE B-6	Typ. Wall/Abutment/Fig.8 Aerial Duct Support
TYPE B-7	Typ. Wood Pole/Fig.8 Aerial Duct Support
TYPE B-11	Typ. Transmission Pole/Fig.8 Aerial Duct Support
TYPE B-12	Typ. Strandvise Pull-Off Attachment
TYPE D-1	Typ. Lattice/Fig.8 Aerial Duct End Bracket
TYPE D-1M	Typ. Lattice/Offset Fig.8 Aerial Duct End Bracket
TYPE D-2	Typ. Portal Lattice/Fig.8 Aerial Duct End Bracket
TYPE D-2M	Typ. Portal Lattice/ Offset Fig.8 Aerial Duct End Bracket
TYPE D-3	Typ. Dead End Bracket
TYPE D-3A	Typ. Down Guy Bracket
TYPE D-4	Typ. A-Frame Structure Dead End Bracket
TYPE D-4A	Typ. Structure Dead End Bracket
TYPE D-4B	Typ. Structure Dead End Bracket
TYPE D-6	Typ. Wall/Abutment Dead End Bracket
TYPE D-7	Typ. Wood Pole Dead End Bracket
TYPE D-7A	Typ. Wood Pole Dead End Bracket 90°
TYPE D-7B	Typ. Wood Pole Dead End Bracket (one side)

TABLE 1

Applicable Standards:

Pertinent provisions of the following listed and other relevant standards shall apply to the work of this Section, except as they may be modified herein:

American Society for Testing and Materials (ASTM):

A475 Zinc-Coated Steel Wire Strand

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Materials:

Structural shapes, plates and rods shall conform to Form 816, Section M.06.02 unless noted otherwise in the contract documents. The material for rolled sections, plates and rods shall be a minimum grade ASTM A36 and ASTM A500 Grade B for structural tubes.

Size of bolt holes shall be 1/16" larger than bolt diameter unless specified otherwise.

All field connections shall be bolted, except as noted.
All connection bolts shall be 5/8" diameter except as noted.
All bolts to have hex heads and nuts and washers.

High strength bolts, nuts and washers shall conform to Form 816, Section M.06.02.3 and shall meet ASTM A325 Type 1. Other connectors, where noted, shall be ASTM A307.

All material provided under this section shall be galvanized after fabrication in conformance with Form 816, Section M.06.03. Fabricator to provide adequate vent holes to all enclosed areas prior to galvanizing.

All stainless steel shall be grade 316L.

Filler material for welding shall conform to Form 816, Section M.06.04.

Polyurethane Sealant shall conform to Federal Specifications TT-S00227E, Type I, or II (Class A or B).

Base plates may be fabricated from material conforming to ASTM A537 or A633 in addition to the steel material listed above. Miscellaneous bolts, nuts and washers shall conform to ASTM A325.

Guy Bracket Assemblies shall be as specified under M.06.02 Structural Steel and M.06.03 Galvanizing of Form 816 or as called for on the plans.

The material used for stranded zinc-coated steel wire rope, shall be as specified for GALVANIZED EXTRA HIGH STRENGTH STEEL WIRE under A475 zinc-coated steel wire strand.

Fittings shall be as specified in the Contract Documents.

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Submittals for Down Guys:

Relevant reports for wire to be used containing the physical and mechanical properties of all components described in this Section shall be submitted. Include the following as a minimum.

Size
Type
Material
Number of and diameter of individual wires
Overall diameter
Cross section area
Weight per foot
Rated breaking load

The Contractor shall provide certification that the zinc-coated steel wire has been designated, fabricated, rated and tested in compliance with the applicable provisions of the standards referenced in these Specifications.

Shop drawings of structural and miscellaneous steel.

Working drawings showing procedures how existing down guys will be relocated and removed, including required temporary supports and back guying.

Submittals for Steel (Miscellaneous):

Shop drawings.

Mill certificates for structural/ miscellaneous steel and proof of US origin.

Charpy V-notch test certificates.

Certificate for high strength bolts (See Section M.06 in the Special Conditions).

Proposed erection procedure to demonstrate compliance with "Requirements for Erection, Demolition, or other Rigging operations over or Adjacent to Railroad Right-of-Way", See Special Conditions.

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Construction Methods:

The installation of new bracket assemblies, drop posts, dead end brackets, and other steel assemblies will occur in the vicinity of electrical energized facilities. De-energizing of the Railroad's, the Connecticut Light and Power Company (CL&P) and the United Illuminating Company's (UI) electric lines may be required to perform work. The Contractor shall perform the work in accordance with the following:

1. During the installation of structural and miscellaneous steel, all equipment and persons will at all times, remain at least 15 feet clear of CL&P and/or UI's existing 115 kV overhead transmission lines, installed on catenary or pole structures along the railroad's mainline right-of-way. When approach closer than the specified distance is required, the Contractor will request in writing, with 90 working days notice, the de-energizing of the utility lines or equipment. De-energizing of the utility power line is contingent on power demand and economic dispatch and shall be coordinated with CL&P and/or UI. The Contractor will assume any risk involved in the reasonable denial of a request to de-energize CL&P and UI's transmission line and the last minute cancellation of an approved request to de-energize the transmission lines. If so ordered by the Engineer, the Contractor will immediately cease all activity in the areas where CL&P and UI transmission lines are to be re-energized.

2. The Contractor and CL&P and/or UI must cooperate fully in order to avoid damage to the conductors, and to insure that no delays will occur in the progress of the work. Therefore, the Contractor shall furnish CL&P and UI with a schedule for this work, which is to include starting and completion dates and, shall notify CL&P and UI 48 hours in advance of the commencement of construction work.

All applicable portion of Form 816, Section 6.03.03 shall apply.

The Contractor shall not fabricate steel attachments intended for existing structures until he has verified in the field the pertinent dimensions of the structures.

All shop connections shall be welded but subject to the Engineer's approval. Any field modification of truss details shall be approved by the Engineer and MNR. All splices shall be full strength bolted splices as defined in AISC Manual of Steel Construction. Gusset plates may be required.

Field welding of galvanized members will not be permitted, except as noted below:

When steel spacers are required for attachment to existing riveted lattice structures, they shall be welded directly to the support brackets. The joining surfaces of the members shall be properly prepared for welding, including removing the initial galvanized coating from the contact surface.

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After welding, the contact areas shall be treated with touch up cold galvanizing compound, which shall be approved by the Engineer before use.

The Railroad's safety procedures require that, as soon as structural and miscellaneous steel has been set in place and before power is restored, temporary grounding must be connected to the aerial ground wire system.

Temporary grounds must be at least equal to one 4/0 cable placed in a position protected from damage and vandalism. Permanent grounding (aerial and ground rod) shall be connected as soon as possible following steel erection.

Before erecting a drop post, dead end bracket, post extension or stringing a messenger wire the Contractor shall ascertain that no energized wires will come into contact with or within 3 feet of a new post, truss, post extension messenger or ground wire. Should energized feeders or catenaries of the existing system be within 3 feet of a structure or ground wire, then the Contractor shall consult the Engineer about protective measures before proceeding with erection.

In certain locations there are signal cables, signal boxes and/or ladders attached to the structures. Should the Contractor have to temporarily relocate these in order to proceed with the installation of steel, the Contractor must obtain prior permission from the Railroad to do so.

Down Guys

Zinc-coated steel wire rope shall be cut and installed using tools and methods specified by the manufacturer.

Down guys shall be installed before loading the structures. They shall be pulled taut, and secured in place with provisions for future adjustment as required to hold the structure in proper alignment after wires are pulled to correct tension. Expanding anchor as specified on the drawing shall be employed for the down guy into the soil.

At locations where existing down guys are being relocated or removed, or replaced with an aerial guy wire, the Contractor is to provide temporary back guying and down guy anchoring, as required, to support the existing down guy loads, and the transfer of loads to the new down guys and/or anchors.

Down guy attachments shall be installed as recommended by the manufacturer.

Down guys shall be installed on any existing un-guyed wood poles supporting new attachments.

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Down guys shall be installed at a minimum angle of 30 degrees from the pole. If limited clearance or other restrictions may require installation at an angle less than 30 degrees, the proposed down guy location shall be brought to the attention of the Engineer for review and approval.

Down guys anchored to the base of structures shall be installed before encasing the structure base in concrete.

The Contractor shall make final adjustments to the down guys as required to compensate for initial stretch.

Yellow guy safety covers guards shall be installed as specified on the drawing.

In certain locations there are signal cables, signal boxes and/or ladders attached to the structures. Should the Contractor have to temporarily relocate these in order to proceed with the installation of steel, the Contractor must obtain prior permission from the Railroad to do so.

Splicing of the galvanized steel wire shall not be permitted.

Overgrown vegetation shall be selectively removed in order to provide a minimum of five feet clearance around the installed down guy and attachments.

Method of Measurement:

Steel used for support of Figure 8 Aerial Duct will not be measured and paid for separately but included in the unit price (CWT) for the STEEL (MISCELLANEOUS) pay item.

No direct payment will be made for galvanizing, but the cost thereof shall be included in the unit price (CWT) of the STEEL (MISCELLANEOUS) pay item.

No direct payment will be made for temporary grounds required by railroad for steel erection, but the cost thereof shall be included in the unit price (CWT) for the STEEL (MISCELLANEOUS) pay item.

Measurements for Type B-1 through Type X-2 Attachments shall be based on the net mass of metal in the fabricated attachment including tubes, angles, bolts, nuts, spacers, washers, 3 bolt clamp, J hooks, shackles and wire mesh complete. This net weight (mass) shall be determined by computation as described in Sub-article 6.03.04.

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Grounding and Isolation Details G-1 through G-5 and IS-1 will be measured for payment by the actual number of accepted attachments of each type installed in accordance with these Contract Documents. These items shall include, for payment purposes, bracket assemblies, drop post supports, dead end supports, guy assembly, guy assembly anchoring, wall mounted brackets, pole extension detail, conduit supports, pole extension connection, 3-bolts clamp assembly and aerial innerduct support, ground wires and ground rods complete including other small steel parts and assemblies.

Guy Bracket Assemblies where installed in conjunction with Down Guys, are not measured for payment, but shall be included for payment under the STEEL (MISCELLANEOUS) pay item.

No separate payment will be made for the temporary (or permanent) support, relocation or removal of existing communication, signal, or ground wires, equipment, or any other obstructions that may interfere with the installation of new steel, but the cost thereof shall be included in the unit price of the STEEL (MISCELLANEOUS) pay item.

The temporary (or permanent) removal, relocation, or restoration, if any, of a member of the structure or of signal cables, signal cases, ladders, platforms or other impediment attached to the structure, in order to facilitate the installation of steel shall not be paid for separately, but the cost thereof shall be included in the unit price of the STEEL (MISCELLANEOUS) pay item.

The guy assemblies will not be measured or paid for separately but included in the unit price of the STEEL (MISCELLANEOUS) pay item. It shall include the complete guy assembly installed, regardless of their length, including guy bracket assemblies and cover guards

There will be no separate payment for excavation, concrete, steel, guy safety covers, but the cost thereof shall be included in the unit prices for the STEEL (MISCELLANEOUS) pay item.

There shall be no separate measurement and payment for the removal of existing down guys, or the installation of temporary back guying and anchors, but the cost thereof shall be included in the unit prices for the STEEL (MISCELLANEOUS) pay item.

Procurement and installation of guy attachment(s) to poles, such as guy bracket assemblies and swivel bracket assemblies shall be included in unit price of the STEEL (MISCELLANEOUS) pay item.

The temporary removal and restoration, if any, of a member of the structure, including truss to post knee brace, or signal cables, signal cases, ladders, platforms or other impediment attached to the structure, in order to facilitate the installation of down guy assemblies shall not be measured and paid for separately, but the cost thereof shall be included in the unit price of the STEEL (MISCELLANEOUS) pay item.

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Basis of Payment:

The work for Grounding and Isolation Details shall be paid for at the contract unit price per each for the following pay items complete, which prices shall include all transportation, materials, equipment, tools and labor incidental thereto.

The work for Type B-1 through Type X-2 attachments shall be paid for at the Contract unit price per hundred weight for the STEEL (MISCELLANEOUS) pay item. Payment under this item shall be for miscellaneous steel, complete in place, which price shall include furnishing, fabricating, transporting, erecting, galvanizing and all materials, equipment, tools and labor incidental thereto.

Pay Item	**Pay Unit**
GROUNDING DETAIL G-1	Each
GROUNDING DETAIL G-2	Each
ISOLATION DETAIL IS-1	Each
GROUNDING DETAIL G-3	Each
GROUNDING DETAIL G-4	Each
GROUNDING DETAIL G-5	Each
STEEL (MISCELLANEOUS)	CWT

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ITEM #0100401A – AC 1-POLE CIRCUIT BREAKER

Description:

This item shall consist of furnishing and installing circuit breakers in existing power panels as shown on the Plans or as directed by the Engineer. It shall be responsibility of the Contractor to ensure each circuit breaker is sized for the equipment being supplied as required by the design and as outlined in these Specifications, and coordinated with any approved substitutions.

Circuit breakers required within field cabinets shall be paid as incidental to the appropriate Item and shall be paid under this Item.

Applicable Standards:

NFPA 70 – National Electrical Code

UL 489/NEMA AB-1 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures

Materials:

Circuit breakers shall comply with UL 489/NEMA AB-1. The circuit breakers shall be molded case, quick-make, quick-break, bolt-on, thermal-magnetic, toggle type breakers. Where installed in an existing panelboard, match existing breaker type, rated voltage, and ampere interrupting current (AIC) rating. In no case shall the AIC rating be less than 10,000A at 240/120 V. Contact ON and OFF positions and trip action due to overload or short circuit shall be clearly indicated by the handle position.

Construction Method:

Contractor shall verify all existing field conditions and make field inspections necessary to prepare accurate shop drawings in accordance with existing conditions. The Contractor shall submit shop drawings and product data to the Engineer for approval prior to supplying this item. Shop drawings shall indicate location of power panel, all existing circuit breakers (including trip, AIC, and voltage ratings), description of the loads attached to the existing circuit breakers, panel ratings and electrical service, and locations for new circuit breakers.

All installations shall conform to the National Electrical Code.

Access to the existing electrical panels shall be scheduled with the Engineer at least 2 weeks in advance. Access will be provided by either Metro North or representative of the local town. If interruption to the electrical service of the panel is required for installation, the Contractor shall submit a detailed plan that identifies all impacted devices and the anticipated duration of interruption. Schedule all interruptions with the Engineer. No interruptions shall be made without approval of the Engineer.

Method of Measurement:

This work shall be measured for payment by the actual number of "Each" purchased, installed, and accepted by the Engineer.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each for "AC 1-Pole Circuit Breaker" furnished, installed, and accepted by the Engineer, which price shall include all material, tools, equipment, labor, and work incidental thereto to complete the work.

Pay Item	**Pay Unit**
AC 1-Pole Circuit Breaker	Each

ITEM #0100426A – WATER TRANSPORTATION FOR RESCUE OPERATIONS

Description: The Contractor shall provide a motor boat, staffed with two people (an operator, and a person trained in lifesaving techniques) when work, considered to be an occupational safety hazard, is in progress above or adjacent to the water. Their sole responsibility will be to patrol in the vicinity of the work and rescue anyone who may fall into the water. The boat shall be equipped with life preservers and any other equipment required by government regulations. The contractor shall provide to the Engineer copies of all necessary permits, licenses, and registrations for the boat and its occupants and shall ensure the personnel are physically able to perform the required tasks.

Work under this item will be performed in accordance with the following:

1. The boat is to be transported, placed in and out of the water, operated and properly stored after use.

2. The boat is to be operable and available at all times. In the event of a breakdown, hazardous above-water work will be discontinued until the boat is repaired or a replacement boat is on station.

3. The unit price will include maintenance, repairs, fuel, registration and insurance.

4. Also included in the unit price will be required safety equipment such as, but not limited to: life vests, protective clothing, oars, life line, anchor, OSHA approved emergency first aid kit, oxygen equipment, backboard, etc.

5. The boat shall be a tri-hull stable bottom boat, not less than six meter in length, and provided with a motor whose power is within the minimum and maximum horsepower requirements indicated by the manufacturer of the boat provided.

6. The unit price will include radio communications equipment capable of providing communication between the boat and the work area on the bridge as well as the Contractor's field office and the Department's field office.

7. The person trained in lifesaving techniques must possess the following current certifications issued by the American Red Cross or equivalent certifications as determined by the Engineer:

   - Standard First Aid (includes CPR training)
   - Life Guard Training or Emergency Water Safety
   - Note: EMT or Paramedic certification from the Connecticut Office of Emergency Medical Services will be acceptable in lieu of the Red Cross "Standard First Aid" certification.

If the person trained in lifesaving techniques possesses certifications from a recognized certifying agency other than the American Red Cross, the contractor shall provide the Engineer with documentation from the Agency indicating that the certification program meets or exceeds the Red Cross certification requirements of this specification. No alternate certification will be acceptable unless approved in writing by the Engineer.

Method of Measurement: This work will be measured for payment by the number of calendar days that the boat is used on safety patrol.

Basis of Payment: Payment for this item shall be made at the contract unit price per day for "Water Transportation for Rescue Operations" which is the actual number of days the boat is used on safety patrol. This item shall include a properly equipped boat complete with all safety equipment required by government regulations, a licensed operator, a person trained in lifesaving techniques, radio communications equipment, all required safety equipment and OSHA approved emergency first aid kit.

Pay Item	**Pay Unit**
Water Transportation for Rescue Operations	Day

ITEM #0100500A – CONSTRUCTION COMMUNICATION EQUIPMENT

Description:

Under this item, the Contractor shall provide:

1. Communication equipment for use by the inspection personnel. This item shall include all necessary equipment, accessories, material and labor to put the system into operation. Provisions shall also be made to maintain all provided communication equipment and any additional communication equipment assigned to the project, as directed by the Engineer.

2. A toll-free, reservation-less telephone conference call account for the use of the Engineer.

Materials:

The equipment for this item shall conform to the following: Handheld cellular phones capable of communicating digitally and tablet computers. This item shall include all necessary equipment, accessories (including but not limited to car charger, holster, and case).

Smart Phones must meet the requirements of this specification as well as the latest minimum specifications posted, as of the project advertising date, at Departments website http://www.ct.gov/dot/cwp/view.asp?a=1410&q=563904. Tablet shall meet the same requirements as the Smart Phone other than calling features.

Construction Methods:

1. Communication Equipment:

   The Contractor shall submit at least three (3) proposals for both the communication equipment described herein and forward to the Engineer for approval. The Department will provide the Contractor with the estimated quantity of phones and tablets required for inspection personnel.

   The three proposals may be for either rental or purchase of equipment that is new or of like-new condition and meeting the specification requirements. Also, the three proposals must indicate the minimum and maximum number of phones that will be allotted. The Engineer will have ten (10) days from receipt of the proposals to inform the Contractor of its selection. Once approved, the Contractor shall order the equipment, and have it installed and operating within fifteen (15) working days.

   The Contractor will furnish to the State, a copy of the monthly call record for each phone when submitting the billing invoices for the communication equipment.

All equipment and associated materials will remain the property of the Contractor upon the completion of the project unless otherwise specified by the Engineer in writing.

2. Telephone Conference Call Account:

The Contractor shall submit three (3) proposals for the telephone conference call account described herein and forward to the Engineer for approval.

The Engineer will have ten (10) days from receipt of the proposals to inform the Contractor of its selection. Once approved, the Contractor shall activate the account within five (5) working days.

Once activated, the Engineer will act as the "moderator" and control all associated PIN numbers.

The Contractor will furnish to the State, a copy of the detailed monthly account history when submitting the billing invoices for the telephone conference call account.

Method of Measurement:

The item, Construction Communication Equipment, will be measured for payment based on actual detailed monthly invoices.

Basis of Payment:

The sum of money shown on the Estimate and in the itemized proposal as "Estimated Cost" for this work will be considered the bid price even though payment will be made as described below. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount for the contract.

The item, "Construction Communication Equipment", will be paid for at the actual detailed monthly account history for services approved by the Engineer, plus a 5% markup.

Payment will include all materials, equipment, labor and maintenance associated with this item.

Pay Item	**Pay Unit**
Construction Communication Equipment	Estimate

ITEM #0502182A – RUBBER GRADE CROSSING

Description:

Work under this item shall consist of furnishing full depth rubber grade crossing material for track crossings and/or hi-rail equipment access of rails with timber or concrete ties at access points shown herein and on the plans.

Materials:

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

Specifications for Rubber Crossings for Concrete Ties:

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:	Pandrol Fast Clips
Field Panels:	Must be full depth rubber panels with width to match Metro North Standard Concrete Cross Tie (enclosed drawing). Panels 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 (see enclosed drawings for Metro North Railroad Standard Concrete Cross-Tie). Panels must interlock and be capable of installation without use of lag screws.
End Ramps (deflector plates):	To be included in price and needed for all crossings.

Specifications for Rubber Crossings for Timber Ties: Similar as for Rubber Crossings for Concrete Ties with following exceptions:

Fasteners Used In Crossing:	Track spikes
Width of Field Panels:	20” for 8’-6” Cross Tie

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

Hi-Rail, Inc.
2539 Woodcliff Court
Lisle, Ill 60532
(630) 961-1659

Omni Grade Crossing, Inc.
Radnor Station Building #1, Suite 300
290 King of Prussia
Radnor, PA 19087
(610) 971-9966

Railway, Inc
120 Nixon Street
P.O. Box 849
Cascade, Iowa 52033
(319) 852-7794

The Contractor shall submit shop drawings of the Rubber Crossing for Timber or Concrete Ties to the Railroad for their review and approval. The crossing panels shall be full depth with the height of panel matching the rail size for the crossing location.

Construction Methods:

Contractor access to tracks (with hi-rail equipment) shall be made at rubber grade crossings which currently exist and are maintained by MNR (see locations in table below and on plans). The Contractor shall verify the condition/presence of these grade crossings as they are subject to change at any time.

If the existing grade crossing are deemed of unsuitable or inadequate condition or location for the Contractor's use, the Contractor shall submit to the Engineer (and MNR) for review and approval the location of a new rubber grade crossing.

The Contractor shall procure and deliver the rubber crossing material to the project site. The Contractor shall coordinate the delivery location with Metro North Railroad. Installation of rubber crossing(s) shall be performed by Metro North Railroad. There will be no charge to the Contractor for this installation work.

Method of Measurement:

Rubber Grade Crossing(s) shall be measured for payment per actual linear foot of rubber crossing supplied, as measured along the centerline of the track. The deflector plates shall not be included in the above measurement.

Basis of Payment:

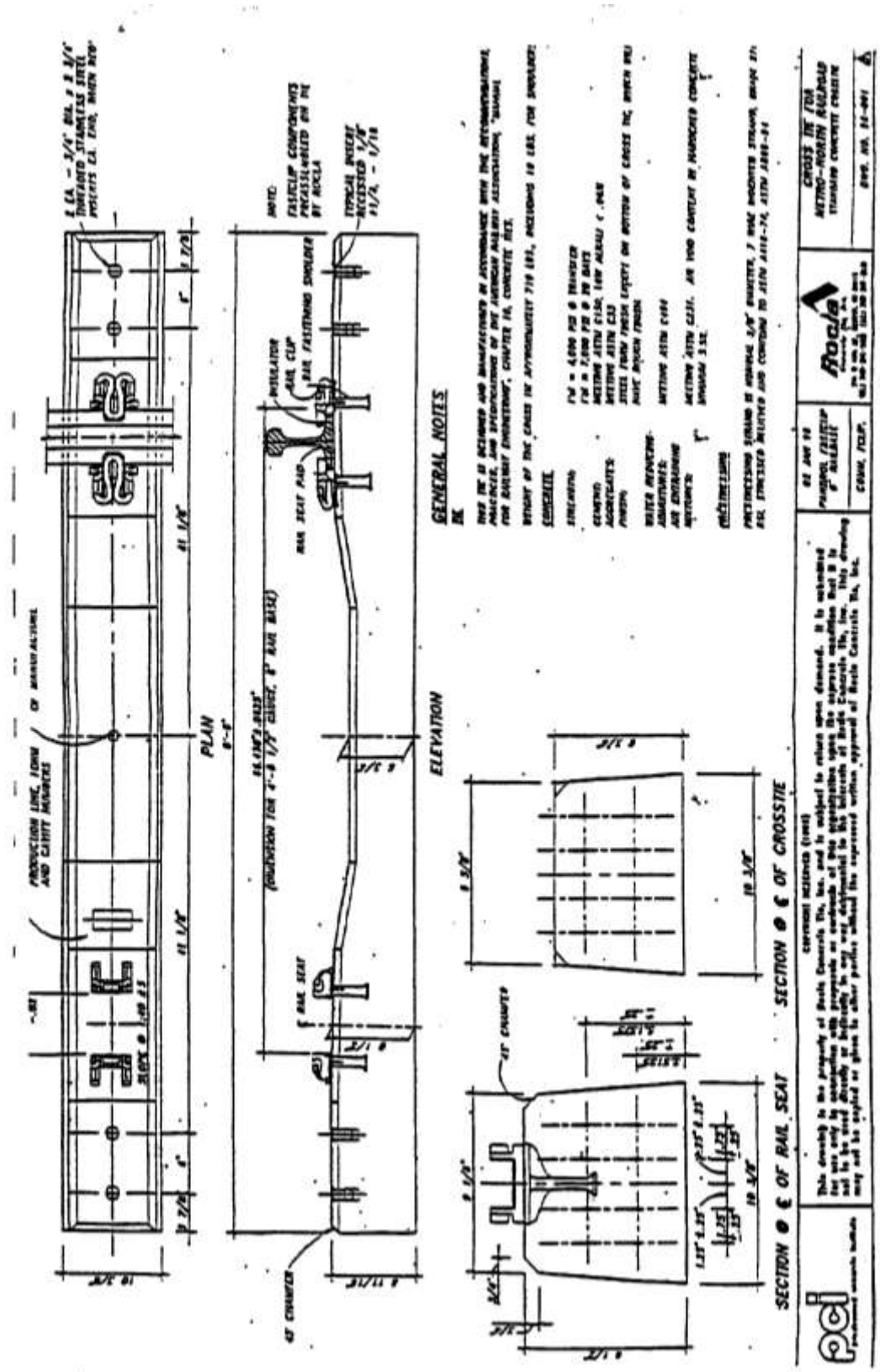
This work will be paid for at the contract unit price per linear foot for "Rubber Grade Crossing", of the required depth and width, which price shall be for materials and delivery only.

No additional payment will be made for the required gauge and field deflector plates which price shall be considered incidental to the cost of the rubber grade crossing.

Pay Item	**Pay Unit**
Rubber Grade Crossing	Linear Foot

Existing Rubber Grade Crossing Locations

MP	CATENARY	TRACK ACCESS (previously used)	ACCESS PAD IN PLACE (as of 9-22-15)	COMMENTS
47.15	628	4, 2	4, 2	Off Sub-Station driveway @ New Creek Rd
47.45	633	4, 3, 2, 1	4, 3, 2, 1	Off Node-House 473 driveway @ Maple Ln.
47.6	636	4, 2	4, 2	Off Sub-Station 634 driveway @ Clayton St.
48.85	657	4, 2	4	Off Sub-Station 634 driveway @ Clayton St.
49.3	664	4, 2, 1	1	Off Southport Freight House @ Old Post Rd.
50.45	685	3, 1	none	West of Fairfield Station @ Node House 505
50.65	689	4, 2, 1, 3	1, 3	East of Fairfield Station @ Carter Henry Dr.
51.95	713	4, 2, 1, 3	3	West of Fairfield Metro Station @ Kings Hwy.
53.3	735	4, 2, 1, 3	none	Burr Rd @ I-95 Overpass.
53.45	738B	4, 2, 1, 3	4, 2	East of Fairfield Ave. @ Off Railroad Ave.
54.5	756	4, 2, 1, 3	none	No road access @ East of South Ave. underpass
55.0	765C	4, 2, 1	none	No road access @ Main St.
55.0	775A	4	none	No road access @ South end of Bridgeport Station
57.5	814	none	4, 2, 1, 3	East of MNR Maint. Yard @ Bishop Ave.
60.6	865	3, 1	3	Devon Tower @ Waterbury Branch


PLAN
ELEVATION
GENERAL NOTES
SECTION ● ℄ OF RAIL SEAT
SECTION ● ℄ OF CROSSTIE

ITEM #0728020A – STONE BALLAST

Description:

This Section specifies the material requirements for ballast to be furnished and placed in accordance with the Plans and Specifications. This Section also includes furnishing all labor, materials and equipment necessary and incidental to placing ballast as directed by the Engineer.

Materials:

The Contractor shall submit, under the provisions of this Section, the following information:

Compliance: Supplier's certification that the material delivered to the site is in compliance with the Specifications.

Samples: Submit as one representative sample and one sample of each new source of supply and requested by Engineer, samples of not less than 150 lbs.

The Contractor shall comply with provisions of Codes, Specifications, Standards, and recommended practices of the most recent edition and addenda thereto of:

AREMA MANUAL: American Railway Engineering and Maintenance of Way Association, Manual for Railway Engineering

ASTM: American Society for Testing and Materials

AASHTO: American Association of State Highway and Transportation Officials

MNRR: Metro North Railroad

Testing and inspection shall conform to the AREMA Manual.

Material not meeting the Specifications shall not be used in the work.

Furnish prepared ballast that is of crushed rock, hard, strong, angular, durable particles, containing no carbonates or slag, free from injurious amounts of deleterious substances.

The ballast shall have a minimum Sand Equivalent of 50 when measured by California Test 217.

Determination of weight per cubic yard shall be in accordance with ASTM C29.

All particles of the ballast shall have been broken by the crusher and have at least two broken surfaces.

All boulders which will pass through a 5-inch circular opening before crushing shall be rejected.

Type A ballast shall be crushed trap rock or granite. It shall: a) be composed of angular fragments which are clear and free from deleterious substance; b) have proper gradation; and c) meet all requirements of this specification. Additionally, ballast shall be in conformance with AREMA Chapter 1, Part 2 except as otherwise specified herein.

Ballast shall conform to the following scale when tested with laboratory sieves having square openings. (Sieves must conform to ASTM E11):

Size No.	Ballast Type	Nominal Size Sq. Openings	Amounts Finer Than Each Sieve (Sq. Opening Laboratory Sieve- Pct. by Wt.) 2"	1½"	1"	3/4"	½"	3/8"	No.4
4	A	1½" - 3/4"	100	90-100	20-55	0-15		0-5	
5	A	1" - 3/8"		100	90-100	40-75	15-35	0-15	0-5

Deleterious substances in ballast shall not be present in excess of the following amounts:

Description:	Percent by Weight:
Soft and friable pieces	3.0 percent
Material finer than No. 200 Sieve	0.5 percent
Clay lumps	0.5 percent

Hardness shall be between 5.5 and 7.0 as measured on Moh Hardness scale.

Water absorption shall not exceed 1.2% when tested in accordance with ASTM C127.

Type A ballast chemical analysis shall reveal quantitatively that at least 70% of test sample is composed of silicon dioxide, aluminum oxide, and iron oxide, but that not more than 25% of test sample is comprised of magnesium oxide, magnesium carbonate and calcium carbonate.

The contractor shall be responsible for assuring ballast cleanliness. A suitable washing facility shall be provided at the quarry for this purpose. This facility shall consist of a high pressure spray over the ballast as it passes on the belt. A quality control plan along with washing procedures must be submitted with contractor's quotation. The QC plan and washing procedures will be subject to approval by the Engineer.

Prepared ballast shall be handled in such a manner that it is kept clean and free from segregation. It shall be only loaded into cars which are in good order, tight enough to prevent leakage and waste of material, and clean and free from rubbish or any substance which would foul the ballast.

L.A. Abrasion	Type "A"
Percent of wear shall not exceed grading of sample	14.6

When L.A. abrasion is in excess of 13.0% wear, cementing value in pounds per square inch shall not exceed 375.

Percent of loss shall not exceed 1.

Impedance must be in excess of 2.6 K ohms.

The quality of stone for ballast from any quarry or new strata opened up, including its soundness, resistance to abrasion, chemical composition, absorption, impedance, hardness and weight per cubic foot, shall be determined prior to its acceptance at a testing laboratory selected by the purchaser. Each stratum or portion of quarry containing a variation of quality of stone shall be tested separately and not averaged. Quality tests and gradation tests shall subsequently be made from time to time as deemed necessary by the purchaser to control the quality and size of ballast furnished by the producer.

Sufficient visual observations, determinations of deleterious substances and analyses of gradation shall be made by the producer prior to shipment to assure compliance with these specifications.

The Contractor shall provide certified results of tests required by specifications. The Engineer reserves the right to witness the performance of tests. If the Contractor desires to use its own testing facilities to make the aforementioned tests, the Engineer's concurrence must be received.

The Sieve Analysis shall be made in accordance with the Method of Tests for Sieve Analysis of Fine and Course Aggregate (ASTM Designation C136).

Los Angeles Abrasion Loss shall be treated in accordance with Method of Test for Abrasion of Course Aggregate by use of the Los Angeles Machine (ASTM Designation C131) except that Grading of the sample for testing shall be as follows:

Sieve Size - Square Openings		
Passing	Retained On	Weight in Grams
2"	1¾ "	1250
1¾"	1½"	1250
1½"	1¼"	1250
1¼"	1"	1250

Soundness shall be treated in accordance with the current Method of Test for Soundness of Aggregate by use of Sodium Sulfate (ASTM Designation C88).

Cementing values shall be tested in accordance with the Logan Walter Page Method (U.S. Department of Agriculture, Bulletin No. 347, 1916, Page 15) except as modified as follows:

1. 500 grams of fines developed from the Los Angeles Abrasion Test (ASTM C131) that has been screened through a 100 mesh sieve, mixed with sufficient water, kneaded for five minutes and allowed to stand in air tight container for two hours, thereby forming a stiff dough that is to be molded into cylindrical briquettes 1 inch diameter by 1 inch in height under pressure of 1877.5 pounds per square inch, after which they are dried for 20 hours in air at room temperature, 4 hours in a hot air bath at a temperature of 212°F, then cooled for 20 minutes in a desiccator, and immediately tested in a compression testing machine for static crushing strength, the bearing heads being suspended by pivots to secure uniform distribution of load which is applied at 600 pounds per minute approximately.

2. The average crushing strength in pounds per square inch of 5 specimens measures the cementing value of this stone.

The Contractor shall certify that ballast delivered to the Railroad is typical of that upon which specified tests have been made.

The selection of samples is as important as the laboratory testing, and care must be taken that the samples obtained show the true nature and conditions of the material to be examined.

Samples of all ballast and samples of stone at quarries for test to determine the acceptability of the source, as well as samples for quality control, shall be selected by a representative of the purchaser. The owner of the quarry or producer may submit samples for inspection or preliminary testing if such action is approved by the Engineer.

Samples of the finished product for gradation and other required tests shall be taken from each 1,000 tons of prepared ballast unless otherwise ordered by the Engineer. Samples shall be representative (full belt) and shall weigh not less than 100 pounds. Where the acceptability of stone from a quarry is to be determined, a 150 pound sample consisting of pieces of approximately 6 by 6 by 4 inches should also be furnished. Method of sampling shall be furnished to the Engineer for approval.

If material prior to, during or after being loaded, does not conform to specifications, Inspector shall notify Contractor to stop operations until all faults have been corrected. Disposal and/or removal of defective material shall be done without cost to the Railroad.

As it is impractical to inspect all ballast at quarry, the Engineer reserves the right to reject any car of ballast (whether previously inspected or not) that does not conform to specifications upon arrival at unloading site.

No ballast shall be unloaded unless it has been approved by the Engineer or agency authorized by the Railroad to test and approve ballast.

Should ballast that does not meet specifications be unloaded prior to the Engineer's approval, then payment will not be made to Contractor. Contractor must remove all defective material from site without cost to the Railroad.

Defective material arriving at site for unloading shall be rejected by the Engineer and disposed of at expense (including all freight and switching costs) of Contractor.

Construction Methods:

Do not place ballast until the Engineer has approved the subgrade upon which the ballast is to be placed.

The Contractor shall place stone ballast to the limits and depths, and to the grade, shown on the Contract Drawings, or as directed by the Engineer.

Ballast shall be placed to 1'-7" below top of rail elevation or as shown on the Contract Drawings.

The Contractor shall tamp the ballast, and give a final lining and surfacing where required, and dress the ballast section.

Ballast shall be thoroughly tamped with tamping machines.

Method of Measurement:

All aggregate required for this work shall be weighed on scale furnished by and at the expense of the Contractor, except as otherwise permitted herein. The scales shall be of a type satisfactory to the Engineer and shall be sealed, at the expense of the Contractor, as often as the Engineer may require. All weighing shall be done in the presence of a representative of the Engineer.

If material is shipped by rail, ballast shall be ordered and payment based upon net ton in carload lots. Adjustments to compensation shall be made for deficiencies in plan depth and cross section as specified herein.

Cars shall be weighed and such weights shall be forwarded with car numbers to the Engineer.

If weighing cars is impractical, weight per cubic yard shall be obtained by weighing sample cubic yard volumes at such intervals as the Engineer may designate. Weight per cubic yard obtained by such tests, amount of cubic yards loaded in each car and car number shall be furnished to the Engineer, and shall be used in calculating weight per car until additional tests are made.

If material is shipped by rail, the car weights may be accepted but scales shall be provided as specified above if the Engineer so directs.

Measurements shall be subject to the following provisions:

Determination of Thickness: The thickness shall be as indicated on the plans, or as ordered by the Engineer and within a tolerance of minus three-quarters of an inch (-¾") to plus one-half inch (+½").

Measurements to determine the thickness will be taken by the Engineer at intervals of 500 feet or less, and shall be considered representative of the lane.

If a thickness measurement is taken and found deficient, the Engineer will take such additional measurements as he considers necessary to determine the longitudinal limits of the deficiency.

The Engineer may waive an occasional measurement outside the tolerances if in his judgment it is not representative of true conditions and providing that:

a) Other thickness measurements taken nearby for the course are within acceptable limits;
b) Proper controls have been exercised by the Contractor; and
c) If there would be no impairment to the serviceability of the complete construction.

No adjustment of the quantity accepted for payment will be made where the thickness does not exceed the allowable plus or minus tolerances.

Where the thickness exceeds that indicated on the plans by more than the prescribed tolerance, that material which is in excess of the total planned depth, plus the tolerance, will not be included for payment.

Areas represented by measurements deficient in thickness in excess of the allowable minus deviation shall be corrected at the Contractor's expense, or with written permission of the Engineer, the deficient areas may remain, and payment will be made at an equitable adjusted price based on weight per cubic yard.

An adjustment in quantity will be made in the materials placed beyond the horizontal limits indicated on the plans by deducting the computed weight of that material extending more than three inches beyond the horizontal plan dimensions.

Basis of Payment:

This work will be paid for at the contract unit price per ton for "Stone Ballast", complete in place, which price shall include all materials, tools, equipment and work incidental thereto.

Pay Item	**Pay Unit**
Stone Ballast	Ton

ITEM #0901003A – STEEL BOLLARD

Description:

The work under this item shall consist of the installation of steel bollards at the locations shown on the plans or as directed by the Engineer. This Section also includes furnishing all labor, materials and equipment necessary and incidentals to furnish and install the steel bollards as directed by the Engineer.

Bollards required for installation of concrete communications vaults shall be paid as incidental to that Item and shall not be paid under this Item.

Materials:

Bollards shall be 6" diameter schedule 80 (Galvanized) filled with concrete, painted safety yellow, extending 4' above grade and 3' below grade with a concrete footing. Placement of bollards shall be as shown in the Plans or as directed by the Engineer. Coordinate bollard placement with existing site conditions.

Protective compound material shall conform to Subarticle M.03.01.11.

Construction Methods:

Do not place bollards until the Engineer has approved the subgrade upon which the bollard is to be placed.

The Contractor shall restore the surface around the bollards in kind and as directed by the Engineer.

The Contractor shall furnish and employ such shores, braces, pumps, sedimentation basins, etc. as may be necessary for the protection of property, proper completion of the work. All bracing etc. shall be removed when no longer required for the construction or safety of the work.

Applicable requirements of Form 816 such as Section 2.02 and 2.05.03 Construction Methods related to backfilling shall be adhered to.

Method of Measurement:

Steel Bollards shall be measured for payment by the number of "Each" completed, furnished, installed and inspected.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each for "Steel Bollard" furnished, installed, and inspected, which price shall include all material, shoring, bracing, excavation, pumping, dewatering, backfill, pervious material, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
Steel Bollard	Each

ITEM #0913045A – 8’ CHAIN LINK FENCE WITH BARBED WIRE

Description:

This work for this item shall consist of furnishing and installing woven wire fencing of the height and type specified and supported by metal posts with angle mounted 3-strand barbed wire, installing grounding and bonding, installing 3-strand barbed wire on existing fence, erected where indicated on the plans or as ordered and in conformity with these specifications.

Materials:

The materials for this work shall conform to the requirements Section 9.13-Chain Link Fence of the State of Connecticut Department of Transportation “Standard Specifications for Roads, Bridges and Incidental Construction” (Form 816, 2004) and Article M.10.05. Barbed wire shall be 3-strands steel wire mounted on angle brackets as indicated on the plans. Grounding material shall conform to Article M.15.13.

Construction Method:

The chain link fence shall be installed as specified in Section 9.13-Chain Link Fence of the State of Connecticut Department of Transportation “Standard Specifications for Roads, Bridges and Incidental Construction” (Form 816, 2004). The two opposing ends of the new chain link fence shall be spliced to the respective ends of the existing similar fencing at or near an existing post in sound and plumbed condition.

The installation of 3-strand barb wire on existing chain link fence shall be installed as specified in Section 9.13-Chain Link Fence of the State of Connecticut Department of Transportation “Standard Specifications for Roads, Bridges and Incidental Construction” (Form 816, 2004) and per manufacturer’s specifications to retrofit the barbed wire.

New fencing and gate shall be bonded to track 3 buried counterpoise (if found) at 50’ maximum intervals with 4/0 copper. If no counterpoise is located bond new fencing and gate to 10 ft. ground rods installed at 50’ maximum intervals or as directed by the Engineer. Such ground rods will be paid under Item #1015021A – 3/4” x 10’ Ground Rod (Each).

Method of Measurement:

This work will be measured for payment by the number of linear feet of completed and accepted chain link fence of the height specified, measured from outside to outside of terminal posts.

Basis of Payment:

This work will be paid for at the contract unit price per linear foot for 8’ Chain Link Fence with Barbed Wire", of the height specified; complete in place which price shall include materials, equipment, tools, excavation, backfill, fabrication, installation, disposal of surplus material, grounding/bonding, installing barbed wire on existing chain link fence and all labor incidental thereto. Payment will be made under:

Pay Item	**Pay Unit**
8’ Chain Link Fence with Barbed Wire	Linear Foot

ITEM #0913122A – 8 FT CHAIN LINK DOUBLE GATE WITH BARBED WIRE

Description:

This work for this item shall consist of removal of existing gate and furnishing and installing an 8 foot high, 20 foot opening Chain Link Double Gate with 3-strand Barbed Wire, a swing type gate operation and supported by metal posts erected where indicated on the plans.

Materials:

The materials for this work shall conform to the requirements of Article M.10.05. The gates shall be of the same type of materials used for the chain link fencing. The height of the gates shall be 8 feet and the width shall be as indicated on the plans. The Barbed wire shall be 3-strand steel wire and shall be attached to the top of the gates with extended posts and fastening hardware as shown on the plans. The materials shall include hardware for a swing type gate.

Construction Method:

The gates shall be installed as specified in Section 9.13-Chain Link Fence of the State of Connecticut Department of Transportation "Standard Specifications for Roads, Bridges and Incidental Construction" (Form 816, 2004).

Method of Measurement:

This work will be measured for payment by the number of linear feet of completed and accepted chain link gates of the height specified, measured from outside to outside end gate posts.

Basis of Payment:

This work will be paid for at the contract unit price per linear feet for "8 Ft Chain Link Double Gate with Barbed Wire", of the type and size specified; complete in place which price shall include gate frame, gate posts, chain link fabric, lock, concrete, barbed wire, fasteners, excavation, backfill, fabrication, installation, disposal of surplus material, and all materials, equipment, tools, labor and any work incidental thereto. Payment will be made under:

Pay Item	Pay Unit
8 Ft Chain Link Double Gate with Barbed Wire	Linear Foot

ITEM #0969030A – PROJECT COORDINATOR (MINIMUM BID)

Article 1.05.08 – Schedules and Reports of the Standard Specifications is hereby amended by the following:

Add the following:

Description: Under this item the Contractor shall furnish the services of an administrative employee, entitled the Project Coordinator, for this Project, to coordinate and expedite all phases of the work required for the Project and to ensure that the construction schedule is maintained.

The minimum lump sum bid for this item shall be equal to 0.5% of the Contractor's total bid. Failure of the Contractor to bid at least the minimum amount will result in the Department adjusting the Contractor's bid to include the minimum bid amount for this item.

The Project Coordinator's resume shall be submitted for approval by name, in writing, within seven (7) calendar days of the award of the Contract, and shall not be changed without prior written notice to the Department.

This resume must demonstrate the Project Coordinator is experienced and versatile in the preparation, interpretation and modification of Critical Path Method (CPM) construction schedules. This must include successful completion of at least three (3) construction projects of similar complexity, where they served in a lead scheduling capacity. If the Contractor does not have a person in their company that has these skills, then the Contractor shall engage the services of a Consultant, subject to the approval of the Engineer, for the scheduling work required. If a Consultant is engaged, they shall be present at the first meeting, along with the Project Contractor, prepared to discuss, in detail, the methods and techniques they propose to use. Thereafter, the Project Coordinator or the Consultant responsible for updating the CPM Schedule shall attend all meetings between the Contractor, its Subcontractors, and any other meetings, which will affect the CPM schedule. The Contractor shall prepare CPM Schedules utilizing the latest version of Primavera Project Planner software.

When the Contract is administered under Section 1.20, the following requirement shall also apply:

The Project Coordinator shall have, in addition to the above noted requirements, a minimum of eight (8) years' experience related to commercial/industrial building construction as a Project Coordinator performing duties similar to those required herein. The Project Coordinator shall have knowledge of all trades involved in the construction, including civil/site work, environmental work, concrete work, masonry work, steel work, wood work, electrical work, and

mechanical work. Other combinations of experience and education totaling ten (10) years in commercial building construction will be considered subject to the approval of the Engineer.

Computer Software and Printer: The Contractor shall provide the following equipment with all the required maintenance and repairs (to include labor and parts) throughout the Contract life. The Engineer reserves the right to expand or relax the specification to adapt to the software and hardware limitations and availability.

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

Software – Minimum Specification: The Contractor shall provide the Engineer with a licensed copy of the latest version of the Oracle Primavera Contractor – Deluxe Version scheduling software, registered in the Department's name, and maintain the Primavera customer support service contract over the duration of the project.

Printer: An addition printer shall be provided that meets the printer specifications noted under contract item for "Construction Field Office" and is compatible with the software.

The Contractor is responsible for service and repairs to all computer hardware. All repairs must be performed within 24 hours. If the repairs require more than a 24 hours then a replacement must be provided.

Construction Methods: The Project Coordinator shall attend all meetings between the Contractor and the Department, the Contractor and its Subcontractors, and any other meetings that affect the progress of the job. The Project Coordinator shall be knowledgeable of the status of all parts of the work throughout the length of the Contract.

Please delete any reference to Bar Chart under 1.05.08 – Schedule and Reports and replace with the following:

Critical Path Method (CPM)

Please add the following:

Proper relationship between all major activities shall be indicated. Node numbers shall be coded such that the major activities shown on the Critical Path Schedule shall be easily referenced to the Detailed Project Schedule when it is developed. Break down the work covered under each

Special Provision, or Division and Section of Article 1.20 of the Standard Specifications, into individual activities required and logically group related activities together within the CPM.

All documents, which require approval by the Department, shall be clearly identified within the schedule. The Department and any outside agency shall be allocated a minimum number of calendar days in accordance with Article 1.20-1.05.02. If Article 1.20 does not apply, then the Department shall be allocated a minimum of thirty (30) calendar days (exclusive of weekends and holidays) for review and approval of each submittal. Any submittals requiring approval by an outside Agency (ConnDEEP, Coast Guard, Army Corps of Engineers, etc.) shall be allocated a minimum of sixty (60) calendar days. The Department shall not be held responsible for any delay associated with the approval or rejection of any substitution or other revisions proposed by the Contractor.

The schedule shall indicate the logic of the work for the major elements and components of work under the Contract, such as the planned mobilization of plant and equipment, sequences of operations, procurement of materials and equipment, duration of activities, type of relationship, lag time (if any), and such other information as it is necessary to present a clear statement of the intended activities.

The schedules shall consist of a network technique of planning, scheduling and control, shall be a clear statement of the logical sequence of work to be done, and shall be prepared in such a manner that the Contractor's work sequence shall be optimized between early start and late start restraints. The Contractor shall use the same criteria in a consistent manner throughout the term of the project. If, at any time, the Contractor alters logic, original durations, and descriptions, adds activities or activity codes or in any way modifies the Baseline Schedule, they must notify the Engineer of the change, in writing, presenting in detail the reasons for the change. The Engineer reserves the right to approve or reject any such change.

The critical path of the project must be identified on the CPM schedule. The critical path is the longest-duration path through the network. The significance of the critical path is that the activities that lie on it cannot be delayed without delaying the project. Because of its impact on the entire project, critical path analysis is an important aspect of project planning.

The critical path can be identified by determining the following four parameters for each activity:

1. ES - Earliest Start Time: the earliest time at which the activity can start given that its precedent activities must be completed first.
2. EF - Earliest Finish Time: equal to the earliest start time for the activity plus the time required to complete the activity.

3. LF - Latest Finish Time: the latest time at which the activity can be completed without delaying the project.

4. LS - Latest Start Time: equal to the latest finish time minus the time required to complete the activity.

The *float time* for an activity is the time between its earliest and latest start time, or between its earliest and latest finish time. Float is the amount of time that an activity can be delayed past its earliest start or earliest finish without delaying the project. Delays to activities on the critical path through the project network in which no float exists, that is, where ES=LS and EF=LF will delay the project.

Float available in the schedule, at any time shall not be considered for the exclusive use of either the Department or the Contractor. During the course of Contract, any float generated due to the efficiencies of either party is not for the sole use of the party generating the float; rather it is a shared commodity to be reasonably used by either party. Project float will be a resource available to both the Department and the Contractor.

Each CPM Schedule submittal shall be in the form of an activity on node diagram (precedence diagramming method) and shall include at a minimum; an Early Start computer sort, a Total Float computer sort, an Activity Number computer sort, a Schedule Diagram in the Time Scaled Logic format and a backup data CD-ROM which includes all Primavera project files. The diagrams may be requested printed out by the Department and shall be on 22" x 34" sheets. Additional, more detailed diagrams for important aspects or phases of the work may be required on large or complex projects.

Activity I.D. numbers shall be keyed to the item numbers assigned on the detailed estimate sheet. The first three digits (four digits for highway illumination, signing, traffic signals and utility work) of the activity I.D. number shall be identical to the first three digits of the item number in the Contract. The remaining digits may be used to provide unique, orderly and sequential I.D. numbers for each activity.

Activity codes shall be added to the schedule dictionary at the direction of the Engineer. At a minimum, activity codes for responsibility (prime, subcontractor by name), location of work (bridge #, span #, sta. #, site, building, type of work, etc.) and stage or phase number should be included.

1. Recovery Schedules: If, in the opinion of the Engineer, the updated schedule indicates that the Project has fallen behind schedule, or that a revision in sequence of operations may be necessary for any other reason, absent a justifiable time extension, the Contractor shall immediately institute all necessary steps to improve the Project's progress and shall submit such revised network diagrams, tabulations and operational plans, as may be

deemed necessary by the Engineer, to demonstrate the manner in which an acceptable rate of progress will be regained.

Should the Contractor not demonstrate an ability to regain an acceptable rate of progress, the Engineer shall require the schedule to be resource loaded with the next monthly update. No additional compensation will be allowed for resource loading the schedule.

2. As-Built Schedules: Within thirty (30) days of completion of the project, including all corrective work, the Contractor shall submit an "As-Built Schedule" showing the actual progress of work. The Contractor shall submit three prints of this final CPM Schedule and one project backup data CD-ROM which include all Primavera project files for the Engineer's exclusive use.

The following shall also apply to Contracts administered under Section 1.20:

3. Daily Construction Reports: The Project Coordinator shall assist the Engineer in the preparation of a daily construction report by ensuring that each of the Contractor's employees and subcontractors working on the Project Site on a given day signs the Engineer's sign-in sheet for that day; and by keeping and providing to the Engineer its own daily list of employees and subcontractors who worked on the Project Site on that day.

Method of Measurement: Within ten (10) calendar days of the award of the Contract, the Contractor shall submit to the Engineer for approval a breakdown of its lump sum bid price for this item detailing:

1. The development cost to prepare the Baseline Schedule in accordance with these specifications. Development costs shall not exceed 25% of the total cost of the item and shall include costs to furnish and install all specified hardware.

2. The cost to provide the services of the Project Coordinator, including costs to prepare and submit the Monthly Updates and Narrative; furnish and submit any Recovery Schedules; furnish and submit Two Week Look Ahead Schedules and maintenance of and supplies for the specified hardware noted above. A per month cost will be derived by taking this cost divided by the number of Contract months remaining from the date of acceptance of the Baseline Schedule.

3. The cost of submission and certification of the As-Built Schedule in accordance with these specifications. The submission and certification costs shall be no less than 2% of the total cost of the item.

4. Substantiation showing that the costs submitted are reasonable based on the Contractor's lump sum bid.

Upon approval of the payment schedule by the Engineer, payments for work performed will be made as follows:

1. Upon approval of the "Baseline" Schedule by the Engineer, the lump sum development cost will be certified for payment.

2. Upon receipt of each monthly narrative and update of the "Baseline" Schedule, the per month cost for the services of the Project Coordinator will be certified for payment.

3. Upon approval of the As-Built Schedule by the Engineer, the lump sum submission and certification cost will be certified for payment.

Basis of Payment: This service will be paid for at the Contract lump sum price for "Project Coordinator" complete, which price shall include the preparation and submission of all schedules, narratives, updates, reports and submittals. The lump sum price shall also include the cost of providing a complete, licensed copy of the Primavera software which will remain the property of the Engineer, and all materials, equipment, labor and work incidental of this service.

The lump sum price will be certified for payment as described in "Method of Measurement" subject to the following conditions:

1. Any month where the monthly update of the "Baseline" CPM schedule is submitted late, without authorization from the Engineer, will result in the following actions:
    a. The monthly payment for the Project Coordinator item will be deferred to the next monthly payment estimate. If any monthly submittal is more than thirty (30) calendar days late, there will be no monthly payment for the services of the Project Coordinator.

    b. The greater of 5% of the monthly payment estimate or $25,000 will be retained from the monthly payment estimate until such time as the Contractor submits all required reports.

    c. If in the opinion of the Engineer, the Contractor is not in compliance with this specification, the Engineer may withhold all Contract payments.

2. In the event the Contract time extends beyond the original completion date by more than thirty (30) calendar days, and a time extension is granted to the Contractor, the Department may require additional CPM updates which will be paid for at the per month cost for the services of the Project Coordinator.

3. If the Contractor is not in compliance with this specification or has failed to submit a "Baseline" schedule, monthly update, or a Recovery Schedule for any portion of the work, the Engineer will withhold all Contract payments until the schedule is submitted to, and approved by, the Engineer.

Pay Item	Pay Unit
Project Coordinator	L.S.

ITEM #0969064A – CONSTRUCTION FIELD OFFICE, LARGE

Description:

Under the item included in the bid document, adequate weatherproof office quarters with related furnishings, materials, equipment and other services, shall be provided by the Contractor for the duration of the work, and if necessary, for a close-out period determined by the Engineer. The office, furnishings, materials, equipment, and services are for the exclusive use of CTDOT forces and others who may be engaged to augment CTDOT forces with relation to the Contract. The office quarters shall be located convenient to the work site and installed in accordance with Article 1.08.02. This office shall be separated from any office occupied by the Contractor. Ownership and liability of the office quarters shall remain with the Contractor.

Furnishings/Materials/Supplies/Equipment:

All furnishings, materials, equipment and supplies shall be in like new condition for the purpose intended and require approval of the Engineer.

Office Requirements:

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

Description \ Office Size	Large
Minimum Sq. Ft. of floor space with a minimum ceiling height of 7 ft.	1000
Minimum number of exterior entrances.	2
Minimum number of parking spaces.	10

Office Layout

The office shall have a minimum square footage as indicated in the table above, and shall be partitioned as shown on the building floor plan as provided by the Engineer.

Tie-downs and Skirting

Modular offices shall be tied-down and fully skirted to ground level.

Lavatory Facilities

For large size field offices the Contractor shall furnish two (2) separate lavatories with toilet (men and women), in separately enclosed rooms that are properly ventilated and comply with applicable sanitary codes. Each lavatory shall have hot and cold running water and flush-type toilets. For all facilities the Contractor shall supply lavatory and sanitary supplies as required.

Windows and Entrances

The windows shall be of a type that will open and close conveniently, shall be sufficient in number and size to provide adequate light and ventilation, and shall be fitted with locking devices, blinds and screens. The entrances shall be secure, screened, and fitted with a lock for which four keys shall be furnished. All keys to the construction field office shall be furnished to the Department and will be kept in their possession while State personnel are using the office. Any access to the entrance ways shall meet applicable building codes, with appropriate handrails. Stairways shall be ADA/ABA compliant and have non-skid tread surfaces. An ADA/ABA compliant ramp with non-skid surface shall be provided with the Extra-Large field office.

Lighting

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

Parking Facility

The Contractor shall provide a parking area, adjacent to the field office, of sufficient size to accommodate the number of vehicles indicated in the table above. If a paved parking area is not readily available, the Contractor shall construct a parking area and driveway consisting of a minimum of 6 inches of processed aggregate base graded to drain. The base material will be extended to the office entrance.

Field Office Security

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

Electric Service

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

A. 120/240 volt, 1 phase, 3 wire
B. Ampacity necessary to serve all equipment. Service shall be a minimum 100 amp dedicated to the construction field office.

C. The electrical panel shall include a main circuit breaker and branch circuit breakers of the size and quantity required.

D. Additional 120 volt, single phase, 20 amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed at each computer workstation location.

E. Additional 120 volt, single phase, 20 amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed, for use by the Telephone Company.

F. Additional 120-volt circuits and duplex outlets as required meeting National Electric Code requirements.

G. One exterior (outside) wall mounted GFI receptacle, duplex, isolated ground, 120 volt, straight blade.

H. After work is complete and prior to energizing, the State's CTDOT electrical inspector, must be contacted at 860-594-2240. (Do Not Call Local Town Officials)

I. Prior to field office removal, the CTDOT Office of Information Systems (CTDOT OIS) must be notified to deactivate the communications equipment.

Heating, Ventilation and Air Conditioning (HVAC):

The field office shall be equipped with sufficient heating, air conditioning and ventilation equipment to maintain a temperature range of 68^{o}-80^{o} Fahrenheit within the field office.

Telephone Service

The Contractor shall provide telephone service with unlimited nation-wide calling plan. For a large field office shall consist of the installation of two (2) telephone lines: one (1) line for phone/voice service and one (1) line dedicated for the facsimile machine. The Contractor shall pay all charges.

Data Communications Facility Wiring

Contractor shall install a Category 6 568B patch panel in a central wiring location and Cat 6 cable from the patch panel to each PC station, Smart Board location, Multifunction Laser Printer/Copier/Scanner/Fax, terminating in a (Category 6 568B) wall or surface mount data jack. The central wiring location shall also house either the data circuit with appropriate power requirements or a category 5 cable run to the location of the installed data circuit. The central wiring location will be determined by the CTDOT OIS staff in coordination with the designated field office personnel as soon as the facility is in place.

For large field offices the Contractor shall run a CAT 6 LAN cable a minimum length of 25 feet for each computer to LAN switch area leaving an additional 10 feet of cable length on each side with terminated RJ45 connectors. Terminate runs to patch panel in LAN switch area. Each run / jack shall be clearly labeled with an identifying Jack Number.

The Contractor shall supply cables to connect the Wi-Fi printer to the Contractor supplied internet router and to workstations as needed. These cables shall be separate from the LAN cables and data Jacks detailed above for the Department network.

The installation of a data communication circuit between the field office and the CTDOT OIS in Newington will be coordinated between the CTDOT District staff, CTDOT OIS staff and the local utility company once the Contractor supplies the field office phone numbers and anticipated installation date. The Contractor shall provide the field office telephone number(s) to the CTDOT Project Engineer within 10 calendar days after the signing of the Contract as required by Article 1.08.02. This is required to facilitate data line and computer installations.

Additional Equipment, Facilities and Services

The Contractor shall provide at the field Office at least the following to the satisfaction of the Engineer:

Furnishing Description	Office Size
	Large
	Quantity
Office desk (2.5 ft x 5 ft) with drawers, locks, and matching desk chair that have pneumatic seat height adjustment and dual wheel casters on the base.	5
Personal computer tables (4 ft x 2.5 ft).	5
Drafting type tables (3 ft x 6 ft) and supported by wall brackets and legs; and matching drafters stool that have pneumatic seat height adjustment, seat back and dual wheel casters on the base.	1
Conference table, 3 ft x 12 ft.	1
Office Chairs.	8
Mail slot bin – legal size.	1
Non-fire resistant cabinet.	2
Fire resistant cabinet (legal size/4 drawer), locking.	2
Storage racks to hold 3 ft x 5 ft display charts.	1
Vertical plan racks for 2 sets of 2 ft x 3 ft plans for each rack.	2
Double door supply cabinet with 4 shelves and a lock – 6 ft x 4 ft.	1
Case of cardboard banker boxes (Min 10 boxes/case)	2
Open bookcase – 3 shelves – 3 ft long.	2
White Dry-Erase Board, 36” x 48”min. with markers and eraser.	1
Interior partitions – 6 ft x 6 ft, soundproof type, portable and freestanding.	6
Coat rack with 20 coat capacity.	-
Wastebaskets - 30 gal., including plastic waste bags.	1
Wastebaskets - 5 gal., including plastic waste bags.	6
Telephone.	1
Full size stapler 20 (sheet capacity, with staples)	5
Desktop tape dispensers (with Tape)	5
Rain Gauge	1

Mini refrigerator - 3.2 c.f. min.	1
Hot and cold water dispensing unit. Disposable cups and bottled water shall be supplied by the Contractor for the duration of the project.	1
Microwave, 1.2 c.f. , 1000W min.	1
Fire extinguishers - provide and install type and *number to meet applicable State and local codes for size of office indicated, including a fire extinguisher suitable for use on a computer terminal fire.	*
Electric pencil sharpeners.	2
Electronic office type printing calculators capable of addition, subtraction, multiplication and division with memory and a supply of printing paper.	2
Large Multi-Function Laser Printer/Copier/Scanner/Fax combination unit, network capable, as specified below under Computer Hardware and Software.	1
Field Office Wi-Fi Connection as specified below under Computer Hardware and Software	1
Wi-Fi Printer as specified below under Computer Hardware and Software.	1
Digital Camera as specified below under Computer Hardware and Software.	3
Infrared Thermometer, including annual third party certified calibration, case, and cleaning wipes.	1
Concrete Curing Box as specified below under Concrete Testing Equipment.	1
Concrete Air Meter and accessories as specified below under Concrete Testing Equipment as specified below. Contractor shall provide third party calibration on a quarterly basis.	1
Concrete Slump Cone and accessories as specified below under Concrete Testing Equipment.	1
First Aid Kit	1

Smart Phones as specified under Computer Hardware and Software.	6

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

Computer Hardware and Software

Field Office Wi-Fi Connection, Wi-Fi Printer, Digital Camera(s), Flip Phones, Smart Phones, Multifunction Laser Printer/Copier/Scanner/Fax, Video Projectors, and Smart Board(s) as well as associated hardware and software, must meet the requirements of this specification as well as the latest minimum specifications posted, as of the project advertising date, at Departments web site http://www.ct.gov/dot/cwp/view.asp?a=1410&q=563904

Within 10 calendar days after the signing of the Contract but before ordering/purchasing the Wi-Fi Printer (separate from the Multifunction Laser Printer/Copier/Scanner/Fax), Field Office Wi-Fi, Digital Camera(s), Flip Phones, Smart Phones, Multifunction Laser Printer/Copier/Scanner/Fax, Video Projector(s) and Smart Board(s) as well as associated hardware, the Contractor must submit a copy of their proposed order(s) with catalog cuts and specifications to the Administering CTDOT District for review and approval. The Wi-Fi Printer, Wi-Fi Router, Flip Phones, Smart Phones, digital cameras, Projector(s) and Smart Board(s) will be reviewed by CTDOT District personnel. The Multifunction Laser Printer/Copier/Scanner/Fax will be reviewed by the CTDOT OIS. The Contractor shall not purchase the hardware, software, or services until the Administering CTDOT District informs them that the proposed equipment, software, and services are approved. The Contractor will be solely responsible for the costs of any hardware, software, or services purchased without approval.

The Contractor and/or their internet service provider shall be responsible for the installation and setup of the field office Wi-Fi, Wi-Fi printer, and the configuration of the wireless router as directed by the Department. Installation will be coordinated with CTDOT District and Project personnel.

After the approval of the hardware and software, the Contractor shall contact the designated representatives of the CTDOT administering District, a minimum of 2 working days in advance of the proposed delivery or installation of the Field Office Wi-Fi Connection, Wi-Fi Printer, Digital Camera(s), Flip Phones, Smart Phones, Multifunction Laser Printer/Copier/Scanner/Fax, Video Projectors and Smart Board(s), as well as associated hardware, software, supplies, and support documentation.

The Contractor shall provide all supplies, paper, maintenance, service and repairs (including labor and parts) for the Wi-Fi printers, copiers, field office Wi-Fi, fax machines and other equipment and facilities required by this specification for the duration of the Contract. All repairs must be performed with-in 48 hours. If the repairs require more than a 48 hours then an equal or better replacement must be provided.

Once the Contract has been completed, the hardware and software will remain the property of the Contractor.

First Aid Kit

The Contractor shall supply a first aid kit adequate for the number of personnel expected based on the size of the field office specified and shall keep the first aid kit stocked for the duration that the field office is in service.

Rain Gauge

The Contractor shall supply install and maintain a rain gauge for the duration of the project, meeting these minimum requirements. The rain gauge shall be installed on the top of a post such that the opening of the rain gauge is above the top of the post an adequate distance to avoid splashing of rain water from the top of the post into the rain gauge. The Location of the rain gauge and post shall be approved by the Engineer. The rain gauge shall be made of a durable material and have graduations of 0.1 inches or less with a minimum total column height of 5 inches. If the rain gauge is damaged the Contractor shall replace it prior to the next forecasted storm event at no additional cost.

Concrete Testing Equipment

If the Contract includes items that require compressive strength cylinders for concrete, in accordance with the Schedule of Minimum Testing Requirements for Sampling Materials for Test, the Contractor shall provide the following equipment.

A) Concrete Cylinder Curing Box – meeting the requirements of Section 6.12 of the Standard Specifications.

B) Air Meter – The air meter provided shall be in good working order and meet the requirements of AASHTO T 152.

C) Slump Cone Mold – Slump cone, base plate, and tamping rod shall be provided in like-new condition and meet the requirements of AASHTO T119, Standard Test Method for Slump of Hydraulic-Cement Concrete.

All testing equipment will remain the property of the Contractor at the completion of the project.

Insurance Policy:

The Contractor shall provide a separate insurance policy, with no deductible, in the minimum amount of five thousand dollars ($5,000) in order to insure all State-owned data equipment and supplies used in the office against all losses. The Contractor shall be named insured on that policy, and the Department shall be an additional named insured on the policy. These losses shall include, but not be limited to: theft, fire, and physical damage. The Department will be responsible for all maintenance costs of Department owned computer hardware. In the event of loss, the Contractor shall provide replacement equipment in accordance with current Department equipment specifications, within seven days of notice of the loss. If the Contractor is unable to provide the required replacement equipment within seven days, the Department may provide replacement equipment and deduct the cost of the equipment from monies due or which may become due the Contractor under the Contract or under any other contract. The Contractor's financial liability under this paragraph shall be limited to the amount of the insurance coverage required by this paragraph. If the cost of equipment replacement required by this paragraph should exceed the required amount of the insurance coverage, the Department will reimburse the Contractor for replacement costs exceeding the amount of the required coverage.

Maintenance

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

Method of Measurement:

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

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

Basis of Payment:

The furnishing and maintenance of the Construction Field Office will be paid for at the Contract unit price per month for “Construction Field Office, (Large),” which price shall include all material, equipment, labor, service contracts, licenses, software, repair or replacement of hardware and

software, related supplies, utility services, parking area, external illumination, trash removal, snow and ice removal, and work incidental thereto, as well as any other costs to provide requirements of this specified this specification.

Pay Item	**Pay Unit**
Construction Field Office, (Large)	Month

ITEM #0970006A – TRAFFICPERSON (MUNICIPAL POLICE OFFICER)
ITEM #0970007A – TRAFFICPERSON (UNIFORMED FLAGGER)

Delete SECTION 9.70 TRAFFICPERSON *in its entirety and replace with the following:*

9.70.01—Description: Under this item the Contractor shall provide the services of Trafficpersons of the type and number, and for such periods, as the Engineer approves for the control and direction of vehicular traffic and pedestrians. Traffic persons requested solely for the contractor's operational needs will not be approved for payment.

9.70.03—Construction Methods: Prior to the start of operations on the project requiring the use of Trafficpersons, a meeting will be held with the Contractor, Trafficperson agency or firm, Engineer, and State Police, if applicable, to review the Trafficperson operations, lines of responsibility, and operating guidelines which will be used on the project. A copy of the municipality's billing rates for Municipal Police Officers and vehicles, if applicable, will be provided to the Engineer prior to start of work.

On a weekly basis, the Contractor shall inform the Engineer of their scheduled operations for the following week and the number of Trafficpersons requested. The Engineer shall review this schedule and approve the type and number of Trafficpersons required. In the event of an unplanned, emergency, or short term operation, the Engineer may approve the temporary use of properly clothed persons for traffic control until such time as an authorized Trafficperson may be obtained. In no case shall this temporary use exceed 8 hours for any particular operation.

If the Contractor changes or cancels any scheduled operations without prior notice of same as required by the agency providing the Trafficpersons, and such that Trafficperson services are no longer required, the Contractor will be responsible for payment at no cost to the Department of any show-up cost for any Trafficperson not used because of the change. Exceptions, as approved by the Engineer, may be granted for adverse weather conditions and unforeseeable causes beyond the control and without the fault or negligence of the Contractor.

Trafficpersons assigned to a work site are to only take direction from the Engineer.

Trafficpersons shall wear a high visibility safety garment that complies with OSHA, MUTCD, ASTM Standards and the safety garment shall have the words "Traffic Control" clearly visible on the front and rear panels (minimum letter size 2 inches (50 millimeters). Worn/faded safety garments that are no longer highly visible shall not be used. The Engineer shall direct the replacement of any worn/faded garment at no cost to the State.

A Trafficperson shall assist in implementing the traffic control specified in the Maintenance and Protection of Traffic contained elsewhere in these specifications or as directed by the Engineer. Any situation requiring a Trafficperson to operate in a manner contrary to the Maintenance and Protection of Traffic specification shall be authorized in writing by the Engineer.

Trafficpersons shall consist of the following types:

1. Uniformed Law Enforcement Personnel: Law enforcement personnel shall wear the high visibility safety garment provided by their law enforcement agency. If no high visibility safety garment is provided, the Contractor shall provide the law enforcement personnel with a garment meeting the requirements stated for the Uniformed Flaggers' garment.

Law Enforcement Personnel may be also be used to conduct motor vehicle enforcement operations in and around work areas as directed and approved by the Engineer.

Municipal Police Officers: Uniformed Municipal Police Officers shall be sworn Municipal Police Officers or Uniformed Constables who perform criminal law enforcement duties from the Municipality in which the project is located. Their services will also include an official Municipal Police vehicle when requested by the Engineer. Uniformed Municipal Police Officers will be used on non-limited access highways. If Uniformed Municipal Police Officers are unavailable, other Trafficpersons may be used when authorized in writing by the Engineer.
Uniformed Municipal Police Officers and requested Municipal Police vehicles will be used at such locations and for such periods as the Engineer deems necessary to control traffic operations and promote increased safety to motorists through the construction sites.

2. Uniformed Flagger: Uniformed Flaggers shall be persons who have successfully completed flagger training by the American Traffic Safety Services Association (ATSSA), National Safety Council (NSC) or other programs approved by the Engineer. A copy of the Flagger's training certificate shall be provided to the Engineer before the Flagger performs any work on the project. Uniformed Flaggers shall conform to Chapter 6E, Flagger Control, in the Manual of Uniformed Traffic Control Devices (MUTCD) and shall wear high-visibility safety apparel, use a STOP/SLOW paddle that is at least 18 inches (450 millimeters) in width with letters at least 6 inches (150 millimeters) high. The paddle shall be mounted on a pole of sufficient length to be 6 feet (1.8 meters) above the ground as measured from the bottom of the sign.

Uniformed Flaggers will only be used on non-limited access highways to control traffic operations when authorized in writing by the Engineer.

9.70.04—Method of Measurement: Services of Trafficpersons will be measured for payment by the actual number of hours for each person rendering services approved by the Engineer. These services shall include, however, only such trafficpersons as are employed within the limits of construction, project right of way of the project or along detours authorized by the Engineer to assist the motoring public through the construction work zone. Services for continued use of a detour or bypass beyond the limitations approved by the Engineer, for movement of construction vehicles and equipment, or at locations where traffic is unnecessarily restricted by the Contractor's method of operation, will not be measured for payment.

Trafficpersons shall not work more than twelve hours in any one 24 hour period. In case such services are required for more than twelve hours, additional Trafficpersons shall be furnished and

measured for payment. In cases where the Trafficperson is an employee on the Contractor's payroll, payment under the item "Trafficperson (Uniformed Flagger)" will be made only for those hours when the Contractor's employee is performing Trafficperson services.

Travel time will not be measured for payment for services provided by Uniformed Municipal Police Officers or Uniformed Flaggers.

Mileage fees associated with Trafficperson services will not be measured for payment.

Safety garments and STOP/SLOW paddles will not be measured for payment.

9.70.05—Basis of Payment: Trafficpersons will be paid in accordance with the schedule described herein.

There will be no direct payment for safety garments or STOP/SLOW paddles. All costs associated with furnishing safety garments and STOP/SLOW paddles shall be considered included in the general cost of the item.

1. Uniformed Law Enforcement Personnel: The sum of money shown on the Estimate and in the itemized proposal as "Estimated Cost" for this work will be considered the bid price even though payment will be made as described below. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount for the contract.

The Department will pay the Contractor its actual costs for "Trafficperson (Municipal Police Officer)" plus an additional 5% as reimbursement for the Contractor's administrative expense in connection with the services provided. The 5% markup will be paid when the Engineer receives cancelled check(s) or receipted invoice(s) as proof of payment from the Contractor.

The invoice must include a breakdown of each officer's actual hours of work and actual rate applied. Mileage fees associated with Trafficperson services are not reimbursable expenses and are not to be included in the billing invoice. The use of a municipal police vehicle authorized by the Engineer will be paid at the actual rate charged by the municipality. Upon receipt of the invoice from the municipality, the Contractor shall forward a copy to the Engineer. The invoice will be reviewed and approved by the Engineer prior to any payments. The rate charged by the municipality for use of a uniformed municipal police officer and/or a municipal police vehicle shall not be greater than the rate it normally charges others for similar services.

2. Uniformed Flagger: Uniformed flaggers will be paid for at the contract unit price per hour for "Trafficperson (Uniformed Flagger)", which price shall include all compensation, insurance benefits and any other cost or liability incidental to the furnishing of the trafficpersons ordered.

Pay Item	Pay Unit
Trafficperson (Municipal Police Officer)	est.
Trafficperson (Uniformed Flagger)	Hr.

ITEM #1008183A – ¾" PVC COATED CONDUIT
ITEM #1008184A – 1" PVC COATED CONDUIT
ITEM #1008188A – 1¼" PVC COATED CONDUIT
ITEM #1008185A – 1½" PVC COATED CONDUIT

Description:

This work shall consist of furnishing and installing new PVC coated rigid galvanized steel (RGS) conduit system and fittings as indicated on the Plans or as directed by the Engineer.

General:

Coordination:

The plans indicate the extent and the general location and arrangement of the work. The Contractor shall study the plans and details so that the work will be properly located and readily accessible. If conflicts occur necessitating departures from the plans, the Contractor shall submit details of departures and reasons therefore shall be submitted as soon as practicable for written approval of the Engineer. Contractor shall ensure any rerouting required does not adversely affect the circuits inside.

Substitutions of products and materials of other Sections may affect wire sizing and/or conduit fill. Contractor shall ensure all substitutions are coordinated with the design and the installation conforms to all Contract requirements and local codes.

Make field inspections necessary in order to prepare accurate shop drawings in accordance with existing conditions. Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation. Include plans, elevations, sections, details, and attachments as needed. Drawings should indicate site specific installation details including showing the exact equipment locations, mounting details, splice locations, riser diagrams, and capacity for holding slack cable(s).

Materials:

The PVC Coated Conduit system shall include necessary PVC coated fittings, boxes, and covers to form a complete encapsulated conduit system. Conduits, couplings, elbows, bends, and nipples shall meet the requirements of NEC, UL 6, ANSI 80.1, NEMA RN-1 as applicable.

The PVC Coated Conduits shall be rigid steel, hot dip galvanized inside and out with hot dipped galvanized threads. The interior galvanizing shall be listed per UL 6. The exterior galvanizing shall be listed per UL 6 as primary corrosion protection. Thread protectors shall be used on the exposed threads of the PVC coated conduit.

The PVC coating, in compliance with NEMA RN-1, shall be nominal 40 mils in thickness continuous over the entire length of the conduit except at the threads, and be free of blisters, bubbles or pinholes. PVC shall be UL listed as a primary corrosion protection.

A urethane coating shall be uniformly and consistently applied to the interior of conduit. This internal coating shall be a nominal 2-mil thickness. All male threads on elbows and nipples shall be protected by this same application of urethane coating.

Coated couplings shall be used with coated conduit. The thickness of the coating on couplings shall be at least equal to the thickness of the coating on the conduit. Each coated coupling shall have a flexible PVC sleeve which extends from each end of the coupling and which will overlap the PVC coating on the conduit when the coupling has been installed on the conduit. The length of the sleeve extension(s) shall be at least equivalent to the nominal conduit size for sizes up through 2". For sizes 2" – 6", the length of the sleeve extension(s) shall be at least 2 in. The PVC sleeve shall be a nominal thickness of 40 mils in thickness. The inside diameter of the overlapping sleeve shall be less than the outside diameter of the PVC-coated conduit.

Conduit straps and clamps used with PVC coated conduit shall also be PVC coated. Where conduit is installed on strut channel, the channel shall be PVC coated or 316 stainless steel unless otherwise noted on the Plans. 316 stainless steel straps may be used with stainless steel channel but shall not be used with PVC coated strut channel.

Product Data:

> Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

Construction Methods:

The Contractor shall adhere to all provisions of the Connecticut DOT Form 816 Standard Specifications.

It shall be responsibility of the Contractor to ensure the PVC coating remains intact on all conduits. Should any of the PVC coating be nicked, scratched or otherwise damaged where the RGS becomes exposed, the Contractor shall be responsible at his expense to repair and restore the PVC coating using a manufacturer approved repair kit and procedure.

To minimize installation damage to the PVC coatings, use tools specially designed for PVC coated conduit or standard tools that have been appropriately modified for installing PVC coated conduit. Standard tools which have not been modified could damage the coatings and shall not be used to install PVC coated conduit. Follow all manufacturer's recommendations and instructions.

Where conduit is threaded in the field, the thread shall be coated with an approved electrically-conductive, corrosion resistant compound. Compound shall be UL listed "FOIZ".

Bending: Conduit bends shall be made with a bender with shoes specifically designed to bend PVC coated conduit. Small conduit sizes may be bent using an EMT hand bender one size larger than the conduit size. Follow all manufacturer instructions and recommendations.

Method of Measurement:

This work shall be measured for payment by the number of "linear feet" of conduit and all fittings installed in accordance with the Plans, specifications, and/or as ordered by Engineer. Measurement shall be along the centerline of the conduit.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per linear foot for "PVC Coated Conduit size specified" furnished and installed, which price shall include the cost of all labor, material (including fittings) and equipment necessary to complete the work.

Pay Item	**Pay Unit**
¾" PVC Coated Conduit	Linear Foot
1" PVC Coated Conduit	Linear Foot
1 ¼" PVC Coated Conduit	Linear Foot
1 ½" PVC Coated Conduit	Linear Foot

ITEM #1008183A
ITEM #1008184A
ITEM #1008185A
ITEM #1008188A

ITEM #1008555A – HDPE INNERDUCT – 1¼”

Description:

This work shall consist of furnishing all labor, tools, and equipment necessary for installing 1¼” high density polyethylene (HDPE) innerduct as indicated on the plans or as directed by the Engineer. The innerduct is to be used for fiber optic cables and will be placed inside cable trays, underground cable troughs, conduits, ducts, and risers as shown in the plans.

Materials:

Innerduct shall be either smooth-walled or corregated. All innerduct shall be acquired from the same vendor. All innerduct shall be UV, riser rated. Each innerduct shall be solid color coded bright ORANGE.

Corrugated: The innerduct shall be corregated, inside and out, High Density Polyethylene (HDPE) plastic co-extruded with a permanent silicone lining delivered on a cable reel.

Smooth Wall: The innerduct shall be smooth-walled, inside and outside, High Density Polyethylene (HDPE) plastic Type SIDR9 delivered on a cable reel. The innerduct shall be extruded from high-density polyethylene (HDPE) resin and conforming to the minimum standards for polyethylene PE345430B as defined in ASTM D3350.

Product Data: Submit Manufacturer’s literature and catalog cuts for all products/materials to the Engineer for review and approval.

Construction Methods:

The innerduct shall be placed inside underground cable troughs, conduits, ducts, cable trays, and risers as shown in the plans. Where innerduct exits a conduit or riser, it shall extend past the conduit or riser at least 6”. All open ends of the innerduct shall be sealed with a rubber expansion type duct plug.

All bends in the innerduct shall be made without kinking, flattening, or appreciably reducing the internal diameter of the innerduct and as recommended by the manufacturer.

Make field inspections necessary in order to prepare accurate shop drawings in accordance with existing conditions. Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation.

Contractor shall coordinate the type of innerduct to be installed at each location. Contractor shall ensure the pulling tension of the innerduct and the cables to be installed within the innerduct will

not be exceeded.

Innerduct shall be installed in continuous lengths to the extent possible. Splicing of innerduct will be permitted using mechanical couplers as required to facilitate the installation with approval of the Engineer. Splicing shall be conducted according to manufacturer's installation specifications and shall have been tested and demonstrated to provide an impermeable seal with a tensile strength equal to or greater than the duct without splices. There shall be no splices in conduits or risers.

The minimum bend radius shall be 24 inches.

The operating temperature range shall be -40 deg. F. to 158 deg. F.

Method of Measurement:

The HDPE Innerduct shall be measured for payment by the number of "Linear foot" furnished, installed, and inspected. Measurement shall include all couplings.

Basis of Payment:

The work under this item shall be pay for at the contract price per linear foot for "HDPE Innerduct 1-¼" " shall include the innerduct and all labor and materials necessary to complete the work. Payment will be made under:

Pay Item	**Pay Unit**
HDPE Innerduct 1¼"	Linear Feet

ITEM #1008908A – CLEAN EXISTING CONDUIT

Description:

Clean existing conduit as required, as shown on the plans or as directed by the Engineer to remove dirt and debris to facilitate the installation of new cable.

Construction Methods:

Where cable is to be installed in existing empty conduit, the conduit may have to be cleared prior to the installation. Cleaning will only be necessary if the new cable cannot be easily installed in the existing conduit. By field inspection, and with the concurrence of the Engineer, determine the sections of conduit that require cleaning. The Contractor may not relocate existing cabling in order to clean and use existing conduit. If existing conduit is unavailable, the Contractor shall run new conduit to accommodate the new cabling.

Clean the conduit by one of the following methods:

1) Rodding.
2) A high pressure jet spray, or air pressure.
3) By pulling a mandrel or ball through the conduit.

Submit in writing the anticipated method of cleaning the conduit to the Engineer for approval prior to cleaning any conduit.

If the conduit is found damaged to any extent that the cleaning process will not clear the obstruction, it will be the judgment of the Engineer whether to replace the entire conduit run or excavate and replace only the damaged section. New Trenching and Conduit shall be paid for under those items.

If the existing conduit is found to be missing hardware such as bonding bushings and bond wire, the missing material shall be provided and installed

Method of Measurement:

Clean Existing Conduit shall be measured for payment by the actual number of “Linear Feet” from termination point to termination point.

Basis of Payment:

The work under the Item "Clean Existing Conduit" shall be paid for at the contract unit price per linear foot, which price shall include all material, tools, equipment, labor, and work incidental thereto. Replacement of any damaged conduit shall be paid for under the applicable conduit item.

Pay Item	**Pay Unit**
Clean Existing Conduit	Linear Feet

ITEM #1015013A - #4 AWG COPPER GROUND WIRE
ITEM# 1015021A - ¾" X 10' GROUND ROD
ITEM #1015025A – 4/0 BARE COPPER GROUND WIRE

Description:

Work under these items shall include all labor, materials and services to install grounding systems. The work shall include all materials, equipment and labor incidental for the completion of all work specified.

General:

The following shall be submitted:

Product Data: Provide manufacturers literature and catalog cuts for copper ground conductor and grounding rods and accessories.

Product Certification: Signed by manufacturer of product certifying that the products comply with the specified requirements.

Materials:

Grounding conductor shall be bare copper conforming to Section M15.13 of the Standard Specifications. Grounding Rods shall be installed in accordance with requirements of the National Electrical Code and National Electrical Safety Code and the requirements specified.

Method of Measurement:

This work will be measured per lineal foot of #4 AWG Copper Ground Wire and per lineal foot of 4/0 Bare Copper Ground Wire and per each for ¾" x 10' Ground Rod, as applicable, complete in place and accepted.

Basis of Payment:

The work will be paid for at the respective Contract Unit Price.

The prices shall include all costs to provide for the completion of the work specified.

Pay Item	Pay Unit
#4/0 Bare Copper Ground Wire	Linear Foot
#4 AWG Copper Ground Wire	Linear Foot
¾" x 10' Ground Rod	Each

ITEM #1015049A – COMMUNICATION VAULT

Description:

This Section specifies the material requirements for a Communication Vault to be furnished and placed in accordance with the Plans and Specifications. This Section also includes furnishing all labor, materials and equipment necessary and incidentals to furnish and install the concrete communications vault as directed by the Engineer.

Materials:

The Contractor shall furnish and install a reinforced concrete vault in accordance with ASTM C858 comprised of interlocking modular sections, metal fabricated enclosure, hinged steel cover for access into the vault, grounding, internal channels, bollards and surface restoration as shown in the Plans.

Furnish materials in accordance with State of Connecticut Department of Transportation standards.

Loading shall be AREMA Cooper E80.

Wall thickness shall be 8”

The Contractor shall submit shop drawings for the vault and all components for approval by the Engineer.

Bollards shall be 6” diameter schedule 80 (Galvanized) filled with concrete, painted safety yellow, extending 4’ above grade and 3’ below grade with a concrete footing. Placement of bollards around the communications vault shall be as shown in the Plans or as directed by the Engineer. Coordinate bollard placement with existing site conditions.

Protective compound material shall conform to subarticle M.03.09

Pervious material shall conform to Article M.02.05.

Construction Methods:

Do not place Vault until the Engineer has approved the subgrade upon which the Vault is to be placed.

Install and seal precast sections in accordance with ASTM C891.

The Contractor shall restore the surface around the Vault in kind and as directed by the Engineer.

Pervious material shall be used for backfilling.

The Contractor shall furnish and employ such shores, braces, pumps, sedimentation basins, etc. as may be necessary for the protection of property, proper completion of the work. All bracing etc. shall be removed when no longer required for the construction or safety of the work.

Applicable requirements of Section 2.05.03 Construction Methods related to backfilling shall be adhered to.

Initial 4ft. of excavation shall be done by hand or other non-destructive method approved by the Engineer.

Contractor shall coordinate with AT&T ducts nearby and other nearby obstructions, both above and below ground. Contractor shall contact AT&T at 1-800-829-1011 and coordinate their work before performing work around the node houses.

Method of Measurement:

Communication Vault shall be measured for payment by the number of "Each" completed, furnished, installed and inspected.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each for "Communication Vault" (including associated bollards) furnished, installed, and inspected, which price shall include all material, shoring, bracing, excavation, pumping, dewatering, backfill, pervious material including crushed stone, tools, equipment, labor, and work incidental thereto. No separate payment for associated bollards will be made.

Pay Item	**Pay Unit**
Communication Vault	Each

ITEM #1019028A – AERIAL FIGURE 8 INNERDUCT

Description:

This item shall consist of furnishing and installing Aerial Figure 8 Innerduct at the locations shown on the plans or as indicated by the Engineer.

The Aerial Figure 8 Innerduct shall be installed along the track right-of-way for the purpose of installing fiber optic cables.

Applicable Standards:

ASTM F2160, ASTM D3350

Materials:

The Aerial Innerduct shall be Duraline 1¼" Figure 8 with integral 3/8" Messenger or approved equal meeting the following requirements:

1. The Aerial Figure 8 Innerduct shall be 1¼" in size.
2. The Aerial Figure 8 Innerduct shall be made of silicone lining with flexible HDPE jacket.
3. The Aerial Figure 8 Innerduct shall have Galvanized Extra High Strength Steel Strand with flexible HDPE jacket on the top of the Innerduct for aerial installation.
4. The Aerial Figure 8 Innerduct average wall shall be 0.13 inch thick.
5. The Aerial Figure 8 Innerduct average outside diameter shall be 1.556 inch.

Construction Method:

Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval. The Contractor shall submit shop drawings to the Engineer for approval prior to supplying this item.

All fittings, adapters, unions, joints, couplers, sealants and other ancillary items required to provide a complete installation shall be supplied by the Contractor and included in this item, and shall be approved by the Engineer prior to installation. Make field inspections necessary in order to prepare accurate shop drawings in accordance with existing conditions. Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation. Include plans, elevations, sections, details, and attachments as needed. Drawings should indicate site specific installation details.

Before installation, the Contractor shall supply to the Engineer for approval a copy of the installation guidelines and procedures provided by the manufacturer. It shall be the responsibility of the Contractor to follow all manufacturer guidelines and procedures for the installation of the Innerduct and to use tools and equipment that are recommended by the manufacturer.

The aerial innerduct shall be grounded as detailed on the plans and other specification items.

The aerial innerduct erection tensions shall be governed by the plans, based on the equivalent span for the tension length and temperature of the conductor.

During stringing of new aerial innderduct, proper vertical and horizontal electrical clearances must be maintained from existing wires and structures.

The tension shall be adjusted so that it will be within plus/ minus five percent of the erection tension as shown on the plans.

The aerial innerduct shall meet NESC requirements for clearance above the ground and are subject to the approval of the Engineer.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information.

Upon receipt, and prior to installation, Contractor shall perform visual inspections to verify Figure 8 Innerduct is not visibly damaged.

Acceptance Testing:

Follow requirements of the Acceptance Testing in other Sections. The Innerduct Acceptance Test Procedures shall cover, at a minimum:

Acceptance measurements on aerial innerduct and messenger wire, all forms and tables to be used for documenting results.

Visual inspection of complete aerial innerduct and messenger wire, all forms and tables to be used for documenting results.

Inspections and checks on other completed installations and all forms and tables to be used for documenting results.

The Acceptance Test Procedures will, as a minimum, include: objective and scope, equipment set-up; equipment to be used; personnel required; estimated

duration; chronological sequence of test steps, pass/fail criteria and samples of data sheets to be used.

An outline of the required inspections/checks/tests/measurements is indicated below for information.

Acceptance Measurements on Aerial Innerduct:

Upon completion of each segment of construction, the Contractor shall measure the Aerial innerduct height, and other required dimensions and record the readings on an Acceptance Measurement Form, in the presence of the Engineer.

Tests shall be scheduled in advance with the Engineer, and shall only be made during times of calm, dry weather, with either steady sunshine, or continuous cloud cover.

Acceptance Measurements tables and forms shall be prepared and shall include the following information:

Track designations

Drawing number(s) where the structures of the wire Figure 8 aerial duct are shown

Name(s) of person(s) responsible for performing the acceptance measurements

Sheet number

Equipment being measured

Temperature of the messenger wire in degrees F during the time of measurement

Stringing tension and sag of the messenger.

Weather condition during time of measurement (e.g., windy, raining)

The date measurement was made

Ground resistance measurement.

Station location of the pole or location where measurement is being taken

The Contractor shall provide a self-propelled, high-rail, man lift platform inspection vehicle for final inspection of each completed Figure 8 Aerial Innerduct run. The inspection vehicle shall be capable of lifting four (4) people to the aerial innerduct height and shall be supplied with a vehicle driver.

The Contractor shall provide all manpower, equipment, and grounding devices required to provide equal-potential grounding protection for inspection personnel on the high rail inspection vehicle. The protection shall be provided for the entire length of Figure 8

Aerial duct run being inspected and shall be in conformance with all Metro-North rules, procedures, and regulations.

The high rail inspection vehicle will be made available for use by the Engineer and the Railroad Inspectors for final inspection of each completed aerial innerduct installation and attachments. The inspection vehicle shall also be made available for use for the re-inspection(s) of completed aerial innerduct and attachments installations when remedial work is required due to deficiencies found during the initial inspection.

Method of Measurement:

"Aerial Figure 8 Innerduct" shall be measured for payment by the actual number of "Linear Feet" furnished, installed, tested, and accepted.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per linear foot for "Aerial Figure 8 Innerduct" which price shall include all materials and incidentals needed to complete the work as described in these Specifications and as shown in the Plans.

Pay Item	**Pay Unit**
Aerial Figure 8 Innerduct	Linear Foot

ITEM #1020004A – WOOD POLE (35 FEET)

Descriptions:

Under this item, the Contractor shall furnish and install a wood utility pole suitable for attachment of aerial figure 8 innerduct, risers, conduits, and ancillary equipment as shown in the Plans.

Materials:

The pole shall meet the requirements of ANSI O5.01 for Class 1 utility poles and shall be 35 feet in length. The pole shall be given a preservative treatment, using a water-borne preservative, in accordance with ANSI Standards and all applicable subsections of the State of Connecticut Standard Specifications.

Construction Methods:

Materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer, unless otherwise specified. The installation shall be accomplished by workmen skilled in this type of work.

The pole shall be erected plumb in an augured hole of sufficient depth to allow for a minimum of 8' embedment. See Standard Specifications Sections 2.03 Structure Excavation, 2.14 Compacted Granular Fill and Section 7.55 Geotextile for Materials and Construction Methods. The Contractor shall restore, in kind, all areas which were disturbed by the pole installation operation. Excess excavated materials shall remain on the railroad right-of-way and shall be spread in non ballasted areas as approved by the Engineer.

Each wood pole shall be grounded and be isolated according to the proper details and according to the Notice to Contractor Grounding and Bonding Systems.

Down guys shall be installed as shown in the specification and paid for under "STEEL (MISCELLANEOUS)".

Down guys shall be installed on any existing un-guyed wood poles supporting new attachments. Guys shall be installed at a minimum angle of 30 degrees from the pole. If limited clearance or other restrictions may require installation at an angle less than 30 degrees, the proposed down guy location shall be brought to the attention of the Engineer for review and approval.

Wood Pole Installation

Wood poles shall be installed as shown on the plans. The top four feet of excavation shall be done by hand or other non-destructive method approved by the Engineer. The bottom four feet of the hole shall be dug by mechanical means and its diameter shall only be large enough to accept the pole and the tamper. The pole shall be placed in the hole and the hole shall be backfilled with compacted granular fill per the Special Provisions and Standard Specifications.

Method of Measurement:

The work will be measured as the number of wood poles (35 feet) furnished, installed, and inspected in accordance with the Contract Documents and as ordered by the Engineer.

The wood pole shall be approved by the Engineer prior to purchase by the Contractor. Approval of materials and equipment will be based on the manufacturer's published data.

Basis of Payment:

The work will be paid for at the contract unit price per each for "Wood Pole (35 feet)" which price shall include all costs to provide for the completion of the work specified, including the wood pole, grounding, isolation, excavation, compacted granular fill, geotextile and spreading of excess material.

Pay Item	**Pay Unit**
Wood Pole (35 feet)	Each

ITEM #1108659A – NETBOSS INTEGRATION

Description:

Metro-North uses NetBoss from NetBoss Technologies, Inc. as a network manager. Under this contract, additional optical switches and power monitoring devices shall be monitored by the existing NetBoss network manager. The Contractor shall furnish the necessary professional services from NetBoss Technologies, Inc. to provide full integration of the devices into the existing NetBoss system.

Services to be provided shall include, but not be limited to, site survey; requirements and scope refinement; acceptance test procedure development; management and engineering support; equipment procurement and inspection; factory integration; shipping; site preparation; connectivity testing and protocol analysis; system device, functional and acceptance testing; system commissioning and final acceptance; customer as-built documentation and training of the modified software.

Materials:

Contractor shall provide the necessary professional service for the following items/devices:

Item	Description	Quantity
1	Configure DPS NetGuardian Agent for 3 more instances installed at Bridgeport, Fairfield, and Greens Farms node houses under this contract	1
2	Configure Sageon Power Agent for 3 more instances installed at Bridgeport, Fairfield, and Greens Farms node houses under this contract	1
3	Create Graphics for 3 Sageon Power Systems installed at Bridgeport, Fairfield, and Greens Farms node houses under this contract	1
4	Create Graphics for 6 Cisco 15454 Devices installed at Bridgeport, Fairfield, and Greens Farms node houses under this contract	1
5	Create Graphics for 3 DPS NetGuardian RTUs installed at Bridgeport, Fairfield, and Greens Farms node houses under this contract	1

Contractor shall provide 90 days of warranty on the services and software provided after acceptance of the completed work.

The Work of this Section shall be performed by NetBoss Technologies, Inc., 10305 102nd Terrace, Sebastian, FL 32958.

Basis of Payment:

The sum of money shown on the Estimate and in the itemized proposal as "Estimated Cost" for this work will be considered the bid price even though payment will be made as described below. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter

the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount for the contract.

The Department will pay the Contractor its actual costs for "NetBoss Integration" plus an additional 5% as reimbursement for the Contractor's administrative expense in connection with the services provided. The 5% markup will be paid when the Engineer receives cancelled check(s) or receipted invoice(s) as proof of payment from the Contractor. Prior to procuring the services, the Contractor shall submit a detailed quote indicating all work to be done by NetBoss for approval by the Engineer. All work and amounts shall be pre-approved by the Engineer. Payment will not be made without pre-approval.

Pay Item	**Pay Unit**
NetBoss Integration	Estimated

ITEM #1108671A – ETHERNET SWITCH – CISCO IE4000

Description:

The Contractor shall furnish and install Cisco® Industrial Ethernet (IE) 4000 Series DIN-mount L2/L3 switches at the locations as shown in the Plans and shall furnish the spare parts listed in this specification.

Materials:

The Cisco IE 4000 switches shall be configured with the minimum requirements as outlined in this Specification.

It shall be the responsibility of the Contractor to coordinate the purchase and delivery of this equipment with the Engineer, MNR Communications, and Cisco to guarantee the most recent version/models are being purchased. It shall also be the responsibility of the Contractor to purchase all necessary components, pieces, parts, modules, cabling, software, and configuration in addition to the parts specifically mentioned above to provide a complete and fully-functioning system as described in these Special Provisions, Plans, and elsewhere in the Contract Documents. Configuration and testing shall be performed by Cisco. Payment of work performed by Cisco will be paid under Item #1108672A – Cisco Professional Services.

The following minimum requirements shall be met for the switch configurations at each station:

Stratford Station

The Contractor shall supply the following items and quantities of switches and components to meet the requirements as shown in the plans for the Stratford Station platform switches:

Cisco Part Number	Description	Quantity
IE-4000-4GS8GP4G-E	Rugged Industrial Ethernet switch w/ 4 Gigabit Ethernet (GigE) SFP Ports, 8 10/100/1000 PoE/PoE+ ports, and 4 dual-purpose SFP Gigabit Ethernet (GigE) Uplinks	2
PWR-IE170W-PC-AC=	High-Voltage AC/DC Power Source, 170W	2
GLC-LX-SM-RGD=	1000 Mbps Single-Mode Rugged SFP, 1300nm	8
L-IE4000-RTU=	Cisco IE 4000 IP Services License	2
CAB-CONSOLE-USB	Cisco Console Cable 6 ft. USB Type A to Mini-B	2
CON-SNT-IE40004P	SMARTNET Warranty Service, 8x5x Next Business Day	4*

*SMARTNET support shall be provided for 2 years for each switch

PECK Bridge

The Contractor shall supply the following items and quantities of switches and components to meet the requirements as shown in the plans for the PECK Bridge switches:

Cisco Part Number	Description	Quantity
IE-4000-4GS8GP4G-E	Rugged Industrial Ethernet switch w/ 4 Gigabit Ethernet (GigE) SFP Ports, 8 10/100/1000 PoE/PoE+ ports, and 4 dual-purpose SFP Gigabit Ethernet (GigE) Uplinks	4
PWR-IE170W-PC-AC=	High-Voltage AC/DC Power Source, 170W	4
GLC-LX-SM-RGD=	1000 Mbps Single-Mode Rugged SFP, 1300nm	16
L-IE4000-RTU=	Cisco IE 4000 IP Services License	4
CAB-CONSOLE-USB	Cisco Console Cable 6 ft. USB Type A to Mini-B	4
CON-SNT-IE40004P	SMARTNET Warranty Service, 8x5x Next Business Day	8*

*SMARTNET support shall be provided for 2 years for each switch

Bridgeport Station

The Contractor shall supply the following items and quantities of switches and components to meet the requirements as shown in the plans for the Bridgeport Station platform switches:

Cisco Part Number	Description	Quantity
IE-4000-4GS8GP4G-E	Rugged Industrial Ethernet switch w/ 4 Gigabit Ethernet (GigE) SFP Ports, 8 10/100/1000 PoE/PoE+ ports, and 4 dual-purpose SFP Gigabit Ethernet (GigE) Uplinks	5
PWR-IE170W-PC-AC=	High-Voltage AC/DC Power Source, 170W	5
GLC-LX-SM-RGD=	1000 Mbps Single-Mode Rugged SFP, 1300nm	20
L-IE4000-RTU=	Cisco IE 4000 IP Services License	5
CAB-CONSOLE-USB	Cisco Console Cable 6 ft. USB Type A to Mini-B	5
CON-SNT-IE40004P	SMARTNET Warranty Service, 8x5x Next Business Day	10*

*SMARTNET support shall be provided for 2 years for each switch

Fairfield Metro Station

The Contractor shall supply the following items and quantities of switches and components to meet the requirements as shown in the plans for the Fairfield Metro Station platform switches:

Cisco Part Number	Description	Quantity
IE-4000-4GS8GP4G-E	Rugged Industrial Ethernet switch w/ 4 Gigabit Ethernet (GigE) SFP Ports, 8 10/100/1000 PoE/PoE+ ports, and 4 dual-purpose SFP Gigabit Ethernet (GigE) Uplinks	6
PWR-IE170W-PC-AC=	High-Voltage AC/DC Power Source, 170W	6
GLC-LX-SM-RGD=	1000 Mbps Single-Mode Rugged SFP, 1300nm	24
L-IE4000-RTU=	Cisco IE 4000 IP Services License	6
CAB-CONSOLE-USB	Cisco Console Cable 6 ft. USB Type A to Mini-B	6
CON-SNT-IE40004P	SMARTNET Warranty Service, 8x5x Next Business Day	12*

*SMARTNET support shall be provided for 2 years for each switch

Fairfield Station

The Contractor shall supply the following items and quantities of switches and components to meet the requirements as shown in the plans for the Fairfield Station platform switches:

Cisco Part Number	Description	Quantity
IE-4000-4GS8GP4G-E	Rugged Industrial Ethernet switch w/ 4 Gigabit Ethernet (GigE) SFP Ports, 8 10/100/1000 PoE/PoE+ ports, and 4 dual-purpose SFP Gigabit Ethernet (GigE) Uplinks	4
PWR-IE170W-PC-AC=	High-Voltage AC/DC Power Source, 170W	4
GLC-LX-SM-RGD=	1000 Mbps Single-Mode Rugged SFP, 1300nm	16
L-IE4000-RTU=	Cisco IE 4000 IP Services License	4
CAB-CONSOLE-USB	Cisco Console Cable 6 ft. USB Type A to Mini-B	4
CON-SNT-IE40004P	SMARTNET Warranty Service, 8x5x Next Business Day	8*

*SMARTNET support shall be provided for 2 years for each switch

Southport Station

The Contractor shall supply the following items and quantities of switches and components to meet the requirements as shown in the plans for the Southport Station platform switches:

Cisco Part Number	Description	Quantity
IE-4000-4GS8GP4G-E	Rugged Industrial Ethernet switch w/ 4 Gigabit Ethernet (GigE) SFP Ports, 8 10/100/1000 PoE/PoE+ ports, and 4 dual-purpose SFP Gigabit Ethernet (GigE) Uplinks	2
PWR-IE170W-PC-AC=	High-Voltage AC/DC Power Source, 170W	2
GLC-LX-SM-RGD=	1000 Mbps Single-Mode Rugged SFP, 1300nm	8
L-IE4000-RTU=	Cisco IE 4000 IP Services License	2
CAB-CONSOLE-USB	Cisco Console Cable 6 ft. USB Type A to Mini-B	2
CON-SNT-IE40004P	SMARTNET Warranty Service, 8x5x Next Business Day	4*

*SMARTNET support shall be provided for 2 years for each switch

Spare Parts

The Contractor shall supply the following items and quantities of switches and components to meet the requirements as shown in the plans for use as spares:

Cisco Part Number	Description	Quantity
IE-4000-4GS8GP4G-E	Rugged Industrial Ethernet switch w/ 4 Gigabit Ethernet (GigE) SFP Ports, 8 10/100/1000 PoE/PoE+ ports, and 4 dual-purpose SFP Gigabit Ethernet (GigE) Uplinks	1
PWR-IE170W-PC-AC=	High-Voltage AC/DC Power Source, 170W	1
GLC-LX-SM-RGD=	1000 Mbps Single-Mode Rugged SFP, 1300nm	4
L-IE4000-RTU=	Cisco IE 4000 IP Services License	1
CAB-CONSOLE-USB	Cisco Console Cable 6 ft. USB Type A to Mini-B	1
CON-SNT-IE40004P	SMARTNET Warranty Service, 8x5x Next Business Day	2*

*SMARTNET support shall be provided for 2 years for each switch

Construction:

Prior to purchase, the Contractor shall submit a complete parts list and "Bill of Materials" (BOM) for approval by the Engineer.

Prior to installation, the Contractor shall submit shop drawings for installation to the Engineer and shall be approved by the Engineer. A complete list of all components, pieces, parts and

modules being supplied shall be submitted to the Engineer for approval.

The spare parts will be held by the Contractor until after the System Acceptance Test is complete. After acceptance of the systems, the Contractor shall deliver the items to the Connecticut Department of Transportation or Metro North Railroad at a designated site within the State of Connecticut. Transfer of ownership and delivery shall be coordinated with the Engineer.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information.

Training:

Refer to "NOTICE TO CONTRACTOR – Training" for overall testing requirements and additional information.

Method of Measurement:

Each Ethernet Switch – Cisco IE4000 shall be measured for payment as "Each" for the actual number of switches listed in this specification and furnished, installed, tested, and accepted.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each "Ethernet Switch – Cisco IE4000" including components all furnished, installed, tested, and accepted, which price shall include all material, spare parts including delivery, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
Ethernet Switch – Cisco IE4000	Each

ITEM #1108672A – CISCO PROFESSIONAL SERVICES

Description:

Cisco equipment furnished under Item #1108671A – "Ethernet Switch – Cisco IE4000" and Item #1108870A – "Backbone Communications Network – Cisco M6" shall be configured by Cisco. In addition, existing network equipment that the new equipment interfaces or integrates with shall also be configured by Cisco to create and maintain a fully functioning and seamlessly integrated communication network for the security network specified in the contract.

Professional services required shall include detailed network design, network implementation planning, hot staging of equipment, migration/cut-in of the live network, testing, and configuration and execution of the network design plan. Provide documentation for the design, implementation plan, testing plans and procedures, and as-built configurations.

Material and Services:

Cisco Professional Services shall include but not be limited to:

A. Provide an assessment of the network requirements for the security system and review of the existing network configuration
B. Develop the high level design, detailed low level design, network implementation plan, and detailed testing plans and procedures.
C. Hot staging of the equipment specified under Item #1108671A and Item #1108870A for up to 45 days at a location provided by the Contractor (with approval from Metro-North and the Engineer). Staging service shall include fully configuring and testing the new equipment as close as possible to the actual live/production environment that the equipment to be installed. Staging service shall include receiving the equipment, detailed inventory of the equipment, and shipping of all equipment to the field locations.
D. Develop method of procedures to integrate (e.g. cut-in) the new equipment into the existing network and expand the network. Scope of work shall include configuration of existing equipment.
E. Provide field support to Metro-North for installation of the DWDM equipment at node houses.
F. Provide field support to the Contractor for installation of network switches (IE4000) at field locations.
G. Execute the approved design and implementation plan in the field. Service shall include final configuration of the system.
H. Fully test the network according to the approved test plan.
I. Develop as-built documents for the network implemented, including hardware installation and software configuration.
J. All documents, procedures, and plans shall be delivered and accepted by Metro-North.

The Work of this Section shall be performed by Cisco Systems, Inc. 170 West Tasman Dr. San Jose, CA 95134. Contractor shall provide 90 days of warranty on the service provided after acceptance of the completed work.

Basis of Payment:

The sum of money shown on the Estimate and in the itemized proposal as "Estimated Cost" for this work will be considered the bid price even though payment will be made as described below. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount for the contract.

The Department will pay the Contractor its actual costs for "Cisco Professional Services" plus an additional 5% as reimbursement for the Contractor's administrative expense in connection with the services provided. The 5% markup will be paid when the Engineer receives cancelled check(s) or receipted invoice(s) as proof of payment from the Contractor. Prior to procuring the services, the Contractor shall submit a detailed quote indicating all work to be done by Cisco for approval by the Engineer. All work and amounts shall be pre-approved by the Engineer. Payment will not be made without pre-approval.

Pay Item	**Pay Unit**
Cisco Professional Services	Estimated

ITEM #1108721A – VIDEO ENCODER

Description:

This item consists of furnishing and installing a Video Encoder for the purpose of porting video feeds from the legacy analog Pelco video system into the existing Verint Nextiva System. All components shall be compatible with and supported by the existing Verint Nextiva head-end.

The Video Encoder will be installed in the CCTV rack at Bridgeport Station. The analog video output on coaxial cable from the existing Pelco fiber receivers will be sent to the Video Encoder. The Video Encoder will convert the analog video to an IP addressable H.264 digital video stream. The digital video will be routed into a switch. The switch will be connected to the digital video system of this project. The Switch will be provided under another bid item. Under the Video Encoder bid item, the Contractor shall be responsible for furnishing and installing the Video Encoder unit, power supply, a rack mount chassis for the Video Encoder unit, relocation of any and all existing hardware to remain, connectors, programming, relocation of and/or replacement of cabling, and ancillary items required for a complete working system.

Materials:

Equipment and materials used shall be standard components that are manufactured and available for purchase as standard replacement parts as long as the product is commercially available from the manufacturer.

Product Data: Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

The Video Encoder shall be Verint S1808E, or approved equivalent (see source limitations below) meeting the following requirements:

A. The video encoder shall be an eight-input (8) video server using H.264 (MPEG-4 Part 10/AVC) Main Profile and MPEG-4 Simple Profile compressions technology.

B. The encoder shall be capable of streaming D1 video images from 8 camera inputs at 30 frames per second under all conditions of motion in the image.

C. The encoder shall support NTSC and PAL signal formats with a programmable resolution from CIF (352 x 240 pixels for NTSC; 352 x 288 pixels for PAL) to D1 format (720 x 480 pixels for NTSC; 720 x 576 pixels for PAL).

D. The encoder shall offer motion detection capabilities.

E. The encoder shall offer triple streaming capabilities; 2 H.264 streams and 1 MPEG-4 stream.

F. The encoder shall provide simultaneous dual (2) H.264 (MPEG-4 Part 10/AVC) encoded video streams at a performance level of no less than D1, 30 frames per second on the first H.264 stream and D1, 15 frames per second on the second H.264 stream; and a single MPEG-4 stream at a performance level of no less than 2CIF, 15 frames per second on all channels simultaneously.

G. The encoder transmitter shall support up to 80 streams per device to allow simultaneous viewing and recording of live video at selected frame rates and/or quality from the Nextiva Video Management and storage software.

H. The encoder shall support:

   a. Constant bit rate (CBR) and Constant frame rate (CFR) H.264 compression. The bit rate mode shall be individually configured for each encoder.
   b. Constant bit rate (CBR), Constant frame rate (CFR) and Constant storage rate (CSR) MPEG-4 compression. The bit rate mode shall be individually configured for each encoder.

I. The encoder shall generate, during normal operation, an event when the coaxial cable used between the unit and a camera is faulty or tampered, causing loss of the video signal and/or if the camera is not connected.

J. The encoder shall offer an intuitive Web Browser Interface to perform configuration and monitoring activities.

   a. The Web Browser Interface shall be localized to support various languages.
   b. A live video viewing functionality shall be part of the Web Browser Interface
   c. A video retrieving functionality shall be part of the Web Browser Interface providing a logic way to present, access and retrieve recorded video from a USB drive.

K. The encoder shall be configurable remotely via the network through the existing Verint Nextiva System.

L. The video encoder firmware, including the video codec, shall be upgradeable remotely via the network, through the existing Verint Nextiva System.

M. The encoder shall possess an internal watchdog to detect and recover from the unlikely occurrence of system lockup.

N. The encoder shall meet or exceed the following design and performance specifications:

a. The pan-tilt-zoom control latency shall be less than 115 msec, excluding network transmission latency.
b. The maximum bandwidth used per video input by the encoder module shall be programmable from 30kbps to 6Mbps.
c. The average compressed image file size generated by the encoder recorder shall be:

    i. At CIF resolution, 1.25 KB to 2.5 KB depending on compression and frame rate settings.
    ii. At D1 resolution, 5 KB to 10 KB depending on compression and frame rate settings.

d. The encoder shall have an MTBF of at least 100,000 hours and shall include Electros Static Discharge (ESD) protection on all input and output signals.

O. The Video Encoder shall meet or exceed the following technical specifications:

Video

Input:	8 composites, 1 Vpp into 75Ω NTSC/PAL, BNC female
Triple Stream:	2 x H.264 and 1 x MPEG-4 streams
Performance:	D1/30 fps, D1/15 fps, 2CIF/15 fps on all channels simultaneously
Compression:	H.264 Main Profile, MPEG-4 Simple Profile (SP)
Resolution:	Scalable from CIF to D1
Bandwidth:	30 Kbps to 6 Mbps (each stream)
Latency (max.):	115 msec

Audio

3 dB Frequency Response:	60 to 3600 Hz (1 kΩ load) 350 to 3600 Hz (16 Ω load)
Input Voltage (max.):	1.4 Vrms
Output Voltage (max.)	800 mVrms / 40 mW (16 Ω load)
Microphone BIAS voltage:	3 V
Connectors	8 stereo jacks (1/8 in.)

Network

Main interface:	RJ-45 Ethernet 10/100/1000BASE-T
Maintenance interface:	RJ-45 Ethernet 10/100/1000BASE-T
Protocols:	TRP/IP, UDP/IP, TCP/IP, RTSP, or multicast IP DNS, NTP, SNMP v1/v2/v3, HTTP, HTTPS, DHCP
Security:	SSL-based authentication, password protected

Alarm

Inputs:	8 dry contacts
Outputs:	2 relay contacts (48 V AC/DC at 500 mA max.)

Power	
Input Voltage:	12 VDC +/- 10%
Power Consumption	20 W max. / 23 W max. (w/ audio)

Physical	
Enclosure:	1U metal case w/ flange mount, black matte finish
Dimensions	17" (L) x 6.6" (W) x 1.7" (H)
	430 mm (L) x 168 mm (W) x 43 mm (H)
Weight:	4.0 lb (typ.)
	1.8 kg (typ.)
Operating Temperature:	32°F to 131°F (0°C to 55°C)
Humidity:	95% (non-condensing)

Certification and Regulation

RoHS-compliant, UL, FCC Part 15 (Subpart B, Class A)

Contractor shall include 120VAC to 12VDC power supply to power the encoder.

Encoder source limitations: Encoders shall be of sole brand, Verint, as determined for the operational and maintenance needs of Metro-North Railroad. Model number substitutions will be considered for newer models that meet or exceed the technical requirements herein. All substitutions shall be fully coordinated with the overall design by the Contractor. In the event the encoder listed is determined to be end-of-life, or near end-of-life, the Contractor shall propose an alternate that satisfies the technical requirements within. All encoders shall be compatible with the Verint Nextiva Video Management System specified elsewhere.

Construction Method:

The Contractor shall submit shop drawings for racks where the encoder will be installed and wiring diagrams to the Engineer for approval prior to supplying this item.

System cutover shall not occur until operational testing of the head-end is complete and verified as working.

All items required shall be installed and staged such that downtime to the existing system is minimized. Test all structured cabling and perform basic functional tests of new equipment to verify operation prior to system cutover.

The Contractor shall submit detailed staging and phasing plan that identifies all impacted devices and the anticipated duration of interruption. Schedule all interruptions with the Engineer. No Work may be performed on the existing system without permission from the Engineer.

The Contractor shall identify and tag any cables being disconnected prior to removal. Any cabling no longer required shall be removed.

The Contractor shall develop a detailed testing plan and submit for approval. Testing shall occur prior to cutover to accurately determine the existing condition of the field equipment and at the completion of all cutovers to ensure existing functionality has been restored. If existing equipment does not operate as expected, immediately notify the Engineer prior to modifying the existing system.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information. At a minimum, the following tests shall be included: verification of proper installation and relocation of equipment per approved drawings and manufacturer recommendations, verification the encoder is monitored by the NMS system, verification of all ports of the encoder function, and verification video is transmitted to and recorded by the VMS. Any tests recommended by the manufacturer shall also be included.

Training:

Refer to "NOTICE TO CONTRACTOR – Training" for overall testing requirements and additional information.

Method of Measurement:

Video Encoder shall be measured for payment by the number of "Each" installed, tested, and accepted.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each "Video Encoder", which price shall include full compensation for all materials including temporary cabling, equipment relocation, and other incidentals needed to complete the work.

Pay Item	**Pay Unit**
Video Encoder	Each

ITEM #1108844A – FIBER OPTIC PATCH PANEL - 72 POSITIONS
ITEM #1108845A – FIBER OPTIC PATCH PANEL – 144 POSITION

Description:

This item shall consist of furnishing and installing 72 or 144 Position Fiber Optic Patch Panels at the locations shown on the plans or as indicated by the Engineer.

Materials:

Product Data: Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

The Fiber Optic Patch Panels shall be Optical Cable Corporation RTC72B72SMLCPS/RTC144B144SMLCPS or equivalent meeting the following requirements:

1. The Fiber Optic Patch Panel shall be a stand-alone unit manufactured for outdoor field cabinets.
2. The Fiber Optic Patch Panel shall include and be capable of accommodating a minimum of 72 or 144 LC terminations as shown in the plans.
3. The Fiber Optic Patch Panel shall include and be capable of terminating up to 72 or 144 connectorized pigtails.
4. The Fiber Optic Patch Panel shall incorporate a hinged access door.
5. The Fiber Optic Patch Panel shall be rack, wall, or shelf mountable as required by the specific location. The patch panel shall be securely fastened in place as recommended by the manufacturer.
6. The Fiber Optic Patch Panel shall include splice trays meeting the following requirements:
    i. The splice trays in the Fiber Optic Patch Panel shall be capable of holding a minimum of 24 splices each. Additional splice trays shall be provided to match the port capacity of the fiber patch panel.
    ii. The splice trays shall incorporate a system to retain and provide strain relief to the fiber optic buffers tubes and connector pigtails.
    iii. The splice trays shall incorporate grooves where the fiber optic splice can be held in place
    iv. Each splice tray shall incorporate a clear snap on lid.
7. The Fiber Optic Patch Panel shall include a restraining system to hold the splice trays securely in place.
8. The Fiber Optic Patch Panel shall incorporate cable guides that maintain fiber strands and fiber buffer tubes bending radius greater than the minimum allowed by the manufacturer.

9. The Fiber Optic Patch Panel shall use 72 or 144 connectorized pigtails to connect the fiber optic cable to the Fiber Optic Patch Panel.
10. The connectorized pigtails shall meet the following requirements:
    i. All fiber optic connectors shall be provided shall be type "LC".
    ii. The connector mean insertion loss shall be 0.15 dB and maximum 0.3 dB.
    iii. The connector mean reflectance shall be "≤ -58 dB" typical
    iv. All LC connectors shall have a durability rate of less than 0.2 dB change over 500 rematings per FOTP-21.
    v. Connectors shall meet ANSI/TIA EIA-604-10 requirements.
    vi. The fiber optic strand of the connectorized pigtail shall have matching optical properties as the fiber optic strand used on the fiber optic cable.
11. The Fiber Optic Patch Panel shall incorporate a restraining mechanism to hold the fiber optic cable central member and outside jacket.
12. The Fiber Optical Patch Panel shall fit in a standard 19" rack.
13. 72-port Fiber Optic Patch Panel shall occupy a maximum of 4U. 144-port Fiber Optic Patch Panel shall occupy a maximum of 7U.
14. All plastic components shall be high impact, self-extinguishing UL listed 94V-0.

Contractor shall furnish all patch (jumper) cables required for complete end-to-end network connectivity as part of this Item. Patch cables shall meet the same requirements as the connectorized pigtails described herein except for providing "LC" connectors on each end. Coordinate connector type with final equipment termination. Provide at least 25% spare patch cables.

Construction Method:

The Contractor shall submit shop drawings and product data to the Engineer for approval prior to supplying this item. It shall be responsibility of the Contractor to ensure all connector types are correct and match the communications equipment being installed as shown in the plans. The Contractor shall furnish connectors for each port and provide to MNR for installation.

Where installed in a rack without rear access, Contractor shall install patch panel on sliding rails properly designed for the size and weight of the fully loaded panel. A patch panel with integrated sliding tray may be substituted but shall meet all requirements herein.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information. At a minimum, the following tests shall be included: verification of proper installation of equipment per approved drawings and manufacturer recommendations, verification of all fiber cables are installed, verification of all port and cable labeling. Any tests recommended by the manufacturer shall also be included.

Method of Measurement:

"FIBER OPTIC PATCH PANEL - 72 POSITIONS" shall be measured for payment by the number of "Each" unit installed, tested, and accepted.

"FIBER OPTIC PATCH PANEL - 144 POSITION" shall be measured for payment by the number of "Each" unit installed, tested, and accepted.

Basis of Payment:

"FIBER OPTIC PATCH PANEL - 72 POSITIONS" shall be paid for at the contract unit price bid per "EACH", which price shall include full compensation for all materials including pigtails, patch cables, and other incidentals needed to complete the work.

"FIBER OPTIC PATCH PANEL - 144 POSITION" shall be paid at the contract unit price bid per "EACH", which price shall include full compensation for all materials including pigtails, patch cables, and other incidentals needed to complete the work.

Pay Item	**Pay Unit**
Fiber Optic Patch Panel, 72 Positions	Each
Fiber Optic Patch Panel, 144 Position	Each

ITEM #1108869A – BACKBONE COMMUNICATIONS NETWORK – POWER UPGRADES

Description:

The Contractor shall furnish equipment to upgrade the existing DC power system in the Metro North Node Houses where the backbone equipment will be installed. The equipment shall be purchased by the Contractor and furnished to MNR. The equipment will be installed, tested and configured by MNR. The equipment furnished under this item shall be considered a complete system and paid for as a lump sum. The Contractor shall also retain the services of Emerson Network Power to assist Metro-North with commissioning of the system as described herein. Such services shall only be used with approval of Metro-North, and direction of the Engineer.

Materials:

Final Bill of Materials shall verified by the vendor and submitted to the Engineer for approval within 30 days of Notice to Proceed. Upon approval, Contractor shall order the equipment within 3 business days.

Emerson Network Power -48V Netsure 721 Power System (NS721)			**Quantities per Node House**		
Item	**Product Description**	**Part Number**	**Greens Farms**	**Fairfield**	**Bridge-port**
1	23” battery tray cover 8U kit	548020	3	3	3
2	Main bay, -48V common equipment	58212700001	1	1	1
3	Relay rack, 45U, 84”H x 24.375”W x 15”D, welded steel	543162	1	1	1
4	Distribution cabinet assembly, 1 row	58212700021	1	1	1
5	Distribution cabinet top shield system assembly	58212700029	1	1	1
6	Interface components for PCU shelf	58212700030	1	1	1
7	Blank cover, PCU	21140440	3	3	3
8	AC connect, front access PCU feed kit	58212700040	1	1	1
9	Rectifier shelf, 6 position, -48VDC	58870500021	1	1	1
10	Battery shunt kit, 800A	58212700090	1	1	1
11	23” battery tray, pre-cabled	58212700093	3	3	3
12	Circuit breaker, 1P, 100A, 80VDC	256695900	3	3	3

Emerson Network Power -48V Netsure 721 Power System (NS721)			**Quantities per Node House**		
Item	**Product Description**	**Part Number**	**Greens Farms**	**Fairfield**	**Bridge-port**
13	1 pole battery disconnect breaker kit, left side	528501	3	3	3
14	Distribution panel, 24 position bullet with return bar	582127000AA	1	1	1
15	Battery disconnect contractor assembly, 600A	582127000CA	1	1	1
16	Low voltage battery disconnect	582127000LB	1	1	1
17	Manual battery disconnect switch	582127000MB	1	1	1
18	Bullet type circuit breaker, 1A, 1P, 80VDC, SPST Aux	101596	1	1	1
19	Bullet type circuit breaker, 60A, 1P, 80VDC, SPST Aux	101607	8	8	8
20	Bullet type circuit breaker, 80A, 1P, 80VDC, SPDT Aux	121995	6	6	6
21	Hardware kit, (32) ¼" nuts, locks, flats	541084	2	2	2
22	LVD driver lite circuit card, main bay	547873	1	1	1
23	EIB interface board	548120	1	1	1
24	Temperature probe, 10m	552992	5	5	5
25	Temperature probe, 3m	556115	3	3	3
26	8-input temperature model	547490	1	1	1
27	Battery termination bus kit	553584	1	1	1
28	NCU controller with 559242 config	1M830DNA55924	1	1	1

Emerson Network Power Additional Equipment			**Quantities per Node House**		
Item	**Product Description**	**Part Number**	**Greens Farms**	**Fairfield**	**Bridge-port**
29	Rectifier, eSure, 3500W, -48VDC	1R483500E	3	3	3
30	Battery Rack, 48V, 5 trays, 23", 100A CB	588820200ZZ002	1	1	1
31	Battery, GNB M12V180FT 180AH battery	547445	32	32	32

Net Guardian Alarm Monitoring RTU			**Quantities per Node House**		
Item	**Product Description**	**Part Number**	**Greens Farms**	**Fairfield**	**Bridge-port**
32	216 - G3 SNMP&DCPX Dual 48V,8ana,RTC, Wago, RoHS	D-PK-NG216-1205 0.00001	1	1	1

Net Guardian Alarm Monitoring RTU			**Quantities per Node House**		
Item	**Product Description**	**Part Number**	**Greens Farms**	**Fairfield**	**Bridge-port**
33	Cable Assembly NG216 G3/NG LT, External Temp. Sensor, 7ft	D-PR-998-10A-07	1	1	1
34	Mtg Ear, NG216 G2 & G3/NetDog G2 Long Ear, 23"	D-CS-325-10A-07	1	1	1
35	Hinged Pluggable back panel 216 line, 23", Wht	D-PK-16PAN-12004.00001	1	1	1
36	Current Sensor 0 to 100Amp DC (analog)	D-PR-577-10A-00	1	1	1
37	DC to DC converter (-48VDC to 24VDC)	D-PC-767-10A-01	1	1	1
38	Water Sensor & Controller	D-PG-271-10A-00	1	1	1

ADC Power Distribution (TE Connectivity)			
Item	**Product Description**	**Part Number**	**Overall Quantity**
39	PowerWorx Power Distribution, 4 TPA/4 GMT	PWX-041RCA4G4YSPWP	3

New England Wire			
Item	**Product Description**	**Part Number**	**Overall Quantity**
40	8AWG 7x24/30 Tinned Copper 100ft roll, Black	N30-30T+00009-2UL	1
41	8AWG 7x24/30 Tinned Copper 100ft roll, Red	N30-30T+00009-3UL	1
42	8AWG 7x24/30 Tinned Copper 100ft roll, Green	N30-30T+00009-4UL	1
43	6AWG 7x37/30 Tinned Copper 1000ft roll, Green	N40-30T+00007-4UL	1
44	1/0 AWG 7x7x22/30 Tinned Copper 1000ft roll, Black	N10-30T+00007-1UL	1

Legrand Rack Products			
Item	**Product Description**	**Part Number**	**Overall Quantity**
45	MM20 Channel Rack, 10.5"D channel, 7'H, 45 RU, tapped #12-24	OR-MM20710-B	3
46	MM6 Vertical manager, With door, 6” x 8” x 7’	OR-MM6VMD706	9
47	Mighty Mo 6 Horizontal Cable Management Panel	OR-MM6HMF1RU	12

The Contractor shall provide engineering, material, and commissioning by Emerson Network Power. Provide at least three (3) days per site commissioning for:

Removal of old PBD and battery bay
Adding new NS721 bay and battery bay in place of old system
Adding eight (8) strings M12V180FT batteries
System turn up and test system
Transferring six (6) loads

In the event the products listed are determined to be end-of-life, or near end-of-life, the Contractor shall propose an alternate that satisfies the technical requirements of the contract. All items shall be compatible with existing Metro-North systems. All substitutions shall be fully coordinated with the overall design by the Contractor with consultation with Emerson Network Power and Metro-North.

Method of Measurement:

The Contractor shall submit to the Engineer for acceptance a breakdown of its lump sum bid price for this item. If the lump sum bid price is unacceptable to the Engineer, substantiation showing that the submitted price costs are reasonable shall be required.

The lump sum bid price breakdown shall show Contractor costs per device or service procured. The Contractor shall be reimbursed for the item after it is furnished and the transfer is carried out as outlined in this specification and approved by the Engineer.

The Backbone Communications Network – Power Upgrade" shall be measured for payment as a Lump Sum of complete system furnished to Metro-North.

Basis of Payment:

The work under this item shall be paid for at the contract Lump Sum price for the complete system as described, which shall include all material, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
Backbone Communications Network - Power Upgrade	LS

ITEM #1108870A – BACKBONE COMMUNICATIONS NETWORK

Description:

The Contractor shall furnish and install a Backbone Communications Network consisting of Cisco communications equipment, including but not limited to a M6 Chassis', line and access cards, interface modules, and other equipment or software as necessary to provide a Carrier Packet Transport (CPT) based communications system at the locations as shown in the Contract Documents or as indicated by the Engineer. The equipment furnished and configured under this item shall be purchased directly from Cisco and shall be considered a complete system and paid for as a lump sum.

Installation of Backbone Communications Network equipment in the node houses will be performed by Metro-North. Contractor shall coordinate turnover of equipment to Metro-North with the Engineer and Cisco.

The Contractor shall also be responsible to provide Cisco 8x5, next business day support for a minimum of 2 years.

The Contractor shall consult with Cisco to provide the system as shown in the Plans and Contract Documents. All work required for a fully functional system that is not performed directly by Cisco Professional Services shall be included in this Item. Work of this section shall be coordinated with Item #1108672A – "Cisco Professional Services".

Applicable Standards:

- ICES-003 Issue 4 (2004)
- GR-1089-CORE, Issue 4 (Type 2 and Type 4 equipment)
- GR-1089-CORE – Issue 03 (Oct 2002) (Objective O3-2 – Section 3.2.1 – Radiated Emissions requirements with all doors open)
- FCC 47CFR15, Class A subpart B (2006)
- UL/CSA 60950 -1 First Edition (2003)

Materials:

The Backbone Communications Network shall include a Cisco Core Transport Switch and power system upgrades. All equipment must be purchased directly from Cisco.

In the event the products listed are determined to be end-of-life, or near end-of-life, the Contractor shall propose an alternate that satisfies the technical requirements of the contract. All items shall be compatible with the existing Metro-North DWDM network. All substitutions shall

be fully coordinated with the overall design by the Contractor with consultation with Cisco and Metro-North.

Cisco Core Transport Switch

The Core Transport Switch shall be the Cisco CPT 600/15454 M6 switch or approved equal.

The Core Transport Switch shall support 2 slots for redundant control cards and 6 slots for line cards.

The Core Transport Switch shall be configured with redundant power supplies, control cards, and fan units.

The Core Transport Switch shall be configured with a Packet Transport Fabric with four (4) 10GE interfaces.

Each Core Transport Switch Packet Transport Fabric shall support 256 Gbps of non-blocking fully redundant switching.

The Core Transport Switch shall be rack mounted.

The Contractor shall supply fiber optic modules to support the network as shown on the drawings and as required by Cisco for the MNR Network.

Supply all necessary software licenses to support a fully functioning network.

The Core Transport Switch shall support the following standards:

- IETF MPLS
- IEEE 802.3
- IEEE 802.3ae – 10 Gigabit Ethernet
- IEEE 802.1D - Spanning Tree Protocol
- IEEE 802.3ad - Link Aggregation
- IEEE 802.1s – Multiple VLAN Instances of Spanning Tree
- 802.1p-Class of Service Prioritization
- 802.1Q - VLAN
- Resilient Ethernet Protocol
- IPv4 & IPv6
- IGMP v1, v2 and v3 snooping
- Multicast VLAN Registration (MVR)

The following materials shall be supplied, at minimum, to meet the requirements and provide the system as detailed in the Plans and Contract Documents:

Hardware

Cisco Part Number	Product Description	Quantities per Node House		
		Greens Farms	Fairfield	Bridgeport
15454-BLANK=	Empty Slot Filler Panel	6	6	6
15454-M6-SA=	6 service slot MSTP shelf, includes M-SHIPKIT, M6-FTF, BRKTS	2	2	2
15454-M6-FTA2=	6 service slot MSTP chassis 2nd gen fan tray	2	2	2
15454-M6-LCD=	6 service slot MSTP chassis LCD display w/ backup memory	2	2	2
15454-M6-ECU2=	6 service slot MSTP external cable connection unit with TOD/PPS	2	2	2
15454-M6-DDR	6 service slot MSTP chassis door	2	2	2
15454-M6-DC=	6 service slot MSTP chassis 30A DC power filter	4	4	4
15454-M-TNCE-K9=	MSTP/NCS 2K transport node controller w/ Ethernet PTP	4	4	4
15454-M-ALMCBL2=	SCSI alarm cable 24AWG 8 inputs	2	2	2
15454-M-USBCBL=	USB cable for passive devices	2	2	2
15454-40-SMR1-C	40Chs SM ROADM with integrated Pre Amplifier	2	2	2
ONS-SE-155-1510=	SFP – OC3/STM1 CWDM, 1510 nm, EXT	2	2	2
15454-GE-XPE=	20 GBE enhanced crossponder	2	2	2
15216-EF-40-ODD=	ONS 15216 40ch mux/demux exposed faceplate patch panel odd	2	2	2
15216-LC-LC-10=	Fiber patchcord – LC to LC – 6 m	3	3	3
15216-LC-LC-MM-2=	Fiber patchcord – LC to LC – multi mode – 2 m	2	2	2
15454-LC-LC-2=	Fiber patchcord – LC to LC – 2 m	8	8	8
15216-ATT-LC-10=	Bulk attenuator – LC connector – 10 dB	5 total		
ONS-XC-10G-SR-MM	XFP – 10GE/10G FC – 850 SR – MM LC	2	2	2
ONS-SC-10G-	XFP – 10G multirate full C band	2	2	2

Cisco Part Number	Product Description	Quantities per Node House		
		Greens Farms	Fairfield	Bridgeport
C=	tuneable DWDM XFP, 50 GHz, LC			
SF15454M-R9.6.0K9	15454 ANSI MSTP R9.6.0 SW, pre-loaded on TCC3, TNC/E, TSC/E	4	4	4
15454-R9.6.0SWK9=	15454 ANSI ETSI MSTP rel. 9.6.0 pkgs, DVD, RTU license	2	2	2
15454-M-ALMCBL2=	SCSI alarm cable 24AWG 8 inputs	2	2	2
ONS-SE-G2F-LX=	SFP – GE/1G-FC/2G-FC/HDTV - 1310nm – SM - LC	60 total		

SMARTnet*

*SMARTNET support shall be provided for a minimum of 2 years for each device. Quantities below reflect 2 years of service for each type of device.

Cisco Part Number	Product Description	Quantities per Node House		
		Greens Farms	Fairfield	Bridgeport
CON-SNT-15454M6S	SMARTnet 8X5XNBD 6 service slot MSTP shelf, including M-SHIPKIT	4	4	4
CON-SNT-MTNCEK9	SMARTnet 8X5XNBD transport node controller Ethernet PTP	8	8	8
CON-SNT-15454SMR1	SMARTnet 8X5XNBD SM ROADM 40Chs Single Module	4	4	4
CON-SNT-1551510	SMARTnet 8X5XNBD SFP – OCS/STM1 CWDM	4	4	4
CON-SNT-15454GE	SMARTnet 8X5XNBD 20 GBE enhanced crossponder	4	4	4
CON-SNT-15216EF4	SMARTnet 8X5XNBD ONS 15216 40ch mux/demux fixed patch panel	4	4	4
CON-SNT-N10GSRM	SMARTnet 8X5XNBD XFP – 10GE/10G FC – 850	4	4	4
CON-SNTP-XC10GC	SMARTnet 8X5XNBD XFP – 10G multirate full C-band tuneable	4	4	4
CON-SNT-N10GSRM	SMARTnet 8X5XNBD SFP – GE/1G-FC/2G-FC	120 total		

Training

The Contractor shall provide at least the equivalent of 456 Cisco Learning Credits for Metro-North personnel. The Contractor shall provide a representative list of classes that can these credits may be used for from various authorized Cisco Training Partners. Metro-North will select training courses based on their requirements. Credits shall only be procured as Metro-North requires the training to avoid expiration of credits. All training courses shall be approved by Metro-North, and procured at the direction of the Engineer. The selected training courses may be procured directly instead of through procurement of Cisco Learning Credits with permission of the Engineer.

Additional training requirements are specified in "NOTICE TO CONTRACTOR – Training".

Construction:

The Contractor shall consult with Cisco on the equipment to be purchased. Contractor shall submit final Bill of Materials and product data prior to ordering for approval by the Engineer.

The Contractor shall provide Cisco Professional Services for installation, configuration, and testing of the backbone network as described as part of other items.

Any ancillary items such as rack mount kits, power supplies, power cables, patch cables, communications cables, connectors, hardware, software, programming, configuration or other items or activities required to bring the system online and fully operational as shown in the Plans and as described in these Special provisions shall the responsibility of the Contractor. Any item not purchased directly from Cisco, such as power cabling or communications cables, must have approval from the Engineer.

Any work at the New Haven Node House, Woodmont Node House, and Devon Node House north of the Project location needed to reconfigure the existing network shall be considered part of this work.

Method of Measurement:

The Contractor shall submit to the Engineer for acceptance a breakdown of its lump sum bid price for this item. If the lump sum bid price is unacceptable to the Engineer, substantiation showing that the submitted price costs are reasonable shall be required.

The lump sum bid price breakdown shall show Contractor costs per device or service procured. The Contractor shall be reimbursed for the item after it is furnished and the transfer is carried out as outlined in this specification and approved by the Engineer.

The "Backbone Communications Network shall be measured for payment as a Lump Sum of complete system furnished, tested, and accepted.

Basis of Payment:

The work under this item shall be paid for at the contract Lump Sum price for the complete system as described, which shall include all material, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
Backbone Communications Network	LS

ITEM #1108871A – NETWORK MANAGEMENT SYSTEM

Description:

There is an existing Cisco Prime Infrastructure Network Management System (NMS) as part of the existing Video Management System. The Contractor shall furnish additional software licenses to manage all network switches, routers, and SNMP capable devices installed under this Contract.

SNMP capable devices shall include cameras.

Metro-North will perform installation and final configuration.

Materials:

The NMS shall include Cisco Prime LAN Management Solution and Cisco Prime Network Control System.

The NMS shall manage all network switches, routers, workstations, servers, and SNMP capable devices provided under this contract. Contractor shall provide the necessary licenses to manage all devices furnished under this contract plus 20% spare.

The existing network monitoring system supports the following:

1. Inventory and topology management
2. Device configuration and administration
3. Device configuration and image management
4. Audit and compliance management
5. Performance and health monitoring
6. Reporting

Construction Methods:

Contractor shall submit a list of all SNMP capable devices furnished under the contract and any available setting, along with the recommended settings for monitoring to Metro-North.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information. Contractor shall assist Metro-North to verify network monitoring

system. Alarms shall be generated, and other monitored points activated/verified where possible to verify functionality.

Method of Measurement:

The Network Management System shall be measured for payment as a "lump sum" for software licenses furnished to Metro-North and tested.

Basis of Payment:

The work under this item shall be paid for at the lump sum price for "Network Management System" furnished and tested, which price shall include all materials, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
Network Management System	Lump Sum

ITEM #0063538A – WORKSTATION
ITEM #1108872A – VIDEO MANAGEMENT SYSTEM
ITEM #1108868A – CCTV WORKSTATION SOFTWARE LICENSES
ITEM #1108881A – VIDEO MANAGEMENT SYSTEM SOFTWARE LICENSES

Description:

There is an existing, redundant Verint Video Management System (VMS) installed at the CCO Shop and T&E building (both located in the New Haven Yard). The Contractor shall furnish, install, and test an expansion of this system to accommodate Phase 2 cameras.

The System provides monitoring, control, and video recording and archiving as specified herein, and as indicated on the Contract Drawings. The System shall comprise of, but not be limited to:

1. Monitoring and control

2. Networked capability for remote monitoring and control

3. Network Video Recording with redundant back-up and archival of video.

The System shall include the following: additional head-end servers, hardware and software licenses, management software, prerequisite software, 19" equipment racks, rack mounted KVM console, video decoders/video encoders, digital video recording/storage severs (e.g., RAID array), client workstations and related software, and all brackets, conduits, fittings, cables, connectors, wires, and ancillary equipment required for a fully functioning system described herein. Contractor shall include any other required equipment for a complete and operating system not included in this list. The system shall provide scalability and future expansion capability.

The VMS head-end servers are configured as a redundant, hot-standby with the CCO shop as primary, and T&E building as backup in the event the primary VMS system becomes damaged or inaccessible. Cameras are recorded at both locations continuously. The Contractor shall coordinate all work with the active system.

This specification covers the Video Management System (including the Network Video Recording System) and the Workstation computers that will all be integrated with each other to provide a complete system. The locations where the Contractor shall install the equipment for the Video Management System, Network Video Recording System, and Workstations shall be as shown in the Plans.

The Contractor shall retain the services of a System Integrator to perform the integration necessary for the inclusion of cameras and components into the existing Verint Nextiva software.

1. The Contractor shall utilize qualified, certified, and licensed personnel with experience in design of integrated security systems from Verint. Prior to commencement of Work, the Contractor shall submit evidence of personnel

having recent certifications for the system.

2. Systems Integrator and Installer shall demonstrate a minimum of 7 years of continuous experience and technical expertise in performing contracts comparable in size and complexity, and whose installation and integration work was performed skillfully in a satisfactory manner and on time.

3. The Systems Integrator shall be of established reputation and experience in the field of Video Surveillance Systems and shall be cerified by the manufacturers of the proposed equipment to install, service, and maintain each manufacturer's equipment.

Requirements set forth in this Section shall apply to all CCTV System components (cameras, illuminators, power supplies, head-end servers, workstations, media converters, etc.) working as a complete system.

CCTV Software Licenses

The Contractor shall supply the following items of CCTV software licenses to meet the requirements as shown in the plans for expansion of the existing CCTV system. Only these items will be paid under Item #1108881A - VIDEO MANAGEMENT SYSTEM SOFTWARE LICENSES. All system configuration, other hardware, and other software required for the VMS shall be paid under Item #1108871A – VIDEO MANAGEMENT SYSTEM.

Verint Part Number	Description
VMS-1CAM-ENT	Verint VMS, One (1) VMS Software Camera License for Enterprise Master Server Systems
VMS-1DUAL-ENT	Verint VMS, One (1) Dual Recording Redundancy Software Camera License for Enterprise Master Server Systems
	Gold Level Maintenance for each camera license and dual recording license furnished under this contract through 12/31/2019.

Furnish licenses for every camera installed or integrated into the existing system as part of the Contract.

CCTV Workstation Licenses

The Contractor shall supply the following items of CCTV workstation licenses to meet the requirements as shown in the plans for expansion of the existing CCTV system. These items only shall be paid under Item #1108868A – CCTV WORKSTATION SOFTWARE LICENSES. All system configuration, other hardware, and other software required for the CCTV workstations shall be paid under Item #0063538A – WORKSTATION.

Verint Part Number	Description
VMS-1RV-S	One (1) Review/Smart Client License
	Gold Level Maintenance for each review/smart client license furnished under this contract through 12/31/2019.

Video Management System

Codes, Standards and Specifications

A. All items furnished and installed under this Specification shall comply with the latest edition of applicable codes, provisions and all applicable standards issued by the organizations referenced below. The following publications are incorporated herein by reference to the extent applicable:

1. National Fire Protection Association (NFPA): NFPA 70 National Electrical Code.

2. Underwriters Laboratories, Inc. (UL) Standards.

3. National Electrical Manufacturers Association (NEMA) Standards.

4. American National Standards Institute (ANSI) Standards.

5. Telcordia Technologies Standards: FR-2063 NEBS Family of Requirements (or equivalent standards, as applicable).

General Requirements

A. The Contractor shall ensure the system provided meet all functional requirements specified. In general, the System shall consist of readily available, reliable, and proven hardware, software, and firmware elements, which fully comply with or exceed the requirements of this Section and the Contract Drawings. If the system does not meet a specific requirement, submit to the Engineer explanation and proposed alternative at least 60 days prior to the commencement of Factory Acceptance Testing or on the first production unit.

B. Provide all equipment required to provide a complete system, whether the equipment is specifically listed in the specification or not. The Contractor shall be responsible for the installation of a completely functional turnkey system.

C. Unless otherwise specified on the Contract Drawings or in this Section, the System shall be manufactured and installed in compliance with NFPA 70, all local codes, and other publications referenced in the Section.

D. All system components, hardware, software, firmware, and equipment furnished under this contract shall conform to the following:

1. All hardware and software used shall be industry standard and conform to established open architecture standards, allowing for a distributed server architecture. This shall include the use of established programming languages,

industry standard and general use database management system and operating systems. All hardware and software utilized shall be the latest commercially available version. The System shall not require any proprietary hardware for video recording and monitoring.

2. All application software and firmware shall be a standard, commercially available, "off-the-shelf" product.

3. Hardware and software shall be scalable, allowing for additional servers, storage units, workstations, cameras, and associated software licenses to be connected without replacement of the System. The System shall allow for use of non-proprietary PC storage hardware that shall not limit the storage capacity and shall allow for gradual upgrades of the recording capacity.

Functional Requirements

A. The primary storage system and VMS head-end servers is located within the CCO Shop in the New Haven Rail Yard. All video system requests shall be retrieved from the primary storage system unless it becomes inaccessible or damaged.

B. A backup storage system is located in the T&E Building second floor communications room in the New Haven Rail Yard. The backup storage system shall record all camera feeds in parallel with the primary storage system for use only when the primary storage system in unavailable. The backup storage system shall replicate any database entries needed to recover video in the event of a catastrophic failure. All requirements applicable to the primary storage system shall apply to the backup storage system.

C. All existing functionality shall remain operational throughout the Contract. Contractor shall document and verify existing operations and functions prior to making any System modifications. Verify all functionality remains after modifications are made. Submit all test procedures in accordance with the "NOTICE TO CONTRACTOR - Acceptance Testing".

D. The Contractor shall configure the cameras added under this Contract to report to the existing CCTV head-end. The System shall include the following capabilities at a minimum:

1. Capture, record, control, and allow monitoring (live or pre-recorded viewing) of all of the cameras provided under the Contract, or existing cameras to be integrated.

2. Viewing real-time and recorded video streams simultaneously from any camera or storage device in the system. The system shall route images from any camera to any viewing station. Viewing permissions shall be based on user login.

3. Storage, retrieval, and search capabilities for a minimum 30 days with simultaneous camera inputs at all ports.

4. Video loss detection. The system shall trigger an alarm to a remote location upon loss of video.

5. The equipment shall be connected to the MNR network and have bidirectional communication capability. Client workstations shall have the capability to communicate with the head-end servers via HTTP and HTTPS.

6. The system shall allow an operator to dynamically specify frame rate adjustment at a particular camera location for monitoring that location. The System shall be capable of configuring recording rate and resolution individually for each camera or encoder locally or remotely. The frame rate shall also be adjustable based on pre-set conditions, such as time-of-day or time-of-week. Changing the parameters shall not interfere with other system operations such as recording or playback.

7. The system shall tag each video frame with a time/date, camera identification and/or station location. The system shall allow additional tagging of images by an operator. The location of the system tag on the image shall be able to be set by the user.

E. Recording Rate and Storage

1. The resolution and clarity of captured images shall be maintained under a range of lighting conditions from darkness through bright sunlight and provide a full color image to the maximum extent of the camera hardware provided by the Contract. The System shall store high quality images with no visible compression artifacts, noise, or dropouts caused by the recording system.

2. Recorded video shall be stored on a hard disk. The use of a tape storage medium is not acceptable.

3. Storage drives shall be configured for RAID 5 or better.

4. Contractor shall furnish, install, and configure the System with additional recording space for IP cameras and encoders for all devices added under this Contract. Use of existing storage space is not permitted unless otherwise shown on the Plans. Storage and recording capabilities shall be based on the following:

5.

i. All cameras and encoders provided under this Contract, plus 50% spare for 24 hours per day, 7 days per week, continuously for 30 days.

ii. IP cameras configured for H.264 compression with a recorded pixel resolution of 720p (1280x720).

iii. External encoders configured for H.264 compression with a recorded pixel resolution of 704x480 (4CIF/NTSC).

iv. Minimum 4000kbps output per IP camera, 768kbps per analog camera via external encoder.

v. RAID 5 storage configurations.

6. Once storage capacity or a pre-defined time (in this case, 30 days) has been reached, the system shall automatically record over previously recorded images on a first-in, first-out basis unless an operator intervenes with the appropriate programming commands to retain video within the storage system.

7. Submit supporting storage calculations based on the values for frame rate, resolution, bandwidth, and recording period. The compressed file sizes used for the storage calculations must give high quality images as described within.

F. Client workstations shall be furnished and installed as indicated on Plans. Furnish, install, and configure client software on each workstation.

G. The System shall interface to external encoders provided under this Contract in order to view and record video from existing analog CCTV cameras. All requirements applicable to camera viewing, recording, and playback shall apply to external encoders unless otherwise noted.

H. Cameras shall not require "genlocking" (synchronizing) to each other or to the system to achieve the required capture rate. Disconnection and disabling of one or more cameras shall not compromise recording from other cameras.

I. System Management and Administration

1. The system shall provide automated, system-wide health monitoring and diagnostics. The diagnostics detailed metrics and real-time displays of performance data help accelerate troubleshooting by graphically highlighting trends and exceptions. The system shall be capable of monitoring SNMP traps of CCTV system equipment such as cameras. This function shall be automatic and alert other systems, such as the central management software, of specified alarms. System management package shall be native to the VMS. The management solution shall allow the system administrator to control, configure, and monitor the VMS and recording system.

2. The administrator shall have the ability to independently set up each camera for frame rate, compression rate, brightness, contrast, and other performance settings.

3. All functions and system settings available by the software shall be made available to the system administrator. The system administrator shall have the ability to add, modify, and remove all configurable items including, but not limited to, users, user groups, user rights, user group rights, system maps, etc.

J. Security Requirements

1. Access to the existing active System will be provided by MNR as needed. Contractor shall request access through the engineer at least two (2) weeks in advance.

2. For test and/or non-production systems:

a. The System shall provide a password initiated security hierarchy, which will provide access privileges to users. There will be a minimum three privileged levels. User accounts are not to be created locally on Windows servers if at all possible.

b. All application users are required to successfully log in to the software before any application functions are accessible. Access to monitors, cameras, recorders, and all software features shall depend on the assigned user rights, which shall be designated through the system administrator.

3. The system shall provide password protection and other suitable protective measures to achieve:

a. Protect video stored within the unit.

b. Protect video following export from the unit.

c. Prevent unauthorized copying of video to removable media.

4. The system shall feature a continuously running activity log with remote access/connectivity page and performance/operation page.

K. Head-end system power shall be 208 VAC, single phase unless otherwise noted. All workstations shall operate on 120 VAC.

L. The System shall maintain full functionality and be capable of operating within the environmental conditions encountered in the locations installed.

Submittals

A. The plans indicate the extent and the general location and arrangement of the work. The Contractor shall study the plans and details so that the work will be properly located and readily accessible. If conflicts occur necessitating departures from the plans, the Contractor shall submit details of departures and reasons therefore shall be submitted as soon as practicable for written approval of the Engineer. Contractor shall ensure all substitutions are coordinated with the design and the installation conforms to all Contract requirements and local codes.

B. Make field inspections necessary in order to prepare accurate shop drawings in accordance with existing conditions. Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation.

C. Submit the following for review and approval as required.

1. Product data for each product specified; samples as required.

2. Plans furnished by the manufacturer.

3. Drawings indicating all work including mounting, riser diagrams, wiring diagrams, and other details.

4. Tagging/labeling nomenclature and related product data.

5. Test procedures for all testing and product data for test equipment; forms to be used for test report; test schedule; certified copies of test results; notification of testing four weeks in advance.

6. Manufacturer's Certification: Signed by the manufacturer certifying that they comply with the specifications requirements. Upon request submit evidence of experience.

7. Product Certification: Signed by manufacturer certifying that products comply with the specified requirements.

8. Installers Certificates: Signed by the Contractor, certifying that the installers comply with the specifications requirements.

9. Field testing organization certificates, signed by the Contractor, certifying that the organization complies with the specifications requirements.

10. User Manuals and System Documentation.

11. Training plans and documentation.

D. Survey the communications rooms and submit, concurrently with product data for the proposed communications room equipment cabinet, a drawing indicating the following:

1. Architectural plan of the room with dimensions, including elevations.

2. Locations of all existing (where applicable) and new cabinets, racks, power plants, cables, cable ladders and conduits with sizes and types indicated. Provide actual (installed) locations as determined by field measurements.

3. A.C. and/or D.C. feeds to equipment cabinets with references to the source locations (A.C. panels, transfer panels).

4. Location of equipment proposed for future installation, as directed.

5. Submit photographs of the Communications Room for each survey.

E. The Contractor shall coordinate all network topology requirements with Metro-North. Submit a request for IP addresses for all devices to the Engineer in Excel format, or other approved format. Allow a minimum of thirty (30) days for a response.

Materials:

Head-End Servers

A. Servers shall be in current manufacturing production and meet or exceed the latest VMS system manufacturer's recommended specifications at the time of procurement and the following:

1. Intel® Xeon® E5-2430, 6-core, 15MB Cache, 2.20 GHz

2. 6GB RAM

3. 24X multi-burner drive

4. (5) 500 GB, 7,200 RPM, SATA hard drives, RAID 1 configuration

5. Dual 10/100/1000 Ethernet communication ports

6. (1) serial port, (4) USB ports

7. Integrated Video Card

8. Integrated RAID Controller

9. Dual redundant, hot-swappable power supplies

10. Operating System: Windows Server 2012 or later, to be coordinated with existing system OS

11. Support external storage devices, to be coordinated with storage array

12. Manufactured by Dell, HP, Lenovo, or approved equal.

13. All hardware shall be compatible with the existing Verint Nextiva VMS Platform.

B. Number of servers shown on the Plans are typical, and based on manufacturer recommendations. Contractor shall be responsible to furnish servers to meet Contract requirements, including spare capacity, based on actual performance characteristics of the servers. In no case shall the number of servers be less than shown on the Plans.

Storage Array

A. Storage arrays shall be in current manufacturing production and meet or exceed the VMS/NVR system manufacturer's recommended specifications and the following:

   1. Dual 8Gb fibre channel controllers

   2. Support RAID 0, 1, 1+0, 4, 5, 6. Storage shall be configured for RAID 5 or better.

   3. Dual redundant, hot-swappable power supplies

   4. Shall be Nexsan E60 series, or approved equal

   5. All hardware shall be compatible with the existing Verint Nextiva VMS Platform

B. Contractor shall be responsible to size storage array in accordance with Contract requirements, including spare capacity. Additional arrays shall be provided to meet Contract requirements.

Workstations

A. Workstations shall be in current manufacturing production and meet or exceed the VMS manufacturer's recommended specifications at the time of procurement and the following:

   1. Intel® Xeon® E5-1650 v3, 6-core, 3.5GHz, 15MB Cache

   2. 24" widescreen (16:9 or 16:10) flat panel anti-glare LCD or LED-backlit display with 1920x1080 min. resolution, high dynamic contrast ratio, 8ms response time, DVI or DisplayPort connection.

   3. 8GB 2133MHz DDR4 ECC RAM

   4. Dual optical drives: 16X (DVD+/-RW) and 48X CD Burner/DVD Combo

   5. AMD FirePro™ W2100 2GB video card

   6. 500GB SATA 7200rpm hard drive

   7. 10/100/1000 Ethernet communication port

   8. (4) USB ports, (1) serial port

   9. Operating system: Windows 7 or later, to be coordinated with existing VMS workstations

   10. USB keyboard and mouse

11. Manufactured by Dell, HP, or approved equal.

12. All hardware shall be compatible with the existing Verint Nextiva VMS Platform.

B. Only that software which is required for review station functionality shall be provided on the CCTV workstation. Contractor shall prevent other devices, such as thumb drives, hard disks, external networks, etc. from connecting the CCTV workstation in accordance with direction from MNR. The Contractor shall furnish, install, and configure any software required for use of the System. This includes, but is not limited to, operating systems, runtime files, additional media players, etc. All software shall be submitted and approved for use by MNR.

Equipment Cabinet

A. Equipment cabinet for T&E building shall be furnished and installed by the Contractor, and meet or exceed the VMS equipment manufacturer's recommended specification. Cabinet shall be designed to house the equipment to be installed and provide adequate airflow and cooling. It shall meet or exceed the following:

1. EIA compliant 19" gangable equipment rack.

2. Fully welded construction provides the following weight capacities: UL Listed load capacity: 2,500 lbs., Static load capacity: 10,000 lbs., seismic certified capacity: 1,050 lbs.

3. Rack shall be constructed of the following materials: top and bottom shall be 14-gauge steel, horizontal braces shall be 16-gauge steel.

4. Dimensions shall be approximately 83-1/8" H x 22" W x 42" D. Contractor to coordinate exact size with equipment requirements.

5. Rack shall come equipped with two pairs of 11-gauge steel rackrail with tapped 10-32 mounting holes in universal EIA spacing, black e-coat finish and numbered rackspaces.

6. Rack shall be fully enclosed with removable perforated front and rear doors, removable solid side panels with recessed lift handles, and removable solid top. Top shall accommodate field drilling for conduit entry.

7. Durable black textured powder coat finish.

8. Cabinet shall satisfy the 2007 & 2010 CBC; 2006, 2009 & 2012 IBC; ASCE 7-05 (2005 Edition) & ASCE 7-10 (2010 Edition) and the 2006 & 2009 editions of NFPA 5000 for use in areas of high seismicity, Seismic Use Group III, Zone 4 or Seismic Design Category (SDC) "D" with lateral force requirements for protecting 1,050 lbs. of essential equipment in locations with the highest level of seismicity and top floor or rooftop installations with an Importance factor (Ip) of 1.5.

9. Supply the cabinet with the required seismic floor anchor bracket

10. UL Listed in the US and Canada

11. Grounding and bonding stud shall be 1/4-20 threaded, installed in base of enclosure

12. Supply 3-1/4" wide, 44 space vertical lacer strip

13. Minimum six horizontal lacer bars

14. Twelve 8" Velcro cable management straps

15. Leveling feet

16. Ground bar

17. Equipment shelves and mounting supports.

18. Drawing pocket/cabinet

19. All required wiring and cabling

20. Cabinet shall be Middle Atlantic Products MRK series, or approved equal.

B. Design and layout of the cabinet shall be submitted and approved prior to ordering. Contractor shall supply any additional accessories required per Engineer's approved submittal.

Power Distribution Units (PDU)

1. 208VAC, single phase

2. L6-30P plug, or as needed to coordinate with feeds provided by MNR

3. (6) IEC C19 and (24) IEC C13 receptacles

4. Metered

Power distribution units shall be coordinated with the power feeds provided by MNR and equipment installed within rack.

Furnish two (2) PDUs for each head-end rack.

KVM Console

A. Furnish and install KVM console switch for all head-end servers. Provide all cabling from KVM console to each server.

B. KVM console shall meet or exceed the following specifications:

1. Integrated 1U rackmount KVM switch with 19" LCD screen, keyboard, touchpad, and ports for at least 8 servers. Console shall support connections to additional consoles or KVM switches.

2. (2) USB ports for connection of external mouse or keyboard.

3. Support resolutions of at least 1280x1024.

4. Compatible with all major operating systems.

5. Support two-level security (administrator vs. user).

6. Auto-scan for discovery of connected systems.

7. Switch ports via console pushbuttons, hotkey keyboard commands, or the on-screen display.

8. Tripp Lite B020-U08-19-K or approved equal.

Execution:

Installation Requirements:

A. General Installation Requirements

1. Install all CCTV equipment to be furnished under this Contract unless otherwise noted. Contractor shall install all equipment and software at the CCO Shop Head End and other remote locations as per this Section. All equipment shall be installed in accordance with the manufacturers' recommendations and MNR Policy. This information shall be submitted at the time catalog cuts and shop drawings are submitted for approval.

2. Prior to delivery of the equipment to the work site, prepare and submit for approval an equipment placement and staging plan. Plan shall be coordinated with the Engineer and all affected trades. The plan shall indicate:

a. General Schedule, schedule by stage or phase, and schedule for each device. Indicate start dates, end dates, and durations. Include major milestones such as fabrication, production testing, shipment, delivery, inspection, site preparation work, installation, energizing, and testing.

b. Placement drawings, both overall and for each installation stage or phase.

c. The order in which the equipment and devices will be installed. Identify the various installation stages or phases. For each stage or phase, identify which devices will be installed, where they will be installed, and in what order.

d. Step-by-step detailed procedures for installation of the equipment including:

i. Pre-delivery of the equipment to the Contractor's storage facility or location.

ii. Inspection at the storage facility or location.

iii. Pre-delivery assembly and testing.

iv. All site work and preparation required for installation of the equipment.

v. Delivery to the work site.

vi. Work site equipment assembly.

vii. Equipment installation.

viii. Procedures for installation, testing, and termination of all power, control, and communications wiring and cabling.

ix. Qualifications of personnel required.

x. Estimated dates and times that preparatory work and equipment placement will be performed.

xi. Identification of interfaces with others (if any).

xii. List of activities required from the Engineer or others, if any, to perform the work.

xiii. Contingency plans for placement, testing, or commissioning delays.

3. Installation of all System equipment and materials shall be in accordance with the manufacturer's recommendations, the approved shop drawings, and the requirements of this section and the Contract Drawings.

a. Locate all equipment which must be serviced, operated, or maintained in fully accessible positions, especially when located in concealed locations.

b. Minor equipment location deviations from the Contract Drawings may be made to allow for better accessibility, but all such deviations shall be approved by the Engineer prior to any work being performed.

c. All equipment, except wiring and conduit, shall be completely accessible without the requirement to remove any portion of the building structure or other system component, except an appropriately sized access door or

ceiling tile.

d. Enclosure access doors shall be hinged and arranged to allow full swing open and complete access to all enclosure components and wiring.

e. Furnish all fittings, conduit associated with panel-to-panel and panel-to-trough/cable tray connections, trough, wireways, boxes, hangers, wiring devices, enclosures, signage, fasteners, connections, control panels, relays, cable trays, and miscellaneous accessories necessary for the complete installation of the System.

f. Contract Drawings are schematic for systems equipment as exact roughing requirements vary slightly with different manufacturers and job conditions. The Contract Drawings represent a schematic depiction of the CCTV System conduit, cable tray, and wire network layout for the system equipment specified. Final conduit, cable tray, and wire quantity, size and arrangement, as well as final routing and placement shall be based on system equipment, manufacturer's engineering requirements, field coordination with other trade work, and existing site conditions.

g. Carefully coordinate the work of this section with all affected trades.

h. Coordinate all cable, conduit and device identifiers with the Engineer. Ensure uniformity and interrelation of identifiers. Avoid identifier duplication.

4. Perform all setting, adjustment, and programming required for a complete and operational CCTV system to include Head End, as approved and as directed by the Engineer. Submit setting, adjustment, and programming information for approval.

5. Furnish and install all required hardware and brackets to install the equipment as specified and as indicated on the Contract Drawings. Furnish and install all required rack mounting kits to install the equipment as specified and as indicated on the Contract Drawings.

6. For systems with camera switching, camera switching shall be smooth and without "roll".

7. Fasteners used for any of the following purposes shall be tamper resistant:

   a. camera housing screws

   b. junction box screws for CCTV or security system applications.

   c. screws in electronic equipment housings

8. Install cable, conduit and raceways in such a manner as to minimize visual impact.

9. Rack-mount the video recording system and related equipment in the Communications Room equipment cabinet. Design mounting methods for any equipment that is not normally rack-mounted.

10. Make electrical connections as required from the equipment to circuit breaker panels.

11. At each camera-mounted threaded pipe joint, install a stainless steel taper pin to prevent rotation due to vibration and vandalism.

B. A binder with a set of as-built drawings and pictures in a legible 11" x17" laminated print outs shall be placed at the head-end rack locations for quick reference to identify all cameras and camera locations connected to the System.

VMS Manufacturer's Service Technician

A. Testing, checking, system startup, and configuration shall be performed under the technical direction of the manufacturer's service engineer. The Contractor, in conjunction with the manufacturer, shall provide, at no additional cost to the Department, start-up service package including travel.

Programming and System Configuration

A. Perform all programming services required to provide a complete and fully functional system. This shall include all high-level database programming which may be required due to any project specific operational or special 3rd party system interfaces to allow for a fully functional system. Ensure that the entire Video Management System (VMS) and all other interfaces are properly configured and programmed to provide complete operation and monitoring as specified herein and/or as indicated in the Contract Drawings. Functions of the System shall include, at a minimum:

1. Simultaneously record and display live video and display recorded video
2. Multiple, simultaneous views of different cameras
3. Event-based recording
4. Mark events and make available for playback and/or archiving at any time
5. Link video events to intrusion alarms and access control exception events in the System database
6. Unlimited users accessing any video feed from any camera
7. Multiple users access to recorded video on the network.
8. User defined profiles for tailored granular access to configuration and operation
9. The ability to enhance a frame of video with embedded features or off-the-shelf software while providing security for the original video image to preserve integrity
10. Configure video bit-rate per camera
11. Pre and post roll in seconds
12. Active event-based archiving

13. Motion detection alarms
14. Set continuous recording mode
15. Video camera groups and tours
16. Still image capture
17. Still image save
18. Export video clip to file
19. Blind camera alarm
20. Resizable video window
21. Video loss detection
22. Save and export recorded video to a file
23. Modifications to or additions of user access rights

B. Contractor shall coordinate all software versions, patches, etc. with the existing system.

1. Furnish and install any major version updates, service packs, update rollups, etc. available from the manufacturer.

2. Notify the Engineer of any patches, firmware updates, and/or software updates required for proper operation and security of the System including operating system or any third party software.

3. All updates shall be approved by the Engineer prior to installation on any of the hardware connected to the System. Submit all requests to the Engineer for approval by Metro-North.

4. Upon approval by Metro-North and the Engineer, approved updates shall be installed by the Contractor on both the existing system and new equipment furnished under this Contract. The Contractor shall be responsible to ensure software versions, patches, etc. for all items furnished and installed under this Contract are fully coordinated with the existing system.

C. All existing functionality shall remain operational throughout the Contract. Contractor shall document and verify existing operations and functions prior to making any System modifications. Verify all functionality remains after modifications are made. New equipment shall be integrated to the existing System and operate as a single system.

D. Submit a System Configuration Plan for approval prior to modifying the existing System. System Configuration Plan shall include, at a minimum:

1. All programming modifications to be made to the existing VMS.

2. Configuration settings for each device and System interfaces.

3. System backup and disaster recovery procedures.

4. Programming and verification procedures.

E. Request programming information relating to alarm events, response instructions, user rights, and any/all special programming information in writing to the Engineer. Allow a minimum of four weeks for a response. As part of the request, provide descriptive information of what is to be reported by the System for each device, and identify all required questions which require a response in order to complete the System's programming. Contractor shall submit final programming information for approval.

F. System Backup

1. Prior to starting System modifications, create a backup of the existing System configurations. This backup shall be maintained for the duration of the Contract.
2. After initial backup, furnish updated backups of any changes to the programming, configuration, or database of the System performed.
3. All backups made to the live System shall be done only with permission of the Engineer and under technical direction of the manufacturer's service technician.
4. The initial and latest back-up media shall be available at the head-end locations for immediate recovery and restoration of the System in the event of a System failure.
5. Develop and implement a programming and backup media tracking and management system to ensure that both the Contractor and Railroad have the latest system back up media and to ensure that in the event of a System failure, the latest backups are used for recovery. This management and tracking system shall include having an off-site copy of the latest backup media and secure storage of all copies of physical backup media to ensure that only authorized Railroad and Contractor personnel have access to the backup media.
6. Prepare Disaster Recovery Procedures which provide compete and step-by-step instructions for restoring the System to its normal operational state with minimal loss of System operational capability or availability, in the event of System failure or in the event that any subsequent modifications to the System by the Contractor after completion Operational Acceptance Test due to the Work of successive installation and testing phases, result in System errors or faults.
7. All backup media shall be furnished by the Contractor.

G. Recording and viewing rates shall be separately configured. The System shall enable multicast video at a maximum of 720p (1280x720), 30 FPS for real time viewing, or any of a series of selectable combinations, and separate unicast video streams simultaneously for recording at similarly variable recording rates, the maximum of which shall be 720p (1280x720).

H. Recording of video shall not be affected by loss of communication with a server. Failover recovery shall be activated for loss of any server. For system equipment with dual data network or communications connections, the network shall automatically allow for re-routing of data network traffic and communications to redundant connection.

I. The System shall be configured to store H.264 compression video at 720p (1280x720) for a 30 day period. The Contractor shall submit calculations for storage capacity to the Engineer. Storage calculations shall be submitted for both H.264 and MPEG-4 compression.

J. All application software and firmware shall be a standard off-the-shelf product. Any custom application software required to meet the requirements of the Specifications and Contract Drawings shall be written in a programming language which is in general use and fully sported from multiple sources. The application software shall be modular, commented, documented, and structured to facilitate software maintenance by MNR.

K. Request the Engineer to schedule a meeting with the user department. At the meeting, inform the user department of available system programming options and obtain their input. Program the system to meet their needs.

1. Develop monitor viewing sequences appropriate for the operations of the facility. Considerations shall include variations for day/night tours, weekends/holidays, alarm activation for each device, monitoring of intruders, and peak hours of operations in the facility.

L. Configure the VMS with graphical maps of the facilities on all System workstations and servers that identify the location of all cameras connected to the System. Graphical maps shall become property of MNR. If a separate program is used to create the graphical representation, source file shall become property of MNR. Submit original file and a licensed copy of the software used to create the file to MNR. Maps shall be configured with GPS coordinates of each device. The Contractor shall be responsible to obtain GPS coordinates by field survey.

M. Program the CCTV workstations to provide calendar-based announcements that regularly scheduled maintenance is required. The maintenance schedule for each device, for which maintenance is recommended by the manufacturer, shall be programmed. The announcements shall include telephone numbers and names of MNR and other service personnel.

Training Program:

Refer to "NOTICE TO CONTRACTOR – Training" for system training program requirements. All general system training requirements shall be included in the "Video Management System" Bid Item, except as specifically noted otherwise.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information.

Method of Measurement:

The Video Management System shall be measured for payment by the number of "Each" complete system installed, tested, made fully operational, with all training completed meeting all requirements described in this specification.

The Video Management System Software Licenses shall be measured for payment by the number of "Each" complete camera license furnished. Complete camera license includes the primary license, fail-over license, and associated maintenance.

The Workstations shall be measured for payment by the number of "Each" complete system installed, tested and made fully operational meeting all requirements described in this specification.

The CCTV Workstation Software Licenses shall be measured for payment by the number of "Each" complete workstation license and associated maintenance furnished.

Basis of Payment:

The work under these items shall be paid for at the contract price per each system installed, tested and made fully operational meeting all requirements described in this specification.

Pay Item	**Pay Unit**
Video Management System Software Licenses	Each
CCTV Workstation Software Licenses	Each
Video Management System	Each
Workstation	Each

ITEM #0063538A
ITEM #1108872A
ITEM #1108868A
ITEM #1108881A

ITEM #1108876A – INFRARED ILLUMINATOR
ITEM #1112226A – PTZ CAMERA DOME
ITEM #1112227A – FIXED MOUNT CAMERA DOME

Descriptions:

This work shall consist of furnishing and installing Fixed and PTZ Closed Circuit Television (CCTV) dome camera assemblies, camera mounting devices, infrared lights and other items at the field locations shown in the Plans and in accordance with the Contract Documents.

Analog elevator cameras are specified and provided in other sections.

Materials:

All materials furnished, assembled, fabricated, or installed shall be new, corrosion resistant and in strict accordance with the details shown in the contract documents. The CCTV Dome Cameras and other items shall be fully compatible with each other and shall have the capability of being fully controlled by software and hardware being furnished under other Contract items. All cameras shall be fully compatible with the existing Verint Nextiva Video Management System at CCO Shop and T&E Building.

General Requirements:

The equipment shall deliver high quality full-motion video during day or night operation with the video transmitted over fiber optic networks installed as part of this project as indicated in the Contract Documents.

Cameras shall be IP-based and comply with established network and video standards. Cameras shall be powered by the network switch utilizing the network cable as shown on the Contract Drawings. Power injectors (midspans) are not acceptable unless specifically shown. Cameras shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications and ONVIF complaint.

Mounting hardware be provided as part of these Items. The camera assembly shall be designed for mounting on a pole, platform canopy, structure, or wall as specified in the contract documents. Adapter plates, where required, shall be provided as part of these Items. Connections between the equipment shall be through weather proof connectors to provide easy replacement. All cabling to the cameras shall be in conduit. Servicing of the camera assembly shall be available in the continental United States or Canada.

All conduits, cabling, hardware and other items not specifically called out elsewhere in the Contract Documents that are required for a complete and fully functioning PTZ or Fixed CCTV

Dome Camera as described in the Specifications and Contract Documents shall be provided by the Contractor as part of these Items.

Contractor shall relocate static station signage as necessary to avoid conflicts between the camera (including mount assembly) and the signs and as indicated on the Plans or directed by the Engineer. Signs that are clamped to the canopy structure and need to be relocated shall be considered incidental to mounting the camera. Signs that are bolted or otherwise permanently attached to the canopy structure and need to be relocated shall be relocated at the direction of the Engineer will be paid under other Items.

Fixed CCTV Camera Requirements

The fixed CCTV camera shall be Axis model Q3505-VE or equivalent (see source limitations below) meeting the following requirements:

Camera Image Sensor:	1/2.8" Progressive Scan RGB CMOS, IR-sensitive
Lens:	Varifocal, Remote focus & zoom, IR-corrected, megapixel, P-iris control
	Focal Length Options:
	3-9 mm, 105°-35° (horizontal), F1.3
	Camera shall have the option of a 9-22mm lens, 33°-16° (horizontal), F1.6. Final lens selection shall be coordinated with field conditions.
Zoom:	3x (optical); 2x (digital)
Minimum Illumination:	Color: 0.18 lx at F1.3 (1080p, 30fps, with WDR)
	B/W: 0.04 lx at F1.3 (1080p, 30fps, with WDR)
Day/Night:	Automatically removable infrared-cut filter
Wide Dynamic Range (WDR):	Up to 120dB
Shutter Time:	1/142850 s to 2 s
Video Compression:	H.264 (MPEG-4 Part 10/AVC)
	Motion JPEG
Resolutions:	1920x1200 to 160x90 with 4:3 and 16:9 aspect ratio options
Frame Rate:	30fps with WDR. Up to 60fps without WDR at 1080p resolution.
Video Streaming:	Multiple, simultaneous, individually-configurable
	H.264: Baseline, Main, and High profiles

	Motion JPEG
	The camera shall support both Maximum Bit Rate (MBR) and Variable Bit Rate (VBR) in H.264 and provide configurable compression levels.
Supported Protocols: SSL/TLS,	IPv4/v6, TCP, UDP, NTP, RTSP, HTTP, HTTPS, FTP, SMTP, DNS, SOCKS, SSH, RTP, RTCP, DHCP
Camera ID:	Up to 20 characters (alphanumeric characters, marks)
Network Interface:	10Base-T/100Base-TX PoE, RJ-45 connector
Inputs and Outputs:	2 configurable I/O ports, accessible via terminal block. Configurable normally open or normally closed
Power:	Power over Ethernet (PoE) 802.3af 11.4W max.
Memory:	512 MB RAM, 128 MB Flash
API:	Open API for software integration
	ONVIF Profile S
Event Triggers:	Video motion detection, External input, Edge storage events, Shock detection
Image Settings:	Electronic image stabilization, white balance (auto and manual), backlight compensation, image rotation (90 degree increments), low light compensation, exposure control, privacy masks
Video Transmission:	HTTP (Unicast), HTTPS (Unicast), RTP (Unicast & Multicast), RTP over RTSP (Unicast), RTP over RTSP over HTTP (Unicast)
Environmental:	-40°C to +60°C (-40°F to +140°F), 10-100% RH (condensing)
EMC Approvals:	FCC Part 15 - Subpart B Class A + B
Railway EMC Approvals:	EN 50121-4, IEC 62236-4
Information Technology:	IEC/EN/UL 60950-1, 60950-22 (Outdoors)
Vibration/Shock:	IEC 60068-2-6/IEC 60068-2-27
MTBF:	>100,000 hours

The camera shall be an outdoor, vandal-resistant network dome camera designed for 24/7/265 use. The enclosure shall include a polycarbonate and aluminum body with encapsulated electronics, weather shield for vertical installations, and meet the requirements of IEC/EN 60529 IP66/67, NEMA 250 Type 4X, and IEC/EN 62262 IK10+ (50 J). Enclosure shall provide the ability to adjust the camera modules angle with -5 to 90˚ tilt, ±360˚ pan and ±95˚ rotation while

maintaining an image that is not interfered by the camera housing. Enclosure shall be equipped with a dehumidifying membrane.

The camera shall feature a black and white mode that may be automatically engaged on low light level and permit the use of an external infrared illuminator or manually selected. The camera shall incorporate independent automatic color-to-black and white switching modes for switchover on light threshold and sensitivity to IR illumination. Automatic color-to-black and white switching shall have selectable light level thresholds (high or low) and duration settings for the selected threshold before automatic switchover occurs.

PTZ Camera Requirements:

The PTZ CCTV camera shall be Axis model Q6044-E or equivalent or equivalent (see source limitations below) meeting the following requirements:

Camera Image Sensor:	1/3" Progressive Scan CCD, IR-sensitive
Lens:	4.4 mm - 132 mm, F1.4-4.6, Autofocus
	62.9°-2.2° (horizontal FOV)
	37°-1.2° (vertical FOV)
Pan/Tilt/Zoom:	Pan: endless 360°
	Tilt: 220°
	Zoom: 30x (optical); 12x (digital)
	Pan and tilt speeds adjustable between .05-450˚/sec.
Effective Pixels:	1.3 megapixel (720p)
Minimum Illumination:	Color: 0.2 lx at F1.4 (30 IRE)
	B/W: 0.04 lx at F1.4 (30 IRE)
Day/Night:	Automatically removable infrared-cut filter
Shutter Time:	1/10000 s to 1/4 s
Video Compression:	H.264 (MPEG-4 Part 10/AVC)
	Motion JPEG
Resolutions:	1280x720 to 320x180
Frame Rate:	30 fps
Video Streaming:	Multiple, simultaneous, individually-configurable
	H.264: Main, Baseline Profiles
	Motion JPEG

	The camera shall support both Constant Bit Rate (CBR) and Variable Bit Rate (VBR) in H.264 and provide configurable compression levels.
Supported Protocols:	IPv4/v6, TCP, UDP, NTP, RTSP, HTTP, HTTPS, SSL/TLS, FTP, SMTP, DNS, SOCKS, SSH, RTP, RTCP, DHCP,NTCIP
Camera ID:	Up to 20 characters (alphanumeric characters, marks)
Network Interface:	10Base-T/100Base-TX PoE (60W), RJ-45 connector
Power:	60W PoE
Memory:	512 MB RAM, 128 MB Flash
API:	Open API for software integration
	ONVIF Profile S
Event Triggers:	Video motion detection, External input, Edge storage events, Shock detection, Fan, PTZ moving, PTZ preset
Image Settings:	Electronic image stabilization, automatic defog, white balance (auto and manual), backlight compensation, image rotation, low light compensation, exposure control, privacy masks
Video Transmission:	HTTP (Unicast), HTTPS (Unicast), RTP (Unicast & Multicast), RTP over RTSP (Unicast), RTP over RTSP over HTTP (Unicast)
Environmental:	-40°C to +50°C (-40°F to +122°F), 10-100% RH (condensing)
EMC Approvals:	FCC Part 15 - Subpart B Class A
Railway EMC Approvals:	EN 50121-4, IEC 62236-4

The camera shall be an outdoor, vandal-resistant network dome camera. The enclosure shall include an aluminum casing with encapsulated electronics and meet the requirements of IEC/EN 60529 IP66, NEMA 250 Type 4X, and IEC/EN 62262 IK10. Enclosure shall include sunshield, temperature sensor, heater, and fan.

The camera shall feature a black and white mode that may be automatically engaged on low light level and permit the use of an external infrared illuminator or manually selected. The camera shall incorporate independent automatic color-to-black and white switching modes for switchover on light threshold and sensitivity to IR illumination. Automatic color-to-black and white switching shall have selectable light level thresholds (high or low) and duration settings for the selected threshold before automatic switchover occurs.

Outdoor pendant adaptor kit (Axis T94M01D or as required to match camera and mounts furnished) shall be included.

Camera source limitations: Cameras shall be of sole brand, Axis, as determined for the operational and maintenance needs of Metro-North Railroad. Model number substitutions will be considered for newer models that meet or exceed the technical requirements herein. All substitutions shall be fully coordinated with the overall design by the Contractor. In the event the cameras listed are determined to be end-of-life, or near end-of-life, the Contractor shall propose an alternate that satisfies the technical requirements within. All cameras shall be fully compatible with the existing Verint Nextiva Video Management System.

Infrared (IR) Illuminators:

1. Contractor shall survey all locations that require IR Illuminators and provide a mounting detail for the mounting method for the IR lights. Where required, provide brackets to support the installation method and location. The detailed design shall be approved by the engineer prior to the start of work.

2. Requirements:

Type:	LED
Angle:	10° / 35° / 60° / 80°/ 120° via interchangeable lenses
Wavelength:	850 nm / 940 nm as shown on the plans
Dimensions (typ.):	5” x 7” x 3.2”
Voltage Input:	12/24 V AC/DC
Power Consumed (max.):	48W
Environmental:	IP66 rated, -50˚C to +50˚C (-58˚F to 122˚F)
Illumination Life:	44,000 hours

The illuminator shall be vandal resistant and manufactured using high impact polycarbonate lensing and shall incorporate and aluminum extruded heat sink to aid LED life expectancy.

The illuminator shall provide photocell-following output.

The illuminator shall permit adjustment of the following parameters and functions:

a. Power select: 20, 40, 60, 80, and 100% power
b. Photocell adjust: 3 sensitivity levels
c. Photocell disable
d. Restore factory defaults
e. LED status indicator on/off toggle

Use of separate remote control is permitted for these functions. Remote control setup shall be able to be disabled to prevent tampering. At least five (5) remote controls shall be provided.

Product Data: Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

Contractor shall ensure all substitutions are coordinated with the design and the installation conforms to all Contract requirements and local codes.

Construction Methods:

The plans indicate the extent and the general location and arrangement of the work. The Contractor shall study the plans and details so that the work will be properly located, readily accessible, and with the best possible view. If conflicts occur necessitating departures from the plans, the Contractor shall submit details of departures and reasons therefore shall be submitted as soon as practicable for written approval of the Engineer. Contractor shall ensure any rerouting required does not adversely affect the communications circuits.

Contractor shall survey all camera locations and provide a mounting detail for the mounting method for the cameras and IR illuminators. Mounting details shown on the Plans are typical and will require variations based on site conditions. Provide brackets to support camera installation location. Provide manufacturer recommended pads and/or vibration dampeners at locations subject to high winds and other vibrations (e.g. PECK Bridge cameras). The detailed mounting design shall be approved by the engineer prior to the start of work. No items shall be attached to catenary poles unless specifically shown on the Plans and subsequently approved in shop drawings.

Pre-Installation:

Prior to installation, each camera location, lens setting, and mounting type shall be field confirmed by generation of a still image (screen shot from a camera and lens configuration identical to that submitted - on a pole, with laptop to capture a picture of the field of view) to be submitted for approval before the camera mount and conduit is installed at each location. Contractor shall provide the Engineer at least two (2) weeks' notice prior to performing surveys to allow Department or Railroad personnel to attend at their option. Coordinate camera locations and field of views with all obstructions such as signage, speakers, lights, poles, catenary structures, etc. Overall camera coverage shall be coordinated to provide as close to 100% platform and entryway coverage as possible.

At the request of MNR Security, the Contractor shall also provide a night-time demonstration of the proposed cameras at the end of a station platform (site to be chosen by MNR). The Contractor shall demonstrate the capabilities and various setting options of the proposed camera under low-light conditions typical of the end-of-platform cameras

that will be installed looking out towards the track. The Contractor shall engage the manufacturer representative to assist with this demonstration if requested.

Contractor shall be responsible to furnish all equipment required for the surveys described above. Such equipment shall remain property of the Contractor. Equipment loaned from the camera manufacturer is acceptable, if available.

Make field inspections necessary in order to prepare accurate shop drawings in accordance with existing conditions and approved field of views. Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation. Note any nearby obstructions that could impact the field of view. Include plans, elevations, sections, details, and attachments as needed. Drawings should indicate site specific installation details including showing the exact equipment locations, mounting details, riser diagrams, mounting heights, distance from edge of platform, and side of pole (where pole mounted).

Installation:

Contractor shall verify all field conditions, ensuring no new obstructions are present. If new obstruction affects the camera view, immediately notify the Engineer.

Camera installation and Field of View adjustment: All cameras shall be located, position confirmed, rotated, and calibrated to provide for optimal fields of view.

Coordination of IR illuminators with cameras: All IR illuminators shall be located, position confirmed, rotated, and calibrated to provide for optimal illumination for the associated camera's field-of-view. Coordinate beam angle and power intensity with camera field-of-view and nearby IR illuminators. Ensure IR illuminators do not blind cameras. Furnish and install any lens changes required to achieve the desired illumination at no additional cost. Adjust photocell to ensure illuminator is coordinated to turn on prior to camera switching to night mode. Hard-wired connection between the camera and IR for day/night function coordination is also be acceptable. The IR illuminators shall be configured to turn off when not needed.

PTZ cameras shall be programmed with all preset locations. At a minimum, presets shall include default view, reverse view, entry points at each facility, and views of opposite platforms (where applicable). Coordinate all preset requirements with MNR Security.

Camera Housings and Mounts:

A. General Requirements for Camera Housings and Mounts

1. Furnish a complete mount for every camera being furnished and installed under this Contract. The mount shall be designed for use with the camera, and for conditions at the installation location. Camera mounts and mounting method shall be rated for

heavy duty and be of sturdy construction. It shall be suitable for indoor and outdoor applications, and have an appearance which matches the surrounding area. The mount shall be made of steel, unless otherwise noted, and painted to match the surrounding area as approved by the Engineer. All hardware shall be tamper resistant. Furnish all accessories required for a complete installation.

2. Furnish conduit adapters and related items as required.
3. Furnish smoked domes where shown on the Contract Drawings.
4. Where indicated on the plans, furnish and install an outdoor gooseneck bracket. Where attached to poles, mount shall not extend past the edge of the pole. Coordinate attachments to new poles with pole manufacturer. Submit mounting/attachment details for approval. Outdoor gooseneck wall bracket shall be Videolarm WM20G or approved equal.
5. Where indicated on the plans, furnish outdoor camera backboxes required for attachment of outdoor gooseneck bracket. Backbox shall be compatible with the approved mount and mounting surface. Backbox shall act as a sealed junction box for routing of cables to the camera, and attachment of conduit, and be able to mount to pole or wall. Plug all unused openings in accordance with manufacturer instructions. Backbox shall be Videolarm APM6 or approved equal.
6. All cameras and other devices, mounts, etc. shall maintain at least 6'-8" clearance above platforms, walkways, stairs, etc.

B. Special Provisions for PECK Bridge Cameras

1. Install bird barrier strips on cameras and IR lights located on the PECK Bridge fenders. Barrier strips shall be high-grade stainless steel and shall allow for easy cutting and surface shape memory. Finish color shall be natural stainless steel. Provide all mounting hardware per manufacturer's recommendations or as shown in the Plans.

Environmental:

Wind: Meet all performance requirements when subjected to a 90 mph wind and able to withstand a 127 mph wind.

Documentation

Six (6) advance copies of equipment manuals furnished by the manufacturer shall be submitted to the Engineer for review at least ten (10) days prior to the scheduled start of the first Stand-Alone Test. The Engineer will verify the manufacturer's equipment manual as part of the test and integration process. The equipment manual incorporating the Engineer's corrections and comments shall be integrated by the Contractor into the operations and maintenance manual as described in the contract documents. The manuals shall, as a minimum, include the following:

1. Complete and accurate schematic diagrams.

2. Complete installation and operation procedures.
3. Complete performance specifications (functional, electrical, mechanical and environmental) of the unit.
4. Complete list of replaceable parts including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA or EIA.
5. Complete maintenance and troubleshooting procedures.
6. Setup and configuration data for each camera location including the camera address, day/night threshold setting, horizontal and vertical limit settings and shutter speed.

Contractor shall use a GPS device to locate all devices at their final installation location. Furnish all GPS coordinates to the Engineer in Microsoft Excel format, along with a complete device schedule to include location description, device ID, mounting type, direction, preset locations, and all other descriptive information.

Upon completion of the installation and testing, prior to acceptance, thoroughly clean (internally and externally) all equipment furnished and/or installed under these Items.

Training:

Refer to "NOTICE TO CONTRACTOR – Training" for overall training requirements and additional information.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information. Prior to purchase of the proposed CCTV camera, contractor shall test the compatibility of the cameras with the existing VMS.

Method of Measurement:

The Fixed Mount Camera Dome will be measured for payment as the number of "Each" satisfactorily furnished, installed, tested and approved by the Engineer.

The PTZ Camera Dome will be measured for payment as the number of "Each" satisfactorily furnished, installed, tested and approved by the Engineer.

The Infrared Illuminator will be measured for payment as the number of "Each" satisfactorily furnished, installed, tested and approved by the Engineer.

Basis of Payment:

The unit price bid for each Fixed Mount Camera Dome, PTZ Camera Dome, and Infrared Illuminator shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work including testing.

Pay Item	**Pay Unit**
Fixed Mount Camera Dome	Each
PTZ Camera Dome	Each
Infrared Illuminator	Each

ITEM #1108882A – VIDEO MANAGEMENT SYSTEM SUPPORT SERVICES

Description:

The Contractor shall furnish an extension of the existing support services agreement between Metro-North and Verint for the existing Verint Nextiva Video Management System described elsewhere.

The Contractor shall provide technical support services to Metro-North for the existing Verint Nextiva System. Upon successful acceptance of the Phase 2 System additions, Contractor shall include technical support services for the combined Verint Nextiva Video Management System. The Contractor shall also furnish Verint certification training for Metro-North personnel.

Metro-North has a direct service agreement with Verint. Work under this Item shall not prevent Metro-North, or any other factory authorized/certified service provider retained by Metro-North or the Department, the ability to perform any system programming, installation, service, or maintenance activities. Work under this Item shall be fully coordinated with the requirements and work of other sections.

Upon contract award, the Contractor shall submit qualifications of the proposed service provider to the Engineer. All Terms and Conditions to the service agreement shall be approved by the Department and Metro-North prior to execution and shall not interfere with the requirements of this Contract. Upon approval of service personnel and Terms and Conditions, the Contractor shall execute a service contract with the authorized service provider.

The Contractor shall be responsible for the performance of the service provider engaged under this Item.

Software Maintenance Extension

The Contractor shall furnish an extension of the existing Software Maintenance Agreement between Metro-North and Verint for the existing system. This extension shall be procured through an authorized Verint reseller on behalf of Metro-North. This agreement shall include support for the following items from 1/1/2017 through 12/31/2019.

Existing Verint License Part Number	Existing License Description	Qty.
NEX-6.3-1CAM-S	Nextiva VMS 6.3, One (1) VMS Software Camera License	65
NEX-6.3-ECI-1CAM-150	Verint VMS 6.3, One (1) VMS Software Camera License for ADVANCED Master Server systems	150
NEX-6.3-1REDCAM-S	Verint VMS 6.3, One (1) Dual Recording Redundancy Software Camera License. This is in addition to the VMS Software Camera License. Available on Verint VMS ENTERPRISE Version only.	223
NEX-6.3-1RV-S	Nextiva VMS 6.3, One (1) Review/Smart Client License	10
NEX-6.3-ECI-SERV151PLUS	Verint VMS 6.3 ENTERPRISE Package. Includes DVD, Software Protection Key. The Enterprise license is mandatory for sites with more than 150 cameras OR if Dual recording, Failover, ESM or Redundancy is required.	1
NEX-SFO-MXFT	Marathon Software FT (Software only). This kit includes Marathon everRun MX Enterprise v6.1 sw for two Verint VMS or PSIM servers, 1 extra HASP HL NET dongle key and first year of maintenance.	1
VMS-6.3-1DUAL-ENT	Verint VMS 6.3, One (1) Dual Recording Redundancy Software Camera License. This is in addition to the VMS Software Camera License. Available on Verint VMS ENTERPRISE Version only.	4
VMS-6.3-1CAM-ENT	Verint VMS 6.3, One (1) VMS Software Camera License for ENTERPRISE Master Server systems	4

This extension shall provide “Gold” level support for the Verint Nextiva system with a minimum of the following directly from Verint:

1. 9:00am to 5:00pm business day telephone technical support
2. Online resources
3. Software error corrections
4. Software updates
5. Microsoft support related to the Verint system

Verint Certification Training for Metro-North

The Contractor shall furnish Verint Core Certification Training Series training for up to five (5) Metro-North personnel. **The Contractor shall submit available training options within fourteen (14) days of Notice to Proceed.** The training shall be procured upon approval by the Engineer and Metro-North.

Such training shall be procured through an authorized Verint reseller.

Technical Services Agreement

The Contractor shall retain the services of a Verint factory authorized service provider to perform the work of this Item.

1. The Contractor shall utilize qualified, certified, and licensed personnel with experience in design of integrated security systems from Verint. Prior to commencement of Work, the Contractor shall submit evidence of personnel having recent certifications for the system.
2. Service provider shall demonstrate a minimum of 7 years of continuous experience and technical expertise in performing contracts comparable in size and complexity, and whose installation and integration work was performed skillfully in a satisfactory manner and on time.
3. The service provider shall be of established reputation and experience in the field of Video Surveillance Systems and shall be certified by the manufacturers of the proposed equipment to install, service, and maintain each manufacturer's equipment.

The authorized service provider shall provide a technical support telephone number for the purpose of providing user assistance and guidance in the implementation, configuration, and troubleshooting of the existing Verint Nextiva System. Such phone number shall incur no additional charges to the user or the Department. During business hours of 9:00am to 5:00pm Eastern Time, service calls shall be returned within two (2) hours or by 5:00pm, whichever is earlier. Service calls made outside this time frame shall be returned by 10:00am the following business day. Business days shall include all days Monday through Friday exclusive of Metro-North holidays.

The service agreement shall include at least 600 hours of support for the duration of the agreement, to be tracked in at least 6 minute (.1 hour) intervals. All service requests shall be authorized by Metro-North. Warrantee service required elsewhere under the Contract shall not count as support time.

In the event Metro-North is unable to fix the support issue with telephone technical support provided by the Contractor, the Contractor shall dispatch an authorized service technician to the site on the next business day, or later if requested by Metro-North. Arrival times shall be coordinated with Metro-North for access to the equipment.

The authorized service provider shall furnish any major version updates, service packs, update rollups, etc. available from the manufacturer for the duration of the agreement. Notify Metro-North of any patches, firmware updates, and/or software updates required for proper operation and security of the System including operating system or any third party software.

No less than once every six (6) months, the authorized service provider shall audit the system and recommend software updates that have not yet been implemented by Metro-North. Upon approval by Metro-North, the authorized service provider shall schedule off-peak hours with Metro-North to install all requested updates. All updates shall be coordinated between the existing Phase 1 hardware, and new Phase 2 hardware whether accepted by the Department or not. All system equipment shall run the same version of all software. The first such audit shall occur no later than 6/30/17.

System Backup

1. Prior to starting System updates or upgrades, create a backup of the existing System configurations.
2. Furnish updated backups of any changes to the programming, configuration, or database of the System performed.
3. All backups made to the live System shall be done only with permission of Metro-North.
4. All backup media shall be furnished by the Contractor.
5. All backups shall be property of Metro-North.

Upon successful acceptance of the Phase 2 System additions, service provider shall include technical support services for the combined Verint Nextiva Video Management System.

As part of the service agreement, the service provider shall furnish all additional training required for five (5) Metro-North personnel to maintain Verint certification through at least 12/31/2019 (such as Verint Upgrade Certification Training). Work associated with the training shall not count towards service time.

The service agreement shall begin on 1/1/2017 and continue through 12/31/2019 unless otherwise terminated by the Department. Termination of the agreement by the Department shall result in a refund of services not provided on a pro rata basis.

Prior to execution of the service agreement, an hourly rate for excess services shall be negotiated and approved by the Department. Such negotiation shall not preclude the Department from discontinuing the service agreement, obtaining services from other sources, or re-negotiating the rate in the future.

Method of Measurement:

The "Video Management System Support Services" shall be measured for payment as a Lump Sum of complete system furnished.

Basis of Payment:

The work under this item shall be paid for at the contract Lump Sum price for the complete system as described, which shall include all materials, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
Video Management System Support Services	Lump Sum

ITEM #1112228A – CCTV CABINET – BASE MOUNTED
ITEM #1112229A – CCTV CABINET – BASE MOUNTED FOUNDATION
ITEM #1112245A – CCTV CABINET – PECK BRIDGE
ITEM #1112246A – CCTV CABINET – CONCRETE PAD

Description:

Under this item, the Contractor shall furnish and install CCTV Cabinets – Base Mounted and CCTV Cabinets – PECK Bridge at the locations shown in the plans and as directed by the Engineer.

The CCTV Cabinet items shall include a 12" base adapter to be included with the cabinet, and each CCTV Cabinet shall require either a concrete foundation under the CCTV Cabinet Foundation item or CCTV Cabinet Platform Pad item depending on location.

The Cabinets shall house the CCTV field equipment supplied under this and other Contract items, including but not limited to fiber optic patch panels, power supplies, communications equipment, and surge suppression equipment.

Materials:

The Cabinets shall be provided complete with all internal components and all mounting hardware necessary to provide for the installation of equipment as described in the plans and Contract Documents. Cabinets shall be sized as shown in the plans. Changes in Cabinet size to accommodate equipment proposed by the Contractor shall require approval by the Engineer.

The Contractor shall submit a detailed layout diagram, interconnection diagram, etc. for each type of Cabinet layout specified for review by the Engineer. Only Cabinets with approved layouts will be accepted under this Contract item.

Product Data: Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

Base Mounted Cabinet Requirements

The Cabinet shall be constructed of 12 gauge Type 316L stainless steel, with fully welded seams, and measure approximately 6' high, 2' wide, and 2' deep. The Cabinet shall accommodate EIA 19" rack mount equipment by providing mounting rails on each side of the Cabinet and in the front and back of the Cabinet. The Cabinet shall be rated as a NEMA Type 4X or 3RX enclosure as indicated on the plans.

All devices shall be hardwired. Plug-in devices are not acceptable.

All components incorporated into the cabinet shall have a minimum operational temperature

range of -13˚F to 158˚F (-25˚C to 70˚C) unless otherwise noted.

Cabinets and their final configurations shall conform to requirements of the National Electrical Code (NFPA 70), National Electrical Safety Code, and all other local codes.

The Cabinet shall have front and rear full size doors, equipped with continuous hinge and heavy-duty pad-lockable handles sized to fit a standard MNR communications padlock. The Cabinet shall have a seamless foam-in-place gasket for water-tight and dust-proof seal. The Cabinet shall include stops on each door, at the top and bottom, with stop positions at 90^{o} and 180^{o}.

Provisions shall be made in the Cabinet for the installation of all equipment that is provided and installed inside the Cabinet under other Contract items.

General Cabinet Requirements

In addition, the following equipment shall be provided in all Cabinet configurations as part of these Contract items:

a) One main circuit breaker

b) Duplex ground fault current interrupter convenience outlet, outdoor rated and weather resistant

c) Surge protection for power lines and signal wires

d) One anodized aluminum drawer that shall slide into and out of the Cabinet to house cabinet and equipment documentation or data pocket on door. Documentation shall be provided in a weather-protective sleeve/envelope or shall be laminated.

e) Cabinet Finish - The cabinet exterior shall be smooth #4 brush finish.

f) Heating and ventilation – For cabinets with equipment that is not rated for temperatures below -10˚F or above 157˚F, heating and ventilation shall be provided for the cabinet.

    1. An appropriately sized cabinet heater shall be provided inside the Cabinet, coordinated with the operating temperatures of the equipment installed. An adjustable thermostat shall be provided to turn the heater on and off. Thermostat setting shall be coordinated with equipment requirements. Provide final calculation based on actual Contractor-submitted and approved equipment. Calculation shall be based on a maximum -10˚F outdoor temperature without direct sunlight.

    2. Fan/filter unit(s) shall be provided to cool and vent the cabinet. Fan/filter shall maintain the cabinet temperature below the maximum normal operating temperature of the equipment inside the cabinet. Fan/filter shall be Type 12/IP54 type. Fan/filter shall be provided with an adjustable thermostat to control on/off operation. Fan/filter shall provide a minimum 162 CFM of free airflow. Install fan/filter behind NEMA 3R rated opening/louver. NEMA 3R exhaust louvers/grilles shall also be provided. Complete fan/filter and exhaust louver/grille combination shall provide a minimum airflow of 149 CFM. Provide final calculation based on actual Contractor-submitted

and approved equipment. Calculation shall be based on a minimum 106˚F outdoor temperature under direct sunlight.

g) Light - Two LED light fixtures with standard size lamps shall be provided at the front and back of each cabinet. The lights shall be configured to turn on upon door opening.

h) Each CCTV Cabinet shall include a 12" cabinet base adapter to raise the cabinet 12" off the mounting surface. The adapter shall be constructed of the same material, finish and methods as the cabinet and shall be from the same manufacturer when available. The cabinet base adapted shall be submitted for approval by the Engineer and included in the shop drawing submittal with the CCTV Cabinet.

i) Tamper switch – Tamper switches shall be installed such that each door is monitored for door status. Tamper switches shall be wired to the alarm inputs of the Cisco switch installed in the cabinet and configured to report through the Network Monitoring System. Switches shall be wired in a normally closed configuration where the circuit opens when the door opens.

j) Protective Vent – For cabinets without a fan and heater, furnish a protective vent to equalize pressure within the sealed cabinet and reduce condensation within the enclosure to protect the electronic equipment. Vent shall meet the following requirements:

1. IP66, IP67, IP68, and IP69k rated
2. Operating temperature of -40˚C to 125˚C per IEC 60068-2-1, 60068-2-2, and 60068-2-14.
3. Humidity testing at 85˚C at 85% RH for 1000 hours per IEC 600-2-78.
4. Salt resistance per IEC 60068-2-11 and 60068-2-52.
5. Corrosive gas testing per GR-3108-CORE
6. Fungus resistance per ASTM G-21
7. UL 94-V0 f1 flammability and UV resistance
8. Hail impact resistance per IEC 62108 10.9
9. Humidity freeze withstand per IEC 62108 10.8
10. Shall be Gore Polyvent XL / M32x1.5 with backing nut or approved equal

Electrical Requirements

Wiring

All cabinet wiring, where connected to terminal strips, relays, switches, radio interference suppressor, etc., shall be identified by the use of insulated pre-printed sleeving slipped over the wire before attachment of the lug or the completion of the connection. The wire markers shall carry the legend in plain words with sufficient details so that a translating sheet will not be required.

All wires shall be cut to the proper length before assembly. No wires shall be doubled back to take up slack. Wires shall be neatly laced into cables with nylon lacing and/or Velcro ties. Cables shall be secured with nylon cable clamps. Furnish and install a complete cable management system to control cable bend radius, provide strain relief, and provide a neat and workmanlike appearance.

All electrical connections in the cabinet, including relays, terminal strips, etc., shall have sufficient clearance between each terminal and the cabinet to provide an adequate distance to prevent a leakage path or physical contact under stress. Where these distances cannot be maintained, barriers must be provided. All equipment grounds shall run directly and independently to the ground bus. The interconnect cabling shall be routed such that when the doors are closed, they do not press against the cables or force the cables against the various components inside the cabinets.

All wiring containing AC line voltage shall be routed and bundled separately and/or shielded from all low voltage circuits. Clearances required by NFPA 70 (National Electrical Code) shall be maintained at all times.

All conductors and live terminals or parts which could be hazardous to maintenance personnel shall be covered with suitable insulating materials.

All wiring containing AC line voltage shall be a minimum size of #12 AWG and conform to XHHW-2 in accordance with other contract provisions. All other electrical conductors used in the cabinet wiring shall be #22 AWG or larger with a minimum of 19 strands. Conductors shall conform to Mil Spec #MIL-W-16878D, type B or D. All conductor specifications shall be coordinated with the equipment requirements. Cat 5e cabling shall conform to the requirements of other sections. Cabling that does not extend outside the cabinet, and all cabinet grounding cabling, shall be considered part of this Item and will not be paid separately.

The AC return and equipment ground wiring shall be electrically isolated from each other and the energized AC wiring by an insulation resistance of at least 10 Megaohms when measured at 250 VAC. Return and equipment grounding wiring shall be color coded white and green respectively.

GFI Duplex Outlet

In addition to any outlets required for equipment service, all cabinets shall be furnished with a 125VAC convenience outlet with integral ground fault current interrupt (GFCI), protected by a circuit breaker. The receptacle shall be a NEMA Type 5-15R outdoor, weather-resistant duplex receptacle located so that no electrical hazard shall exist when used by service personnel.

Circuit Breaker(s)

The cabinet circuit breakers shall be approved and listed by Underwriter's Laboratories (UL 489). Supplemental breakers (UL 1077) are not acceptable. The operating mechanisms shall be

enclosed, trip free from operating handle on overload, and trip indicating. Breakers shall have a minimum interrupt capacity of 10,000 amperes and be thermal-magnetic type.

Properly rated equipment circuit breaker(s) shall be provided for the equipment complement shown on the plans. Breaker sizes shown on plans are representative only and may vary based on equipment submitted and approved. Contractor shall coordinate all breaker sizes and curve characteristics with selected equipment and manufacturer recommendations.

Radio Interference Suppressor

All cabinets shall be equipped with a radio interference suppressor installed at the circuit breaker. The suppressor shall provide a minimum attenuation of 50 dB over a frequency range of 200 kHz to 75 MHz. The suppressor shall be hermetically sealed in a substantial metal case filled with a suitable insulation compound.

The suppressor terminals shall be nickel plated, brass studs of sufficient external length to provide space for connection of two appropriately sized conductors and shall be so mounted that the terminals cannot be turned in the case. The suppressors shall be designed for operation at 125 VAC, 60 Hz at the proper current rating as determined by the Contractor per the equipment complement as indicated on the plans. The suppressors shall meet applicable EIA specifications and shall be approved by UL.

Power Cable Input and Junction Terminals

Power distribution blocks suitable for use as a power feed and junction points shall be furnished and installed for two and three wire circuits as indicated on the plans. The line side of each circuit shall be capable of handling the number of wires required. Terminal blocks shall be sized to accommodate each wire required without a reducing splice. Splices shall only be performed where approved by the Engineer. Any splices performed in the cabinet shall be done via terminal blocks.

Terminal Blocks

Terminal blocks shall be accessible to the extent that it shall not be necessary to remove any electronic equipment from the cabinet to make an inspection or connection. Terminal blocks shall be two position multiple pole barrier type. Shorting bars shall be provided in each of the positions provided along with an integral marking strip. Terminal blocks shall be so arranged that they shall not upset the entrance, routing, and connection of incoming field conductors. All terminals shall be suitably identified by legends permanently affixed and attached to the terminal blocks. No electrically alive parts shall extend beyond the protection afforded by the barriers. Doubling up conductors on one terminal should be avoided and only performed where the terminals are listed for such purpose and approved by the Engineer. Use bridging clips or additional terminals as necessary.

AC terminal blocks shall be Underwriter's Laboratory approved for 600 Volts AC minimum and

shall be suitable for outdoor use. Terminals used for field connections shall secure conductors by means of a #10-32 nickel or cadmium plated brass binder head screw. Terminals used for interwiring connections, but not for field connections, shall secure conductors by means of a #6-32 nickel or cadmium plated brass binder head screw.

As a minimum, all connections to and from the electronic equipment shall terminate to an inter-wiring type block unless otherwise directed by the Engineer. These blocks will act as intermediate connection points for all electronic equipment inputs and outputs.

All return and equipment grounding wiring shall terminate to the ground bus installed in the cabinet.

Warning Labels

Contractor shall include warning labels required by applicable NFPA, ANSI, and UL standards. Warning labels shall comply with ANSI Z525.4 – Standard for Product Safety Signs and Labels. All panels with multiple power sources shall contain the warning "WARNING: Multiple power sources. Disconnect all sources prior to maintenance" or similar. Submit all label wording and layouts for approval prior to fabrication.

Cabinet Grounding

A solid copper ground bus bar shall be permanently affixed to the inside surface of a cabinet wall. The point of contact between the ground bus and cabinet wall shall have less than 1 ohm resistance. The copper ground bus bar shall have a minimum of 20 connector points, each capable of securing at least one #10 conductor. The ground bar shall also accommodate one #4 conductor for the main grounding connection. AC return and equipment ground wiring shall return to the ground bus bar. Cabinet shall have a grounding stud on the body and bonding provision on the door. Door shall be bonded to the body.

All cabinets shall be grounded in accordance with other sections of these Specifications. Work of this item shall include all materials required to properly ground the cabinets to the station ground grid at stations; or structural steel at PECK Bridge.

Power Line Surge Protector

A power line surge protector shall be installed in each cabinet between the load side of the input power circuit breaker and ground. The surge protector shall not dissipate any energy and shall not provide any series impedance during standby operation. The units shall return to non-shunting mode after the passage of any surge and shall not allow the shunting of AC power.

The surge protector shall have the following minimum characteristics:

Working Voltage: 120VAC Single Phase
Protection Mode: Common Mode (L/G and N/G) and Differential Mode (L/N)

Nominal UL Discharge Current (I_n, 8/20µs): 20kA
Maximum Discharge Current (I_{max}, 8/20µs withstand): 165kA
Maximum Discharge Current (I_{imp}, 10/350µs withstand): 50kA total
Short Circuit Current Rating: 100kA
UL 1449, Type 1/Type 2 Device
Fault Indicator Window
Operating Temperature: -40˚C to 80˚C

Base Mounted Cabinet Foundation and Concrete Pad Requirements

All materials labor and incidentals to install the Cabinets shall be included in these items, including foundations, surface preparation, excavation, drilling, channels, hardware and other items required for a complete installation.

All materials and construction methods shall conform to the applicable sections of the Standard Specifications Section 10.02 Light Standard and Traffic Control Foundations and Section 10.17 service Entrance and Cabinet.

Construction Methods:

The Plans indicate the extent and the general location and arrangement of the work. The Contractor shall study the plans and details so that the work will be properly located and readily accessible. If conflicts occur necessitating departures from the plans, the Contractor shall submit details of departures and reasons therefore shall be submitted as soon as practicable for written approval of the Engineer. Contractor shall ensure any rerouting required does not adversely affect the system.

Substitutions of products and materials of other Sections may affect cabinet size, layout, and equipment required in the cabinets. Contractor shall ensure all substitutions are coordinated with the design and the installation conforms to all Contract requirements and local codes.

Make field inspections necessary in order to prepare accurate shop drawings in accordance with existing conditions. Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation. Include plans, elevations, sections, details, and attachments as needed. Drawings should indicate site specific installation details including showing the exact equipment locations, mounting details, conduit runs, conduit entry, riser diagrams, wiring diagrams, and other details necessary for complete review. No cabinet shall be installed without an approved layout, wiring diagrams, and other associated shop drawings.

Mounting and other modifications shall not affect the NEMA 4X or 3RX rating of the enclosure.

Base Mounted Cabinets installed on station platforms and PECK Bridge shall require a concrete pad as indicated on the plans. All other Base Mounted Cabinets shall be installed on concrete

foundations. All mounting hardware shall be stainless steel and all installation methods shall conform to the requirement set forth in Connecticut DOT Standard Publication 816.

All materials labor and incidentals to install the Cabinets shall be included in these items, including foundations, excavation, drilling, grounding, surface preparation, channels, hardware and other items required for a complete installation.

Documentation

Each field cabinet shall be supplied with three (3) copies of the Final Cabinet Wiring Diagram. One (1) copy shall be placed in a clear plastic envelope and left in the cabinet. Two (2) copies shall be delivered to the Engineer.

Assembly

CCTV Cabinets shall be assembled in a controlled environment and factory tested before being delivered to the work site and installed. Refer to "NOTICE TO CONTRACTOR - Acceptance Testing" for additional information.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information. Testing shall include all components and wires installed in the cabinet and also the installation of the cabinet itself comply with contract specification and approved drawings.

Method of Measurement:

The work will be measured for payment by the actual number of each complete furnished, installed, inspected, and tested.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each unit furnished and installed, which price shall include all material, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
CCTV Cabinet – Base Mounted	Each
CCTV Cabinet – PECK Bridge	Each
CCTV Cabinet – Base Mounted Foundation	Each
CCTV Cabinet – Concrete Pad	Each

ITEM #1112237A – REMOTE CCTV CABINET
ITEM #1112247A – REMOTE SWITCH CABINET BASE

Descriptions:

Under this item, the Contractor shall furnish and install Remote CCTV Cabinets (Cabinets) at the locations shown in the plans and as directed by the Engineer. The cabinets are also referred to as "Remote Switch Cabinets."

The Cabinets shall house the CCTV field equipment supplied under this and other Contract items, including but not limited to remote CCTV switches, a duplex receptacle, light, surge suppression equipment and other equipment as shown in the Plans.

The Remote CCTV Cabinets shall not have internal components requiring ventilation and shall be rated NEMA Type 4X.

Materials:

The Cabinets shall be provided complete with all internal components and all mounting hardware necessary to provide for the installation of equipment as described in the plans and Contract Documents. Cabinets shall be sized as shown in the plans. Changes in Cabinet size to accommodate equipment proposed by the Contractor shall require approval by the Engineer.

Product Data: Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

The Contractor shall submit a detailed layout diagram for each type of Cabinet layout specified for review by the Engineer. Only Cabinets with approved layouts will be accepted under this Contract item.

Remote CCTV Cabinet Requirements

The Cabinet shall be constructed of 14 gauge Type 316L stainless steel, with fully welded seams, and measure approximately 24" wide x 24" tall x 10" deep. The cabinet shall be rated as a NEMA Type 4X enclosure. The Contractor shall coordinate final size of enclosure with all equipment to be installed and their required clearance.

All devices shall be hardwired. Plug-in devices are not acceptable.

All components incorporated into the cabinet shall have a minimum operational temperature range of -13˚F to 158˚F (-25˚C to 70˚C) unless otherwise noted.

The Cabinet shall have a continuously hinged full size door on the front, equipped with a heavy-

duty pad-lockable handle sized to fit a standard MNR communications padlock.

Provisions shall be made in the Cabinet for the installation of all equipment that is provided and installed inside the Cabinet under other Contract items.

In addition the following equipment shall be provided in all Cabinet configurations as part of this Contract item:

a) One main circuit breaker

b) One duplex receptacle (GFCI).

c) Surge protection for power lines

d) LED light that turns on when the door is opened.

e) Cabinet Finish - The cabinet exterior shall be smooth #4 brush finish.

f) Circuit breakers properly sized for the equipment to be installed in the cabinet.

g) Drawing pocket on door. Documentation shall be provided in a weather-protective sleeve/envelope or shall be laminated.

h) Tamper switch – A tamper switch shall be installed such that each door is monitored for door status. Tamper switches shall be wired to the alarm inputs of the Cisco switch installed in the cabinet and configured to report through the Network Monitoring System. Switches shall be wired in a normally closed configuration where the circuit opens when the door opens.

i) Protective Vent – Furnish a protective vent to equalize pressure within the sealed cabinet and reduce condensation within the enclosure to protect the electronic equipment. Vent shall meet the following requirements:

1. IP66, IP67, IP68, and IP69k rated
2. Operating temperature of -40˚C to 125˚C per IEC 60068-2-1, 60068-2-2, and 60068-2-14.
3. Humidity testing at 85˚C at 85% RH for 1000 hours per IEC 600-2-78.
4. Salt resistance per IEC 60068-2-11 and 60068-2-52.
5. Corrosive gas testing per GR-3108-CORE
6. Fungus resistance per ASTM G-21
7. UL 94-V0 f1 flammability and UV resistance
8. Hail impact resistance per IEC 62108 10.9
9. Humidity freeze withstand per IEC 62108 10.8
10. Shall be Gore Polyvent XL / M32x1.5 with backing nut or approved equal

Cabinets and their final configurations shall conform to requirements of the National Electrical Code (NFPA 70), National Electrical Safety Code, and all other local codes.

Electrical Requirements

Wiring

All cabinet wiring, where connected to terminal strips, relays, switches, radio interference suppressor, etc., shall be identified by the use of insulated pre-printed sleeving slipped over the wire before attachment of the lug or the completion of the connection. The wire markers shall carry the legend in plain words with sufficient details so that a translating sheet will not be required.

All wires shall be cut to the proper length before assembly. No wires shall be doubled back to take up slack. Wires shall be neatly laced into cables with nylon lacing and/or Velcro ties. Cables shall be secured with nylon cable clamps. Furnish and install a complete cable management system to control cable bend radius, provide strain relief, and provide a neat and workmanlike appearance.

All electrical connections in the cabinet, including relays, terminal strips, etc., shall have sufficient clearance between each terminal and the cabinet to provide an adequate distance to prevent a leakage path or physical contact under stress. Where these distances cannot be maintained, barriers must be provided. All equipment grounds shall run directly and independently to the ground bus. The interconnect cabling shall be routed such that when the doors are closed, they do not press against the cables or force the cables against the various components inside the cabinets.

All wiring containing AC line voltage shall be routed and bundled separately and/or shielded from all low voltage circuits. Clearances required by NFPA 70 (National Electrical Code) shall be maintained at all times.

All conductors and live terminals or parts which could be hazardous to maintenance personnel shall be covered with suitable insulating materials.

All wiring containing AC line voltage shall be a minimum size of #12 AWG and conform to XHHW-2 in accordance with other contract provisions. All other electrical conductors used in the cabinet wiring shall be #22 AWG or larger with a minimum of 19 strands. Conductors shall conform to Mil Spec #MIL-W-16878D, type B or D. All conductor specifications shall be coordinated with the equipment requirements. Cat 5e cabling shall conform to the requirements of other sections. Cabling that does not extend outside the cabinet, and all cabinet grounding cabling, shall be considered part of this Item and will not be paid separately.

The AC return and equipment ground wiring shall be electrically isolated from each other and the energized AC wiring by an insulation resistance of at least 10 Megaohms when measured at 250 VAC. Return and equipment grounding wiring shall be color coded white and green respectively.

GFCI Duplex Outlet

In addition to any outlets required for equipment service, all cabinets shall be furnished with a 125VAC convenience outlet with integral ground fault current interrupt (GFCI), protected by a circuit breaker. The receptacle shall be a NEMA Type 5-15R outdoor, weather-resistant duplex receptacle located so that no electrical hazard shall exist when used by service personnel.

Circuit Breaker(s)

The cabinet circuit breakers shall be approved and listed by Underwriter's Laboratories (UL 489). Supplemental breakers (UL 1077) are not acceptable. The operating mechanisms shall be enclosed, trip free from operating handle on overload, and trip indicating. Breakers shall have a minimum interrupt capacity of 10,000 amperes and be thermal-magnetic type.

Properly rated equipment circuit breaker(s) shall be provided for the equipment complement shown on the plans. Breaker sizes shown on plans are representative only and may vary based on equipment submitted and approved. Contractor shall coordinate all breaker sizes and curve characteristics with selected equipment and manufacturer recommendations.

Radio Interference Suppressor

All cabinets shall be equipped with a radio interference suppressor installed at the circuit breaker. The suppressor shall provide a minimum attenuation of 50 dB over a frequency range of 200 kHz to 75 MHz. The suppressor shall be hermetically sealed in a substantial metal case filled with a suitable insulation compound.

The suppressor terminals shall be nickel plated, brass studs of sufficient external length to provide space for connection of two appropriately sized conductors and shall be so mounted that the terminals cannot be turned in the case. The suppressors shall be designed for operation at 125 VAC, 60 Hz at the proper current rating as determined by the Contractor per the equipment complement as indicated on the plans. The suppressors shall meet applicable EIA specifications and shall be approved by UL.

Power Cable Input and Junction Terminals

Power distribution blocks suitable for use as a power feed and junction points shall be furnished and installed for two and three wire circuits as indicated on the plans. The line side of each circuit shall be capable of handling the number of wires required. Terminal blocks shall be sized to accommodate each wire required without a reducing splice. Splices shall only be performed where approved by the Engineer. Any splices performed in the cabinet shall be done via terminal blocks.

Terminal Blocks

Terminal blocks shall be accessible to the extent that it shall not be necessary to remove any electronic equipment from the cabinet to make an inspection or connection. Terminal blocks shall be two position multiple pole barrier type. Shorting bars shall be provided in each of the positions provided along with an integral marking strip. Terminal blocks shall be so arranged that they shall not upset the entrance, routing, and connection of incoming field conductors. All terminals shall be suitably identified by legends permanently affixed and attached to the terminal blocks. No electrically alive parts shall extend beyond the protection afforded by the barriers. Doubling up conductors on one terminal should be avoided and only performed where the terminals are listed for such purpose and approved by the Engineer. Use bridging clips or additional terminals as necessary.

AC terminal blocks shall be Underwriter's Laboratory approved for 600 Volts AC minimum and shall be suitable for outdoor use. Terminals used for field connections shall secure conductors by means of a #10-32 nickel or cadmium plated brass binder head screw. Terminals used for interwiring connections, but not for field connections, shall secure conductors by means of a #6-32 nickel or cadmium plated brass binder head screw.

As a minimum, all connections to and from the electronic equipment shall terminate to an inter-wiring type block unless otherwise directed by the Engineer. These blocks will act as intermediate connection points for all electronic equipment inputs and outputs.

All return and equipment grounding wiring shall terminate to the ground bus installed in the cabinet.

Warning Labels

Contractor shall include warning labels required by applicable NFPA, ANSI, and UL standards. Warning labels shall comply with ANSI Z525.4 – Standard for Product Safety Signs and Labels. All panels with multiple power sources shall contain the warning "WARNING: Multiple power sources. Disconnect all sources prior to maintenance" or similar. Submit all label wording and layouts for approval prior to fabrication.

Cabinet Grounding

A solid copper ground bus bar shall be permanently affixed to the inside surface of a cabinet wall. The point of contact between the ground bus and cabinet wall shall have less than 1 ohm resistance. The copper ground bus bar shall have a minimum of 20 connector points, each capable of securing at least one #10 conductor. The ground bar shall also accommodate one #4 conductor for the main grounding connection. AC return and equipment ground wiring shall return to the ground bus bar. Cabinet shall have a grounding stud on the body and bonding provision on the door. Door shall be bonded to the body.

All cabinets shall be grounded in accordance with other sections of these Specifications. Work of this item shall include all materials required to properly ground the cabinets to the station ground grid at stations; or structural steel at PECK Bridge.

Power Line Surge Protector

A power line surge protector shall be installed in each cabinet between the load side of the input power circuit breaker or fuse and ground. The surge protector shall not dissipate any energy and shall not provide any series impedance during standby operation. The units shall return to non-shunting mode after the passage of any surge and shall not allow the shunting of AC power.

The surge protector shall have the following characteristics:

Working Voltage: 120VAC Single Phase
Protection Mode: Common Mode (L/G and N/G) and Differential Mode (L/N)
Nominal UL Discharge Current (I_n, 8/20µs): 20kA
Maximum Discharge Current (I_{max}, 8/20µs withstand): 165kA
Maximum Discharge Current (I_{imp}, 10/350µs withstand): 50kA total
Short Circuit Current Rating: 100kA
UL 1449, Type 1/Type 2 Device
Fault Indicator Window
Operating Temperature: -40˚C to 80˚C

Remote Switch Cabinet Base Requirements

All materials labor and incidentals to install the Cabinets shall be included in these items, including foundations, surface preparation, excavation, drilling, hardware and other items required for a complete installation.

Where located on station platforms, remote CCTV cabinets shall have a stainless steel base as shown on the Plans, made of the same material with the same finish as the cabinet and by the same manufacturer, when available. The stainless steel base shall be mounted on 6" concrete pad.

All materials and construction methods shall conform to the applicable sections of the Standard Specifications Section 10.02 Light Standard and Traffic Control Foundations and Section 10.17 service Entrance and Cabinet.

Construction Methods:

The plans indicate the extent and the general location and arrangement of the work. The Contractor shall study the plans and details so that the work will be properly located and readily accessible. If conflicts occur necessitating departures from the plans, the Contractor shall submit details of departures and reasons therefore shall be submitted as soon as practicable for written approval of the Engineer. Contractor shall ensure any rerouting required does not adversely affect the system.

Substitutions of products and materials of other Sections may affect cabinet size, layout, and equipment required in the cabinets. Contractor shall ensure all substitutions are coordinated with the design and the installation conforms to all Contract requirements and local codes.

Make field inspections necessary in order to prepare accurate shop drawings in accordance with existing conditions. Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation. Include plans, elevations, sections, details, and attachments as needed. Drawings should indicate site specific installation details including showing the exact equipment locations, mounting details, conduit runs, conduit entry, riser diagrams, wiring diagrams, and other details necessary for complete review. No cabinet shall be installed without an approved layout, wiring diagrams, and other associated shop drawings.

Mounting and other modifications shall not affect the NEMA 4X rating of the enclosure.

The Remote CCTV Cabinets shall be installed at the locations shown in the plans. Cabinets mounted on station platforms require a concrete pad and stainless steel base. All mounting hardware shall be stainless steel and all installation methods shall conform to the requirement set forth in Connecticut DOT Standard Specifications Form 816.

All materials labor and incidentals to install the Cabinets shall be included in these items, including foundations, excavation, drilling, surface preparation, channels, hardware and other items required for a complete installation.

Documentation

Each field cabinet shall be supplied with three (3) copies of the Final Cabinet Wiring Diagram. One (1) copy shall be placed in a clear plastic envelope and left in the cabinet. Two (2) copies shall be delivered to the Engineer.

Assembly

Remote CCTV Cabinets shall be assembled in a controlled environment and factory tested before being delivered to the work site and installed. Refer to "NOTICE TO CONTRACTOR -

Acceptance Testing" for additional information.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information. Testing shall include all components and wires installed in the cabinet and also the installation of the cabinet itself comply with contract specification and approved drawings.

Method of Measurement:

Remote CCTV Cabinet will be measured for payment by the number of "Each" complete furnished, installed, inspected, grounded, and tested.

Remote Switch Cabinet Base will be measured for payment by the number of "Each" complete furnished, installed, inspected, grounded, and tested.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each "Remote CCTV Cabinet" and "Remote Switch Cabinet Base" furnished and installed, which price shall include all material, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
Remote CCTV Cabinet	Each
Remote Switch Cabinet Base	Each

ITEM #1112241A – FIBER OPTIC CABLE SPLICE ENCLOSURE

Description:

The Contractor shall furnish Fiber Optic Splice Enclosures to be installed aerially, in manholes, splice/pull boxes or at other locations as shown in the Contract Documents or as indicated by the Engineer.

The Splice Enclosures shall be purchased by the Contractor and supplied to MNR at the direction of the Engineer. MNR will install the Splice Enclosures at the locations shown in the Plans. It shall be responsibility of the Contractor to ensure the Splice Enclosure is sized for the number of splices as required by the design and as outlined in this specification.

The Splice Enclosures shall be supplied with all sleeves, hole hardware, attachment hardware, splice trays, and all other items as required for a complete installation.

Materials:

Splice Enclosure:

The Fiber Optic Splice Enclosures shall be Optical Cable Corporation FG8-6S or equivalent, meeting the following specifications:

The Fiber Optic Splice Enclosures shall be weather tight suitable for uncontrolled environments.

The Fiber Optic Splice Enclosures shall have four individual, self-sizing grommeted cable ports.

The Fiber Optic Splice Enclosures shall have cable retention clamps to provide pullout rating required by Telcordia.

The Fiber Optic Splice Enclosures shall meet Telcordia aerial and UV resistance requirements.

The Fiber Optic Splice Enclosures shall be Rural Utility Service (RUS) Listed.

Hardware:

Splice sleeves shall be 3M part number 2170 or equivilant.

Hole hardware shall be 3M part number FGD-1H or equivalent.

Construction:

The Contractor shall submit manufacturers cut sheets to be approved by the Engineer.

Method of Measurement:

The Fiber Optic Cable Splice Enclosure shall be measured as the actual number of "Each" furnished and accepted by the Engineer, and transferred to MNR Communications Department.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each "Fiber Optic Cable Splice Enclosure" furnished, accepted by the Engineer and transferred to MNR, which price shall include all material, tools, equipment, labor, and work incidental thereto to complete the work.

Pay Item	**Pay Unit**
Fiber Optic Cable Splice Enclosure	Each

ITEM #1112243A – FIBER OPTIC CABLE STORAGE "SNOW SHOE"

Description:

This item shall consist of furnishing Aerial Fiber Optic Cable Storage "Snow Shoe" at the locations shown on the plans or as indicated by the Engineer.

The Snow Shoes shall be purchased and installed by the Contractor at the locations shown in the Plans. It shall be responsibility of the Contractor to ensure each Snow Shoe is sized for the quantity and type of cable as required by the design and as outlined in these Specifications.

Applicable Standards:

ASTM F2160, ASTM D3350

Materials:

The Aerial Fiber Optic Cable Storage shall meet the following requirements:

1. The Aerial Fiber Optic Cable Storage shall be aluminum Opti-Loop® or equivalent for strand/messenger cable application.
2. The Aerial Fiber Optic Cable Storage shall be all aluminum construction with continuous welds at crossbars and ends.
3. The Aerial Fiber Optic Cable Storage shall have dual coat baked on polyester power coat finish.
4. The Aerial Fiber Optic Cable Storage shall have tie eyelets to accommodate both stainless steel and tie wrap securing methods.
5. The Aerial Fiber Optic Cable Storage shall have radius ends to ensure no sharp corners.
6. The Aerial Fiber Optic Cable Storage shall have minimal surface are to minimize tree and ice loading.

Construction Method:

The Contractor shall submit shop drawings and product data to the Engineer for approval prior to supplying this item.

Method of Measurement:

This work shall be measured for payment by the actual number of "Each" purchased, installed, and accepted by the Engineer.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each for "Fiber Optic Cable Storage Snow Shoe" furnished, installed, and accepted by the Engineer, which price shall include all material, tools, equipment, labor, and work incidental thereto to complete the work.

Pay Item	**Pay Unit**
Fiber Optic Cable Storage "Snow Shoe"	EA

ITEM #1112244A – REMOVAL, STORAGE, AND TRANSFER OF CCTV EQUIPMENT

Description:

This work shall consist of removing, storing, and turning over to Connecticut Department of Transportation the CCTV surveillance equipment being replaced in accordance with the plans, specifications or as directed by the Engineer.

Equipment to remove includes all items associated with the CCTV system that is being replaced or removed. These items include the following items called out in the plans or as directed by the Engineer:

CCTV Cameras

CCTV Mounts

CCTV Cabinets

CCTV Power Supplies

CCTV Poles

Digital Video Recorders

Conduits and Cables

Associated Supports

Cameras, mounts, power supplies, cabinets, and other accessories shall be removed and stored. The Contractor shall provide a detailed inventory of all materials removed. Items such as conduit, junction boxes, fittings, etc. may be disposed of as directed by the Engineer. The Contractor shall package and deliver all materials requested by the Connecticut Department of Transportation as directed by the Engineer. All digital video recorders shall be turned over to Metro North Security. All other items shall be properly disposed of by the Contractor only after permission from the Engineer.

Certain elements of the existing CCTV system will remain in place to facilitate the integration of legacy analog cameras into the new CCTV system as shown in the plans. Relocation of existing elements to remain will be paid by Item #1108721A – Video Encoder specified elsewhere. Temporary relocations of existing equipment required for proper staging and phasing of the work shall be included in the work of this section.

Materials:

All of the work, materials, labor, storage and all other costs that are required to complete the work described in this specification for the removal of the existing CCTV and related components shall be included in this item.

Construction Methods:

All provisions outlined in these Contract Documents shall be complied with in addition to the following:

Care shall be exercised in removing equipment and any appurtenances attached to them so that elements to remain, including but not limited to conduits, junction boxes, poles or mounting surfaces, will not be damaged.

The contractor will be required to replace or repair, to the satisfaction of the Engineer, any equipment damaged, destroyed or lost due to the contractor's operations or negligence as determined by the Engineer.

All holes in materials to remain resulting from this work shall be plugged, sealed, and/or backfilled with suitable material and restored to match the adjacent surface as approved by the Engineer.

Method of Measurement:

The Contractor shall submit to the Engineer for acceptance a breakdown of its lump sum bid price for this item. If the lump sum bid price is unacceptable to the Engineer, substantiation showing that the submitted price costs are reasonable shall be required.

The lump sum bid price breakdown shall show Contractor costs per station, platform, or other location. The Contractor shall be reimbursed for the item as the work is completed at each station, platform, or other location and the equipment is removed, and transfer is carried out as outlined in this specification and approved by the Engineer.

Basis of Payment:

The quantity to be paid for under this item(s) will be the total cost for the removal of all elements actually relocated, removed, stored, disposed of or turned over to Connecticut Department of Transportation as shown on the plans or in the contract documents.

Pay Item	**Pay Unit**
Removal, Storage and Transfer of CCTV Equipment	Lump Sum

ITEM #1112248A – 60W PoE POWER INJECTOR
ITEM #1112249A – PTZ POWER SUPPLY

Description:

The Contractor shall furnish and install PTZ power supplies and 60W PoE (Power over Ethernet) Injectors as shown in the Plans and Contract Documents to provide 60W power to the PTZ cameras via Ethernet cable.

Materials:

The Contractor shall furnish and install a PTZ Power Supply conforming to the following minimum requirements:

Nominal output voltage:	24 or 48 VDC
Rated output power:	120 watts (minimum of 100 watts)
Efficiency:	90%+
Input voltage:	88-264 VAC
Typ. input current:	1.4A (115VAC)
Working temp/humidity:	-40 to 70˚C (-40 to 158˚F)/100% non-condensing
MTBF:	>289,000 hours

UL 508 listed

The Contractor shall furnish and install a 60W PoE Injector conforming to the following minimum requirements:

Input voltage:	24 or 48VDC
Rated output power:	60 watts
Power consumption:	4.8 watts max
Housing protection:	IP30
Working temp/humidity:	-40 to 75˚C (-40 to 167˚F)/5-95% non-condensing
MTBF:	>2,400,000 hours
Input ports:	RJ-45 (10/100/1000BaseT) data, hardwired power
Output ports:	RJ-45 (10/100/1000BaseT) 60W PoE out
Surge resistance:	3kV

Conforms to IEEE 802.3af/at, 802.3 for 10BaseT, 802.3u for 100BaseT, 802.3ab for 1000BaseT
UL 508 listed, EN60950-1
External LED Indicators, overload current protection, reverse polarity protection

Product Data: Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation. Include plans, elevations, sections, details, and attachments as needed.

Substitutions of products and materials of other Sections may affect product requirements. Contractor shall ensure all substitutions are coordinated with the design and the installation conforms to all Contract requirements and local codes.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information. Prior to installation, the PTZ power supplies and 60W PoE Injectors shall be factory tested to ensure compatibility with the approved PTZ camera. At a minimum, the following tests shall be included: verification that devices are installed per approved drawings and manufacturer recommendations, and verification of proper voltage output from the power supply. Any tests recommended by the manufacturer shall also be included.

Construction Methods:

Each PTZ power supply and 60W PoE Injector shall be installed at the locations as shown in the Plans. Furnish and install all required mounting brackets, mounting hardware, wiring, and other accessories required for complete installation.

PTZ power supply and 60W PoE Injector shall be hardwired.

Method of Measurement:

PTZ power supplies and 60W PoE injectors shall be measured for payment by the number of "Each" furnished, installed, inspected, and tested.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each "PTZ Power Supply" and "60W PoE Power Injector" furnished and installed, which price shall include all material, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
PTZ Power Supply	Each
60W PoE Power Injector	Each

ITEM #1112255A – IR ILLUMINATOR POWER SUPPLY – RACK MOUNT

Description:

The Contractor shall furnish and install rack mount power supplies as shown in the Plans and Contract Documents to provide 24VAC/28VAC power to the IR illuminators.

Materials:

The Contractor shall furnish and install a Rack Mount IR Illuminator Power Supply conforming to the following material requirements:

Chassis for installation in a standard EIA 19" equipment rack that will be provided in the CCTV Equipment Cabinets. Each IR Illuminator Power Supply shall use no more than 2U of rack space.

Front panel LED lights indicating the status of each of the power supply outputs.

Terminal blocks with locking screw flanges for terminating power cables on the rear of the power supply.

Power supply shall be UL listed.

Electrical Requirements

Input Power
115VAC, 60Hz
6 Amp Power Consumption (690VA)

Output Power
25A at 24VAC (600VA) or 20A at 28VAC (560VA)
Number of outputs: 16
Class 2 rated outputs (2.5 amps each)

Operating Temperature: 0˚C to 49˚C ambient

All power connections (both input and output) shall be hardwired.

Product Data: Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation. Include plans, elevations, sections, details, and attachments as needed.

Substitutions of products and materials of other Sections may affect power supply requirements. Contractor shall ensure all substitutions are coordinated with the design and the installation conforms to all Contract requirements and local codes.

Construction Methods:

Each IR Illuminator Power Supply – Rack Mount shall be installed at the locations as shown in the Plans. Ensure power supply rating is not exceeded.

All power connections (both input and output) shall be hardwired.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information. At a minimum, the following tests shall be included: verification of proper installation of equipment per approved drawings and manufacturer recommendations, test voltage of all the power supply outputs meet specification and configuration. Any tests recommended by the manufacturer shall also be included.

Method of Measurement:

IR Illuminator Power Supply – Rack Mount shall be measured for payment by the number of "Each" furnished, installed, inspected, and tested.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each "IR Illuminator Power Supply – Rack Mount" furnished and install, which price shall include all material, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
IR Illuminator Power Supply – Rack Mount	Each

ITEM #1112256A – POE SURGE PROTECTION CHASSIS – RACK MOUNT
ITEM #1112257A – POE SURGE PROTECTION CHASSIS – WALL MOUNT
ITEM #1112258A – POE SURGE PROTECTION MODULE

Description:

The Contractor shall furnish and install PoE (Power over Ethernet) surge protectors as shown in the Plans and Contract Documents to protect the Cisco switches from power surges through the data lines. Rack mounted surge protectors shall be provided in racks, CCTV cabinets, and other locations identified in the Plans. Wall mounted surge protectors shall be provided in Remote CCTV cabinets. For Ethernet devices connected that do not use PoE, provide non-PoE surge protection modules of the same type.

Materials:

The Contractor shall furnish and install Ethernet surge protectors conforming to the following minimum requirements:

Agency approval:	UL497 (primary) and UL 497B (isolated loop)
Response time:	1-5 nanoseconds
Port type:	RJ-45 in and out, Category 6 Ethernet, all wires shall be protected
Clamping Level:	75V for PoE or 16V for non-PoE
Capacitance:	<20pF

Products shall be provided with lifetime warrantee from the manufacturer and $5000 connected equipment warranty.

Rack mounted units shall accommodate up to 12 devices and be 1U (1.75” high). Wall mounted units shall accommodate up to 6 devices and shall be 10.25”H x 4”W x 2.1”D. PoE surge protection modules shall be modular, allowing each to be populated as needed or changed in the event of failure.

Product Data: Submit Manufacturer’s literature and catalog cuts for all products/materials to the Engineer for review and approval.

Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation. Include plans, elevations, sections, details, and attachments as needed.

Substitutions of products and materials of other Sections may affect product requirements. Contractor shall ensure all substitutions are coordinated with the design and the installation conforms to all Contract requirements and local codes.

Construction Methods:

Each surge protection chassis shall be installed at the locations as shown in the Plans. Populate as required for each location plus least 2 spare PoE devices. In locations where providing 2 spare would require another chassis, chassis shall be fully populated and the additional spare chassis is not required. Furnish and install all required mounting brackets, mounting hardware, wiring, and other accessories required for complete installation.

Module shall be grounded in accordance with manufacturer instructions and recommendations with a #6 AWG conductor minimum. Contractor shall test and verify ground connection.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information. At a minimum, the following tests shall be included: verification the surge protector is installed per approved drawings and manufacturer recommendations, and verification of proper grounding of the surge protectors. Any tests recommended by the manufacturer shall also be included.

Method of Measurement:

Rack mounted PoE surge protector chassis, wall mounted PoE surge protector chassis, and PoE surge protection modules shall be measured for payment by the number of "Each" furnished, installed, inspected, and tested. Item "PoE Surge Protection Module" shall include both PoE and non-PoE Ethernet surge protection modules as required.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each "PoE Surge Protection Chassis – Rack Mount" and "PoE Surge Protection Chassis – Wall Mount" and "PoE Surge Protection Module" furnished and installed, which price shall include all material, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
PoE Surge Protection Chassis – Rack Mount	Each
PoE Surge Protection Chassis – Wall Mount	Each
PoE Surge Protection Module	Each

ITEM #1112263A – CCTV POLE TYPE B – STRAIGHT POLE
ITEM #1112253A – CCTV POLE TYPE C – DUAL CAMERA MAST ARM
ITEM #1112254A – CCTV POLE TYPE D – MAST ARM

Description:

This item consists of furnishing and installing a CCTV pole at each location as shown in the plans. The poles shall be either a straight pole, or a mast arm pole for overhanging the platform. The poles shall be designed as shown in the Plans and as described in these Specifications.

Materials:

The CCTV Poles shall be constructed of aluminum and shall conform to the following requirements:

Pole Material

Seamless, extruded structural aluminum square tube complying with ASTM B 429/B 429M, Alloy 6063-T6 with two access handholes in pole wall.

Shape

The pole shall be square without taper

Mounting Provisions

When applicable, mast arms shall be welded directly to face of CCTV pole. Aluminum welding shall conform to AWS D1.2. Flange for bolted mounting as shown on the Plans. All fastening hardware shall be stainless steel.

Pole Base

The pole shall be fully welded to a cast aluminum, alloy 356-T6 base plate, sized to the dimensions shown in the Plans. All anchors and associated hardware shall be stainless steel. Anchor rods shall conform to ASTM A193 Grade B8M, and nuts shall conform to ASTM A194 Grade 8M. All pole bases shall be provided with base covers, which shall completely enclose the base plate and anchoring hardware so as to prevent any exposure to the outside environment. Grout shall be of non-shrink type and in accordance with Form 816, Section M.03.01.12.

Handholes

The pole shall have two access handholes in pole wall, not blocking or interfering with equipment to be installed on the pole.

Finish

The poles shall be powder coated to match the color of the existing poles where they will be installed. All colors shall be approved by the Engineer prior to having the finish applied to the poles.

Construction Methods:

The Contractor shall submit shop drawings for CCTV poles prior to supplying this item. The material, construction, color and all details of the poles construction must be approved by the Engineer.

Contractor shall coordinate devices to be mounted on the poles with surrounding area and requirements of other sections of the Contract Documents. Coordinate with the pre-installation camera surveys and shop drawing requirements of the CCTV cameras.

Each pole shall include a 6" concrete pad as shown in the Plans. Concrete pads shall be reinforced with welded steel wire fabric using 2" minimum cover.

All poles shall be grounded in accordance with other sections of these Specifications. Work of this item shall include all materials required to properly ground the poles to the station ground grid at stations; or structural steel at PECK Bridge.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information. As part of the Field Installation Testing, Contractor shall verify poles and devices mounted to poles are installed in accordance with approved shop drawings and manufacturer instructions.

Method of Measurement:

CCTV Pole of type specified shall be measured for payment by the number of "Each" furnish, approved, installed, grounded, inspected, and accepted.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each for "CCTV Pole Type Specified", which price shall include full compensation for all materials and other incidentals needed to complete the work.

Pay Item	**Pay Unit**
CCTV Pole Type B – Straight Pole	Each
CCTV Pole Type C – Dual Camera Mast Arm	Each
CCTV Pole Type D – Mast Arm	Each

ITEM #1113033A – 4 STRAND SINGLE-MODE FIBER OPTIC CABLE
ITEM #1113042A – 144 STRAND SINGLE-MODE FIBER OPTIC CABLE
ITEM #1113043A – 24 STRAND SINGLE-MODE FIBER OPTIC CABLE
ITEM #1113912A – INSTALL EXISTING FIBER CABLES THROUGH CONDUITS

Description:

The Contractor shall furnish and install the fiber optic cabling at the locations shown on the plans or as indicated by the Engineer. 144-fiber and 24-fiber cables shall be Gel-Free Loose Tube construction. 4-fiber cables shall be tight buffered construction.

Any other ancillary components required to form a complete fiber optic cable plant, including but not limited to, moisture and water sealants, cable caps, fan-out kits, etc., shall be supplied under these items for fiber optic cable and will not be paid for separately.

All materials required for complete installation shall be provided by the Contractor unless otherwise noted. Fiber optic splicing and field-connectorizing will be performed by Metro-North. The Contractor shall furnish all consumables required for fiber optic splicing and terminating. Provide at least 20% spare. All other work shall be performed by the Contractor unless specifically noted otherwise.

In some locations, fiber cables will be provided by others. These cables will either be furnished to the contractor, left coiled on a catenary structure, or left at other locations as shown on the Plans. These fiber cables shall be installed through conduits as shown on the plans or as directed by the Engineer. Conduits installed under this contract will be paid under other items. All Contract requirements for new fiber cables shall apply to existing fiber cables.

Available Standards:

ANSI/IDEA, IEC, RUS, Telcordia GR-20

Materials:

Product Data: Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

The 144 Strand Single-Mode Fiber Cable shall be Corning ALTOS® p/n 144EU4-T4101D20 or approved equal.

The 24 Strand Single-Mode Fiber Cable shall be Corning ALTOS® p/n 024EU4-T4101D20 or approved equal.

The 4 Strand Single-Mode Fiber Cables shall be Corning FREEDM® p/n 004E8F-31131-29 or approved equal.

Functional Requirements:

All fibers within a cable must be usable and meet required specifications.

A. Single Mode Loose Tube

1. Optical Requirements

Fiber Type	Single-mode
Fiber Core Diameter	9 µm (nominal)
Fiber Category	OS2
Fiber Code	E
Performance Option Code	01
Wavelengths	1310 nm / 1383 nm / 1550 nm
Maximum Attenuation	0.4 dB/km / 0.4 dB/km / 0.3 dB/km

2. Mechanical Requirements

Max. Tensile Strengths, Short-Term	600 lbf
Max. Tensile Strengths, Long-Term	200 lbf
Weight	144 Fiber – 109 lb/1000 ft 24 Fiber – 49 lb/1000ft
Nominal Outer Diameter	144 Fiber – 0.62 in 24 Fiber – 0.41 in
Min. Bend Radius Installation	144 Fiber – 9.3 in 24 Fiber – 6.2 in
Min. Bend Radius Operation	144 Fiber – 6.2 in 24 Fiber – 4.1 in

Central Element	Dielectric
Fiber Count	24 or 144
Fiber Coloring	Blue, Orange, Green, Brown, Slate, White, Red, Black, Yellow, Violet, Rose, Aqua
Fibers per Tube	12
Number of Active Tubes	2 or 12
Buffer Tube Color Coding	24 Fiber - Blue, Orange 144 Fiber - Blue, Orange, Green, Brown, Slate, White, Red, Black, Yellow, Violet, Rose, Aqua

Buffer Tube Diameter	0.1 in
Number of Filling Elements	24 Fiber – 4 144 Fiber – 0
Tape	Water-swellable
Number of Ripcords	1
Outer Jacket Material	Polyethylene (PE)
Outer Jacket Color	Black

3. Environmental Characteristics

Storage	-40°C to 70°C (-40°F to 158°F)
Installation	-30°C to 70°C (-22°F to 158°F)
Operation	-40°C to 70°C (-40°F to 158°F)

B. Single Mode Tight Buffered

1. Optical Requirements

Fiber Type	Single-mode
Fiber Core Diameter	9 µm (nominal)
Fiber Category	OS2
Fiber Code	E
Performance Option Code	31
Wavelengths	1310 nm / 1383 nm / 1550 nm
Maximum Attenuation	0.65 dB/km / 0.65 dB/km / 0.5 dB/km

2. Mechanical Requirements

Max. Tensile Strengths, Short-Term	150 lbf
Max. Tensile Strengths, Long-Term	45 lbf
Weight	16 lb/1000 ft
Nominal Outer Diameter	0.22 in
Min. Bend Radius Installation	3.2 in
Min. Bend Radius Operation	1.1 in

Central Element	Dielectric
Fiber Count	4
Tight Buffer Coloring	Blue, Orange, Green, Brown
Tensile Strength Elements	Water-Swellable Strength Yarns
Number of Active Tubes	2 or 12
Cladding	125 µm
Tight Buffer Diameter	900 ± 50 µm
Outer Jacket Material	Flame-Retardant, UV-Resistant
Outer Jacket Color	Black

3. Environmental Characteristics

Storage	-40°C to 70°C (-40°F to 158°F)
Installation	-10°C to 60°C (14°F to 140°F)
Operation	-40°C to 70°C (-40°F to 158°F)

C. Field-Terminated LC Connectors (for tight buffered cable)

1. Verify type of connector required for all field devices. Contractor shall provide fiber connectors compatible with approved fiber and attached devices.

Fiber Category	OS2
Nominal Fiber Outer Diameter	125 µm
Insertion Loss	0.2 dB typical, 0.5 dB max
Reflectance	<= -55dB
Operating Temp	-40°C to 75°C (-40°F to 167°F)
Durability	<= 0.2dB change by 500 rematings
Intermateability	TIA/EIA 604-10 and IEC61754-20
Approvals	EIA/TIA 568-B.3
Material	Ceramic Ferrule, Composite Housing

Corning UniCam Connector, LC (OS2) or approved equal.

Construction Method:

The Contractor shall adhere to the following guidelines for installation, testing and documentation.

Installation in Conduit or Aerial Innerduct

The cable pulling operation shall be performed such that a minimum bending of the cable shall occur in the unreeling and pulling operations. Entry guide chutes shall be used to guide the cable into the pullbox conduit ports. Lubricating compound shall be used to minimize friction. Corner rollers (wheels), if used, shall not have radii less than the minimum installation bending radius of the cable. A series array of smaller wheels can be used for accomplishing the bend if the array is specifically approved by the cable manufacturers. The pulling tension shall be continuously measured and shall not be allowed to exceed the maximum tension specified by the manufacturer of the cable, or fuse links and breaks shall be used to ensure that the cable tensile strength is not exceeded. The pulling system shall have an audible alarm that shall sound whenever a preselected tension level is reached. Tension levels shall be recorded continuously and shall be given to the Engineer upon request.

Pullboxes shall be installed by the Contractor as needed and as indicated on the Plans. The Contractor may be required to install the cable one pullbox at a time. The direction of the cable pull shall be determined by the Contractor with adherence to any staging and sequencing plans and track outage requirements dictated by MNR and shall require the approval of the Engineer. Pullboxes shall be considered incidental to the associated conduit system. No additional payment will be made.

Connectorizing the fibers and splicing to patch panel pigtails will be performed by Metro-North. It shall be responsibility of the Contractor to provide all materials including connectors, sleeves, and hardware and ancillary items as required for a complete installation as shown in the plans.

Cables shall be left in an accessible location for MNR to perform splicing or connectorizing. Provide slack at each splice/termination point.

Prior to installing any existing cables, verify the length of the cable is suitable for the location and purpose to be installed including slack for splicing or termination. No payment will be made for existing cables installed that are found to be too short for its intended purpose, and shall be removed by the contractor at no additional cost to the Department.

Documentation Requirements

Installation Practices for Outdoor Fiber Optic Cable Systems Documentation

The Contractor shall examine the proposed cable plant design. At least one month prior to starting installation of the fiber optic cable plant, the Contractor shall submit to the Engineer for approval ten (10) copies of the Contractor's "Installation Practices for Outdoor Fiber Optic Cable Systems" manual. This manual shall address the Contractor's proposed practices covering all aspects of the fiber optic cable plant.

This submittal shall include all proposed procedures and list of installation equipment. Test and quality control procedures shall be detailed as well as procedures for corrective action.

Shop Drawings

Submit shop drawings coordinated with conduit/innerduct layout shop drawings and all other work for approval prior to performing any installation.

Test Procedures

In accordance with these Specifications, and the "NOTICE TO CONTRACTOR – ACCEPTANCE TESTING", submit test plan and procedures for approval prior to testing.

Operation and Maintenance Documentation

After the fiber optic cable plant has been installed, ten (10) complete sets of Operation and Maintenance Documentation shall be provided. The documentation shall, as a minimum, include the following:

Complete and accurate as-built diagrams showing the entire fiber optic cable plant including locations of all splices.
Complete parts list including names of vendors.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information.

Contractor shall provide all labor, material, instruments, and apparatus for all tests. Fiber optic testing personnel shall be experienced, trained, and certified to perform fiber optic tests. All work shall be performed in accordance with these guidelines, current industry testing standards, and the test equipment manufacturer's recommendations. Testing equipment shall have valid calibration certificate.

Factory Tests:

Fiber optic cables shall be tested by the manufacturer prior to shipping. This does not apply for existing cables furnished by others.

Pre-Installation Tests:

Prior to installation, the contractor shall inspect the cable for visual damage. The Contractor shall perform an OTDR test on any new reel of fiber optic cable before it is installed. These measurements shall ensure that all strands have continuity for the full length of the reel and proper loss requirements.

Tests shall also be performed on existing fibers to establish baseline performance. Pre-installation tests for existing cables (or cables provided by others) shall mimic post-installation test described below. Should the Contractor not perform pre-installation testing, the Contractor shall be responsible to replace the damaged cable at their expense if it is found to be defective after installation.

If pre-installation testing indicates any potential break, failure, or other compromise, immediately notify the Engineer. Do not install any damaged cables.

Post-Installation Test:

The Contractor shall test the fiber bi-directionally with both Light Source/Power Meter (LS/PM) method (Optical Loss Test Set may be substituted for LS/PM) and OTDR method after installation, prior to splicing and termination by MNR. Should it be determined by the Engineer that the fiber cable was damaged during installation, it shall be replaced at the Contractor's expense. Certified test reports shall be provided for each test. The results shall meet EIA/TIA 568 recommended standards for fiber optics at the minimum. Tests shall be performed at 1310nm, 1550nm, and 1625nm frequencies in both directions for single mode fiber. Overall loss profile of the cable span should be

preserved and recorded by obtaining hard copy and electronic copy from the test equipment.

Contractor shall supply Certified Test Results all test results in electronic form and paper form.

Method of Measurement:

The Fiber Optic Cables shall be measured for payment by the actual number of "Linear Feet" for each type installed, tested, and accepted as outlined in these Specifications and elsewhere in the Contract Documents.

The Contractor shall be responsible for testing the fiber optic cable and providing test results to the Engineer for approval as outlined in the Specifications and elsewhere within the Contract Documents.

"Install Existing Fiber Cables Through Conduits" shall be measured for payment by the actual number of "Linear Feet" of cable installed in conduit, duct, or innerduct; from conduit (or duct) termination point to conduit (or duct) termination point. Coils at the end of fiber shall not be counted in calculating this item.

Basis of Payment:

Fiber Optic Cables shall be paid at the contract unit price per "LF", which price shall include all materials, labor, equipment and incidentals required to install the 144, 24, and 4 strand Fiber Optic Cables and complete the work as shown in the Plans or as directed by the Engineer.

Installing Existing Fiber through Conduits shall be paid at the contract unit price per "LF", which price shall include all materials, labor, equipment, and incidentals required to install the existing cables and complete the work as shown in the Plans or as directed by the Engineer.

Pay Item	**Pay Unit**
144 Strand Single-Mode Fiber Optic Cable	LF
24 Strand Single-Mode Fiber Optic Cable	LF
4 Strand Single-Mode Fiber Optic Cable	LF
Install Existing Fiber Cable Through Conduits	LF

ITEM #1113911A – MODIFICATION OF EXISTING RACK

Description:

Under this item, the Contractor shall furnish and install equipment typically installed in CCTV Cabinets in existing racks, racks provided by MNR, and/or racks provided elsewhere in the Specifications at the locations shown in the plans and as directed by the Engineer, such as Bridgeport Station Westbound IT Room, PECK Bridge Basement, and Fairfield Metro Station Eastbound Electrical Room.

Head-end equipment installed in existing racks shall be paid under work of Item #1108871A – Video Management System specified elsewhere. The relocation and/or integration of existing equipment to remain shall be paid under work of Item #1108721A – Video Encoder specified elsewhere. Removal of existing equipment, including temporary relocations required for proper staging and phasing, shall be paid under Item #1112244A – Removal, Storage, and Transfer of CCTV Equipment specified elsewhere.

The existing racks shall house the CCTV field equipment supplied under this and other Contract items, including but not limited to fiber optic patch panels, power supplies, communications equipment and surge suppression equipment.

Materials:

The Contractor shall provide all internal components with all mounting hardware necessary to provide for the installation of equipment as described in the plans and Contract Documents.

The Contractor shall submit a detailed layout diagram for each layout specified for review by the Engineer. Only racks with approved layouts will be accepted under this Contract item.

Product Data: Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

General Rack Requirements

All devices shall be hardwired. Plug-in devices are not acceptable unless otherwise noted.

Cabinets and their final configurations shall conform to requirements of the National Electrical Code (NFPA 70), National Electrical Safety Code, and all other local codes.

Provisions shall be made in the Cabinet for the installation of all equipment that is provided and installed inside the Cabinet under other Contract items.

In addition, the following equipment shall be provided in all rack configurations as part of this Contract item:

a) One main circuit breaker

b) Duplex ground fault current interrupter convenience outlet, outdoor rated (not required at Bridgeport Station or PECK Bridge)

c) Surge protection for power lines and signal wires

d) One anodized aluminum drawer that shall slide into and out of the rack to house cabinet and equipment documentation or data pocket on door. Documentation shall be provided in a weather-protective sleeve/envelope or shall be laminated.

e) Tamper switch – Tamper switches shall be installed such that each door is monitored for door status. Tamper switches shall be wired to the alarm inputs of the Cisco switch installed in the cabinet and configured to report through the Network Monitoring System. Switches shall be wired in a normally closed configuration where the circuit opens when the door opens.

f) Power Distribution Unit – At Bridgeport Station, where required for support of existing equipment, furnish and install a power distribution unit. Unit shall provide output of at least twelve (12) receptacles. Coordinate receptacle types with equipment to be plugged in. Unless otherwise required by the equipment, PDU shall provide NEMA 5-15R or NEMA 5-20R receptacles. Coordinate plug type for PDU input with existing receptacle on cable tray above rack.

Where equipment requires rear access and existing rack does not provide access to the back, provide equipment on sliding rails.

Electrical Requirements

Wiring

All cabinet wiring, where connected to terminal strips, relays, switches, radio interference suppressor, etc., shall be identified by the use of insulated pre-printed sleeving slipped over the wire before attachment of the lug or the completion of the connection. The wire markers shall carry the legend in plain words with sufficient details so that a translating sheet will not be required.

All wires shall be cut to the proper length before assembly. No wires shall be doubled back to take up slack. Wires shall be neatly laced into cables with nylon lacing and/or Velcro ties. Cables shall be secured with nylon cable clamps. Furnish and install a complete cable management system to control cable bend radius, provide strain relief, and provide a neat and workmanlike appearance.

All electrical connections in the cabinet, including relays, terminal strips, etc., shall have sufficient clearance between each terminal and the cabinet to provide an adequate distance to prevent a leakage path or physical contact under stress. Where these distances cannot be maintained, barriers must be provided. All equipment grounds shall run directly and

independently to the ground bus. The interconnect cabling shall be routed such that when the doors are closed, they do not press against the cables or force the cables against the various components inside the cabinets.

All wiring containing AC line voltage shall be routed and bundled separately and/or shielded from all low voltage circuits. Clearances required by NFPA 70 (National Electrical Code) shall be maintained at all times.

All conductors and live terminals or parts which could be hazardous to maintenance personnel shall be covered with suitable insulating materials.

All wiring containing AC line voltage shall be a minimum size of #12 AWG and conform to XHHW-2 in accordance with other contract provisions. All other electrical conductors used in the cabinet wiring shall be #22 AWG or larger with a minimum of 19 strands. Conductors shall conform to Mil Spec #MIL-W-16878D, type B or D. All conductor specifications shall be coordinated with the equipment requirements. Cat 5e cabling shall conform to the requirements of other sections. Cabling that does not extend outside the cabinet, and all cabinet grounding cabling, shall be considered part of this Item and will not be paid separately.

The AC return and equipment ground wiring shall be electrically isolated from each other and the energized AC wiring by an insulation resistance of at least 10 Megohms when measured at 250 VAC. Return and equipment grounding wiring shall be color coded white and green respectively.

GFCI Duplex Outlet

In addition to any outlets required for equipment service, cabinets shall be furnished with a 125VAC convenience outlet with integral ground fault current interrupt (GFCI), protected by a circuit breaker (unless otherwise noted). The receptacle shall be a NEMA Type 5-15R outdoor, weather-resistant duplex receptacle located so that no electrical hazard shall exist when used by service personnel. This outlet is not required in Bridgeport or PECK Bridge racks.

Circuit Breaker(s)

The cabinet circuit breakers shall be approved and listed by Underwriter's Laboratories (UL 489). Supplemental breakers (UL 1077) are not acceptable. The operating mechanisms shall be enclosed, trip free from operating handle on overload, and trip indicating. Breakers shall have a minimum interrupt capacity of 10,000 amperes and be thermal-magnetic type.

Properly rated equipment circuit breaker(s) shall be provided for the equipment complement shown on the plans. Breaker sizes shown on plans are representative only and may vary based on equipment submitted and approved. Contractor shall coordinate all breaker sizes and curve characteristics with selected equipment and manufacturer recommendations.

Radio Interference Suppressor

All cabinets shall be equipped with a radio interference suppressor installed at the circuit breaker. The suppressor shall provide a minimum attenuation of 50 dB over a frequency range of 200 kHz to 75 MHz. The suppressor shall be hermetically sealed in a substantial metal case filled with a suitable insulation compound.

The suppressor terminals shall be nickel plated, brass studs of sufficient external length to provide space for connection of two appropriately sized conductors and shall be so mounted that the terminals cannot be turned in the case. The suppressors shall be designed for operation at 125 VAC, 60 Hz at the proper current rating as determined by the Contractor per the equipment complement as indicated on the plans. The suppressors shall meet applicable EIA specifications and shall be approved by UL.

Warning Labels

Contractor shall include warning labels required by applicable NFPA, ANSI, and UL standards. Warning labels shall comply with ANSI Z525.4 – Standard for Product Safety Signs and Labels. All panels with multiple power sources shall contain the warning "WARNING: Multiple power sources. Disconnect all sources prior to maintenance" or similar. Submit all label wording and layouts for approval prior to fabrication.

Power Cable Input and Junction Terminals

Power distribution blocks suitable for use as a power feed and junction points shall be furnished and installed for two and three wire circuits as indicated on the plans. The line side of each circuit shall be capable of handling the number of wires required. Terminal blocks shall be sized to accommodate each wire required without a reducing splice. Splices shall only be performed where approved by the Engineer. Any splices performed in the cabinet shall be done via terminal blocks.

Terminal Blocks

Terminal blocks shall be accessible to the extent that it shall not be necessary to remove any electronic equipment from the cabinet to make an inspection or connection. Terminal blocks shall be two position multiple pole barrier type. Shorting bars shall be provided in each of the positions provided along with an integral marking strip. Terminal blocks shall be so arranged that they shall not upset the entrance, routing, and connection of incoming field conductors. All terminals shall be suitably identified by legends permanently affixed and attached to the terminal blocks. No electrically alive parts shall extend beyond the protection afforded by the barriers. Doubling up conductors on one terminal should be avoided and only performed where the terminals are listed for such purpose and approved by the Engineer. Use bridging clips or additional terminals as necessary.

AC terminal blocks shall be Underwriter's Laboratory approved for 600 Volts AC minimum and

shall be suitable for outdoor use. Terminals used for field connections shall secure conductors by means of a #10-32 nickel or cadmium plated brass binder head screw. Terminals used for interwiring connections, but not for field connections, shall secure conductors by means of a #6-32 nickel or cadmium plated brass binder head screw.

As a minimum, all connections to and from the electronic equipment shall terminate to an inter-wiring type block unless otherwise directed by the Engineer. These blocks will act as intermediate connection points for all electronic equipment inputs and outputs.

All return and equipment grounding wiring shall terminate to the ground bus installed in the cabinet.

Cabinet Grounding

A solid copper ground bus bar shall be permanently affixed to the inside surface of a cabinet wall. The point of contact between the ground bus and cabinet wall shall have less than 1 ohm resistance. The copper ground bus bar shall have a minimum of 20 connector points, each capable of securing at least one #10 conductor. The ground bar shall also accommodate one #4 conductor for the main grounding connection. AC return and equipment ground wiring shall return to the ground bus bar. Cabinet shall have a grounding stud on the body and bonding provision on the door. Door shall be bonded to the body.

All cabinets shall be grounded in accordance with other sections of these Specifications.

Power Line Surge Protector

A power line surge protector shall be installed in each cabinet between the load side of the input power circuit breaker and ground. The surge protector shall not dissipate any energy and shall not provide any series impedance during standby operation. The units shall return to non-shunting mode after the passage of any surge and shall not allow the shunting of AC power.

The surge protector shall have the following minimum characteristics:

Working Voltage: 120VAC Single Phase
Protection Mode: Common Mode (L/G and N/G) and Differential Mode (L/N)
Nominal UL Discharge Current (I_n, 8/20µs): 20kA
Maximum Discharge Current (I_{max}, 8/20µs withstand): 165kA
Maximum Discharge Current (I_{imp}, 10/350µs withstand): 50kA total
Short Circuit Current Rating: 100kA
UL 1449, Type 1/Type 2 Device
Fault Indicator Window
Operating Temperature: -40˚C to 80˚C

Construction Methods:

The plans indicate the extent and the general location and arrangement of the work. The Contractor shall study the plans and details so that the work will be properly located and readily accessible. If conflicts occur necessitating departures from the plans, the Contractor shall submit details of departures and reasons therefore shall be submitted as soon as practicable for written approval of the Engineer. Contractor shall ensure any rerouting required does not adversely affect the system.

Substitutions of products and materials of other Sections may affect layout and equipment required in the cabinets. Contractor shall ensure all substitutions are coordinated with the design and the installation conforms to all Contract requirements and local codes.

Make field inspections necessary in order to prepare accurate shop drawings in accordance with existing conditions. Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation. Include plans, elevations, sections, details, and attachments as needed. Drawings should indicate site specific installation details including showing the exact equipment locations, mounting details, conduit runs, conduit entry, riser diagrams, wiring diagrams, and other details necessary for complete review. No cabinet equipment shall be installed without an approved layout, wiring diagrams, and other associated shop drawings.

All materials labor and incidentals to install the Cabinets shall be included in these items, including foundations, excavation, drilling, grounding, surface preparation, channels, hardware and other items required for a complete installation.

Documentation

Each field cabinet shall be supplied with three (3) copies of the Final Cabinet Wiring Diagram. One (1) copy shall be placed in a clear plastic envelope and left in the cabinet. Two (2) copies shall be delivered to the Engineer.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information. Testing shall include all components and wires installed in the cabinet and also the installation of the cabinet itself comply with contract specification and approved drawings.

Method of Measurement:

The work will be measured for payment by the actual number of each complete furnished, installed, inspected, and tested.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each unit furnished and installed, which price shall include all material, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
Modification of Existing Rack	Each

ITEM #1113913A – DEMARCATION BOX

Description:

The Contractor shall furnish demarcation boxes to be at locations as shown in the Contract Documents or as indicated by the Engineer.

It shall be responsibility of the Contractor to ensure the demarcation box is sized to fit adequate fiber cable slack and fiber splice enclosures as specified for the number of splices as required by the design and as outlined in this specification.

The demarcation box shall be supplied with all sleeves, hole hardware, attachment hardware, and all other items as required for a complete installation.

Materials:

Demarcation Box:

The Fiber Optic Splice Enclosures shall be American Products OFC-4830 PL or equivalent, meeting the following specifications:

Minimum Dimensions: 48”H x 30”W x 12”D.

Heavy-gauge, corrosion resistant galvanized steel construction. Powder coat finish shall meet or exceed GR487 standards and be resistant to chipping from dents and scratches.

Shall accommodate splice enclosures specified in other sections and fiber cable slack.

Weather stripping on doors.

Integrated fiber cable management brackets.

Stainless steel hardware.

Construction:

The Contractor shall submit manufacturer’s cut sheets and site-specific mounting details to be approved by the Engineer. Mounting details shall be coordinated with conduit entry requirements and existing obstructions present.

Method of Measurement:

The Demarcation Box shall be measured as the actual number of “Each” furnished, installed, and inspected.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each "Demarcation Box" furnished and installed, which price shall include all material, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
Demarcation Box	Each

ITEM #1113914A – RACK ENCLOSURE

Description:

This work shall consist of furnishing all labor, tools, and equipment necessary for furnishing and installing a new rack enclosure at Fairfield Metro Station as indicated on the plans or as directed by the Engineer. The Communications Cable is to be used for connecting equipment and providing interfaces with devices such as CCTV cameras, switches, media converters, workstations and other equipment as shown in the Plans. Equipment to be installed in the cabinet will be paid under other items.

Materials:

The Contractor shall provide a complete rack enclosure with all mounting hardware necessary install the rack enclosure.

The rack enclosure shall be coordinated with the work of other sections. The Contractor shall submit a detailed layout diagram for each layout specified for review by the Engineer. Only racks with approved layouts will be accepted under this Contract item.

Product Data: Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

General Rack Enclosure Requirements

1. EIA compliant 19" gangable equipment rack
2. Overall dimensions: 71"H x 22"W x 26"D, 37U usable rack space with 24" useable depth.
3. Fully welded construction provides the following weight capacities: UL Listed load capacity: 2,500 lbs., Static load capacity: 10,000 lbs., seismic certified capacity: 1,050 lbs.
4. Rack shall be constructed of the following materials: top and bottom shall be 14-gauge steel, horizontal braces shall be 16-gauge steel
5. Rack shall come equipped with two pairs of 11-gauge steel rackrail with tapped 10-32 mounting holes in universal EIA spacing, black e-coat finish and numbered rackspaces
6. Rack shall be fully enclosed with removable solid front door with plexi-glass window, removable solid side panels with recessed lift handles, and removable solid top. Top shall accommodate field drilling for conduit entry.
7. Durable black textured powder coat finish
8. Cabinet shall satisfy the 2007 & 2010 CBC; 2006, 2009 & 2012 IBC; ASCE 7-05 (2005 Edition) & ASCE 7-10 (2010 Edition) and the 2006 & 2009 editions of NFPA 5000 for use in areas of high seismicity, Seismic Use Group III, Zone 4 or

Seismic Design Category (SDC) "D" with lateral force requirements for protecting 1,050 lbs. of essential equipment in locations with the highest level of seismicity and top floor or rooftop installations with an Importance factor (Ip) of 1.5

9. Supply the cabinet with the required seismic floor anchor bracket
10. UL Listed in the US and Canada
11. Grounding and bonding stud shall be 1/4-20 threaded, installed in base of enclosure
12. Supply 3-1/4" wide, 44 space vertical lacer strip
13. Minimum six horizontal lacer bars
14. Twelve 8" Velcro cable management straps
15. Leveling feet
16. Cabinet shall be Middle Atlantic Products MRK series, or approved equal.

Coordinate additional rack accessories with those required by Item #1113911 – Modification of Existing Rack, such as ground bar, equipment shelves/drawing pockets, slide rails, intrusion alarm, etc.

Construction Methods:

The Plans indicate the extent and the general location and arrangement of the work. The Contractor shall study the plans and details so that the work will be properly located and readily accessible. If conflicts occur necessitating departures from the plans, the Contractor shall submit details of departures and reasons therefore shall be submitted as soon as practicable for written approval of the Engineer. Contractor shall ensure any rerouting required does not adversely affect the system.

Substitutions of products and materials of other Sections may affect cabinet size, layout, and equipment required in the cabinets. Contractor shall ensure all substitutions are coordinated with the design and the installation conforms to all Contract requirements and local codes.

Make field inspections necessary in order to prepare accurate shop drawings in accordance with existing conditions. Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation. Include plans, elevations, sections, details, and attachments as needed. Drawings should indicate site specific installation details including showing the exact equipment locations, mounting details, conduit runs, conduit entry, riser diagrams, wiring diagrams, and other details necessary for complete review. No cabinet shall be installed without an approved layout, wiring diagrams, and other associated shop drawings.

Rack shall be installed as shown on plans. Exact location shall be coordinated with the Engineer and MNR in the field. Install rack on a 3" concrete pad as indicated on the plans. All mounting hardware shall be stainless steel and all installation methods shall conform to the requirement set forth in Connecticut DOT Standard Publication 816 and manufacturer instructions and recommendations, including seismic floor bracket and anchors.

All materials labor and incidentals to install the rack enclosure shall be included in these items, including foundations, excavation, drilling, grounding, surface preparation, channels, hardware and other items required for a complete installation.

Documentation

Each field cabinet shall be supplied with three (3) copies of the Final Cabinet Wiring Diagram. One (1) copy shall be placed in a clear plastic envelope and left in the cabinet. Two (2) copies shall be delivered to the Engineer.

Method of Measurement:

The work will be measured for payment by the actual number of "Each" complete furnished, installed, and inspected.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each unit furnished and installed, which price shall include all material, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
Rack Enclosure	Each

ITEM #1113915A – ELEVATOR MODIFICATIONS

Description:

This work shall consist of modifications to existing elevators and their traveling cables performed by the manufacturer or authorized service provider of the elevator. The work shall be coordinated with materials under other items furnished by the Contractor.

The Contractor shall be responsible to coordinate the installation requirements of the analog elevator cameras provided in other sections with the manufacturer and/or maintainer of the elevators.

Materials:

It shall be the responsibility of the Contractor to coordinate the installation requirements of the analog elevator CCTV cameras with the manufacturer and maintainer of the elevator at each facility.

At Bridgeport and Fairfield Metro Stations, the elevators are maintained by Schindler under contract by Fusco Management. The Contractor shall retain the services of the existing maintenance contractor to perform all elevator modifications. The Schindler account manager is Jeanne Biafore, 860-502-2005, jeanne.biafore@us.schindler.com.

The Contractor shall furnish a complete bill of materials and shop drawings, coordinated with the work of other sections, indicating all equipment to be used, traveler cabling requirements, and other details necessary to perform the installation. The cameras shall be integrated into the system as shown in the Plans and described herein. The CCTV camera shall conform to the following requirements:

Basis of Payment:

The sum of money shown on the Estimate and in the itemized proposal as "Estimated Cost" for this work will be considered the bid price even though payment will be made as described below. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount for the contract.

The Department will pay the Contractor its actual costs for “Elevator Modifications” plus an additional 5% as reimbursement for the Contractor’s administrative expense in connection with the services provided. The 5% markup will be paid when the Engineer receives cancelled check(s) or receipted invoice(s) as proof of payment from the Contractor. Prior to procuring the services, the Contractor shall submit a detailed quote indicating all work to be done by the

elevator manufacturer and/or maintainer for approval by the Engineer. All work and amounts shall be pre-approved by the Engineer. Payment will not be made without pre-approval.

Pay Item	**Pay Unit**
Elevator Modifications	Estimated

ITEM #1113916A – ELEVATOR DEMARCATION BOX

Descriptions:

This work shall consist of furnishing analog elevator cameras and furnishing and installing other associated devices at locations shown in the Plans and in accordance with the Contract Documents.

The cameras shall be installed by the elevator manufacturer and/or maintainer. All work performed by the manufacturer and/or maintainer will be paid by other items.

The Contractor shall be responsible to coordinate the complete installation requirements of the analog elevator cameras.

Materials:

The equipment shall deliver high quality full-motion video during day or night operation with the video transmitted over fiber optic networks installed as part of this project as indicated in the Contract Documents. Mounting hardware and all interconnecting cabling between the camera assembly and the field cabinet shall also be provided as part of this item. Adapter plates, where required, shall be provided as part of this item. Connections between the equipment shall be through weather proof connectors to provide easy replacement. Servicing of the camera assembly shall be available in the continental United States or Canada.

All conduits, cabling, hardware and other items not specifically called out elsewhere in the Contract Documents that are required for a complete and fully functioning analog elevator camera as described in the Specifications and Contract Documents shall be provided by the Contractor as part of this item.

Analog Elevator CCTV Camera and Lens:

It shall be the responsibility of the Contractor to coordinate the installation requirements of the analog elevator CCTV cameras with the manufacturer of the elevator at each facility. The Contractor shall furnish a bill of materials and shop drawings indicating all equipment to be used, traveler cabling requirements and other details necessary to perform the installation. The cameras shall be integrated into the system as shown in the Plans and described herein. The CCTV camera shall conform to the following requirements:

1. Furnish a camera for each elevator cab.
2. The camera shall be Integrated Day Night active-infrared type. The camera shall have automatic, photocell-controlled day-night switching. The camera shall have daytime color mode and night-time IR monochrome mode. The camera shall operate at zero lux in night-time monochrome mode. The camera shall have a 1/3” CCD sensor. The camera

shall produce a 720TVL. The camera shall produce a signal to noise ratio of greater than 54 dB (AGC off) under normal daylight conditions. The camera shall have a dynamic range of greater than 94 dB under normal daylight conditions (HDR on).

3. The camera shall be equipped with 3 high efficiency LED infrared array allowing for clear pictures in zero lux conditions. The LEDs shall be optimized to produce an evenly-distributed field of illumination at 940 nm. The LEDs shall be intensity-adjustable.
4. The camera shall be available with a 2.0 mm wide-angle lens allowing a full 139º H-FoV and 104º V-FoV of the entire room. The camera shall be able to view the entire floor and all four walls of a 15 foot square room (4.5x4.5 m), including the two walls to which it is attached.
5. The camera shall have a progressive scanning system.
6. The camera shall be vandal resistant. The camera shall be ruggedized for vandal resistance. The camera shall be in a truncated tetrahedron shape or equal ensuring a flush installation into ceiling/wall corners. The camera shall incorporate a 45° tilted face to enable viewing of entire rooms, including directly underneath the camera itself. The camera shall have no exposed wiring or anchor points. The camera shall be rated to IK10 impact.
7. The camera shall have a flush-mounted front faceplate secured in place with three tamper-resistant screws and a gasket behind the faceplate to ensure water-tightness from periodic splashes of liquids caused through attempted vandalism or cleaning.
8. The camera shall be rated to IP 65 standard against water and dust ingress.
9. The camera housing shall be made of welded aluminum and be powder-coat painted in white.
10. The camera shall operate at a temperature range from -10°C to +50°C (14°F to +122°F).
11. The camera shall be energy efficient, drawing no more than 12.3W maximum.
12. The camera shall have high light sensitivity of color: 0.04 lx (0.00372 fc), Monochrome: 0.0 lx (IR on). The camera design shall eliminate the possibility of focus shift to ensure accurate focus for a daytime average wavelength of 500 nm and a night-time average wavelength of 940 nm.
13. The camera shall produce accurate color representation by eliminating IR bleed and/or other color distortions.
14. The camera shall provide a multi-language On-screen display (OSD).
15. The camera shall have a built-in control panel to allow on-site adjustment of the camera settings.
16. The camera shall provide a built-in test pattern generator for testing and fault-finding.
17. The camera shall have line lock in AC power mode to stabilize the image.
18. The camera shall provide a 1 Vpp, 75 Ohm analog output on BNC connector (NTSC).

19. The camera shall provide a 1 Vpp, 75 Ohm analog output on a 2.5 mm jack connector for installation purposes (NTSC).
20. Furnish the camera with the manufacturer's mounting accessories, such as backing plate and corner mounting accessories, recommended for the type of installation required.
21. Furnish cameras with all cabling, connectors, and other items necessary for integration into the system as described in the Plans.
22. Shall be Bosch Flexidome AN corner 9000, VCN-9095-F121 or approved equal.

Elevator Demarcation Box Cabinet:

The Cabinet shall be constructed of 14 gauge Type 316L stainless steel, with fully welded seams and sized by the Contractor for all required parts. The cabinet shall be rated as a NEMA Type 4X enclosure. The Cabinet shall have a continuously hinged full size door on the front, equipped with a heavy-duty pad-lockable handle sized to fit a standard MNR communications padlock. The cabinet exterior shall be smooth #4 brush finish. All devices shall be hardwired. Plug-in devices are not acceptable.

In addition the following equipment shall be provided in all Cabinet configurations as part of this Contract item:

a) One duplex receptacle (GFCI).

b) Surge protection for power lines.

c) Circuit breakers properly sized for the equipment to be installed in the cabinet.

d) Drawing pocket on door. Documentation shall be provided in a weather-protective sleeve/envelope or shall be laminated. Documentation shall include wiring through the elevator traveler cable to the camera, and any converters required.

e) Camera power supply. 120VAC input, class 2 output coordinated with camera power requirements, UL listed, 32˚F to 131˚F operating temperature

f) All required converters required to interface elevator camera, traveling cables, camera power supply, and encoder.

g) Video Encoder: The Video Encoder shall be Verint S1801E-PoE, or approved equivalent (see source limitations below), meeting the following requirements:

   a. The video encoder shall be a single video server using H.264 (MPEG-4 Part 10/AVC) Main Profile and MJPEG compression technologies.
   b. Video Input: 1 composite, 1Vpp into 75 ohms NTSC/PAL, BNC female.
   c. Network Interface: RJ-45, Ethernet 10/100 Base-T
   d. Network Protocols: RTP/IP, UDP/IP, RTSP, or multicast IP. Shall also support DNS, NTP, SNMP v1/v2c/v3, HTTP, HTTPS, DHCP client, and

802.1x. Security shall be SSL-based authentication, password protected, HTTPS.

e. Power: PoE (802.3af), max 5W power

f. Operating Temperature: 32˚F to 131˚F, 95% non-condensing RH

g. The encoder shall be capable of three (3) H.264 video streams and (1) MJPEG of D1 video images from 1 camera input at 30 frames per second under all conditions of motion in the image

h. The encoder shall support NTSC and PAL signal formats with a programmable resolution from CIF (352 x 240 pixels for NTSC; 352 x 288 pixels for PAL) to D1 format (720 x 480 pixels for NTSC; 720 x 576 pixels for PAL).

i. Each stream shall be configurable from 30Kbps to 6Mbps.

j. UL Listed, FCC Part 15 (Subpart B, Class A) compliant

k. Encoder source limitations: Encoders shall be of sole brand, Verint, as determined for the operational and maintenance needs of Metro-North Railroad. Model number substitutions will be considered for newer models that meet or exceed the technical requirements herein. All substitutions shall be fully coordinated with the overall design by the Contractor. In the event the encoder listed is determined to be end-of-life, or near end-of-life, the Contractor shall propose an alternate that satisfies the technical requirements within. All encoders shall be compatible with the Verint Nextiva Video Management System specified elsewhere.

Cabinets and their final configurations shall conform to requirements of the National Electrical Code (NFPA 70), National Electrical Safety Code, and all other local codes.

Product Data: Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

Shop Drawings: The Contractor shall submit a detailed layout diagram for each type of Cabinet layout specified for review by the Engineer. Only Cabinets with approved layouts will be accepted under this Contract item.

Electrical Requirements

Wiring

All cabinet wiring, where connected to terminal strips, relays, switches, radio interference suppressor, etc., shall be identified by the use of insulated pre-printed sleeving slipped over the wire before attachment of the lug or the completion of the connection. The wire markers shall carry the legend in plain words with sufficient details so that a translating sheet will not be required.

All wires shall be cut to the proper length before assembly. No wires shall be doubled back to take up slack. Wires shall be neatly laced into cables with nylon lacing and/or Velcro ties. Cables shall be secured with nylon cable clamps. Furnish and install a complete cable management system to control cable bend radius, provide strain relief, and provide a neat and workmanlike appearance.

All electrical connections in the cabinet, including relays, terminal strips, etc., shall have sufficient clearance between each terminal and the cabinet to provide an adequate distance to prevent a leakage path or physical contact under stress. Where these distances cannot be maintained, barriers must be provided. All equipment grounds shall run directly and independently to the ground bus. The interconnect cabling shall be routed such that when the doors are closed, they do not press against the cables or force the cables against the various components inside the cabinets.

All wiring containing AC line voltage shall be a minimum size of #12 AWG and conform to XHHW-2 in accordance with other contract provisions. Cat 5e cabling shall conform to the requirements of other sections. Cabling that does not extend outside the cabinet, and all cabinet grounding cabling, shall be considered part of this Item and will not be paid separately.

All conductors and live terminals or parts which could be hazardous to maintenance personnel shall be covered with suitable insulating materials.

All wiring containing AC line voltage shall be a minimum size of #12 AWG and conform to XHHW-2 in accordance with other contract provisions. All other electrical conductors used in the cabinet wiring shall be #22 AWG or larger with a minimum of 19 strands. Conductors shall conform to Mil Spec #MIL-W-16878D, type B or D. All conductor specifications shall be coordinated with the equipment requirements.

The AC return and equipment ground wiring shall be electrically isolated from each other and the energized AC wiring by an insulation resistance of at least 10 Megaohms when measured at 250 VAC. Return and equipment grounding wiring shall be color coded white and green respectively.

GFCI Duplex Outlet

In addition to any outlets required for equipment service, all cabinets shall be furnished with a 125VAC convenience outlet with integral ground fault current interrupt (GFCI), protected by a circuit breaker. The receptacle shall be a NEMA Type 5-15R outdoor, weather-resistant duplex receptacle located so that no electrical hazard shall exist when used by service personnel.

Circuit Breaker(s)

The cabinet circuit breakers shall be approved and listed by Underwriter's Laboratories (UL 489).

Supplemental breakers (UL 1077) are not acceptable. The operating mechanisms shall be enclosed, trip free from operating handle on overload, and trip indicating. Breakers shall have a minimum interrupt capacity of 10,000 amperes and be thermal-magnetic type.

Properly rated equipment circuit breaker(s) shall be provided for the equipment complement shown on the plans. Breaker sizes shown on plans are representative only and may vary based on equipment submitted and approved. Contractor shall coordinate all breaker sizes and curve characteristics with selected equipment and manufacturer recommendations.

Radio Interference Suppressor

All cabinets shall be equipped with a radio interference suppressor installed at the circuit breaker. The suppressor shall provide a minimum attenuation of 50 dB over a frequency range of 200 kHz to 75 MHz. The suppressor shall be hermetically sealed in a substantial metal case filled with a suitable insulation compound.

The suppressor terminals shall be nickel plated, brass studs of sufficient external length to provide space for connection of two appropriately sized conductors and shall be so mounted that the terminals cannot be turned in the case. The suppressors shall be designed for operation at 125 VAC, 60 Hz at the proper current rating as determined by the Contractor per the equipment complement as indicated on the plans. The suppressors shall meet applicable EIA specifications and shall be approved by UL.

Power Cable Input and Junction Terminals

Power distribution blocks suitable for use as a power feed and junction points shall be furnished and installed for two and three wire circuits as indicated on the plans. The line side of each circuit shall be capable of handling the number of wires required. Terminal blocks shall be sized to accommodate each wire required without a reducing splice. Splices shall only be performed where approved by the Engineer. Any splices performed in the cabinet shall be done via terminal blocks.

Terminal Blocks

Terminal blocks shall be accessible to the extent that it shall not be necessary to remove any electronic equipment from the cabinet to make an inspection or connection. Terminal blocks shall be two position multiple pole barrier type. Shorting bars shall be provided in each of the positions provided along with an integral marking strip. Terminal blocks shall be so arranged that they shall not upset the entrance, routing, and connection of incoming field conductors. All terminals shall be suitably identified by legends permanently affixed and attached to the terminal blocks. No electrically alive parts shall extend beyond the protection afforded by the barriers. Doubling up conductors on one terminal should be avoided and only performed where the terminals are listed for such purpose and approved by the Engineer. Use bridging clips or additional terminals as necessary.

AC terminal blocks shall be Underwriter's Laboratory approved for 600 Volts AC minimum and shall be suitable for outdoor use. Terminals used for field connections shall secure conductors by means of a #10-32 nickel or cadmium plated brass binder head screw. Terminals used for interwiring connections, but not for field connections, shall secure conductors by means of a #6-32 nickel or cadmium plated brass binder head screw.

As a minimum, all connections to and from the electronic equipment shall terminate to an inter-wiring type block unless otherwise directed by the Engineer. These blocks will act as intermediate connection points for all electronic equipment inputs and outputs.

All return and equipment grounding wiring shall terminate to the ground bus installed in the cabinet.

Warning Labels

Contractor shall include warning labels required by applicable NFPA, ANSI, and UL standards. Warning labels shall comply with ANSI Z525.4 – Standard for Product Safety Signs and Labels. All panels with multiple power sources shall contain the warning "WARNING: Multiple power sources. Disconnect all sources prior to maintenance" or similar. Submit all label wording and layouts for approval prior to fabrication.

Power Line Surge Protector

A power line surge protector shall be installed in each cabinet between the load side of the input power circuit breaker or fuse and ground. The surge protector shall not dissipate any energy and shall not provide any series impedance during standby operation. The units shall return to non-shunting mode after the passage of any surge and shall not allow the shunting of AC power.

The surge protector shall have the following characteristics:

Working Voltage: 120VAC Single Phase
Protection Mode: Common Mode (L/G and N/G) and Differential Mode (L/N)
Nominal UL Discharge Current (I_n, 8/20µs): 20kA
Maximum Discharge Current (I_{max}, 8/20µs withstand): 165kA
Maximum Discharge Current (I_{imp}, 10/350µs withstand): 50kA total
Short Circuit Current Rating: 100kA
UL 1449, Type 1/Type 2 Device
Fault Indicator Window
Operating Temperature: -40˚C to 80˚C

Cabinet Grounding

A solid copper ground bus bar shall be permanently affixed to the inside surface of a cabinet

wall. The point of contact between the ground bus and cabinet wall shall have less than 1 ohm resistance. The copper ground bus bar shall have a minimum of 20 connector points, each capable of securing at least one #10 conductor. The ground bar shall also accommodate one #4 conductor for the main grounding connection. AC return and equipment ground wiring shall return to the ground bus bar. Cabinet shall have a grounding stud on the body and bonding provision on the door. Door shall be bonded to the body.

All cabinets shall be grounded and bonded in accordance with other sections of these Specifications. Elevator demarcation boxes shall be grounded using the AC equipment ground. Work of this item shall include all materials required to properly ground the cabinet.

Elevator Demarcation Box Cabinet Mounting

All materials labor and incidentals to install the Cabinets shall be included in this item, including surface preparation, drilling, hardware and other items required for a complete installation. Contractor shall submit shop drawings of cabinet mounting with associated hardware.

Construction Methods:

The plans indicate the extent and the general location and arrangement of the work. The Contractor shall study the plans and details so that the work will be properly located and readily accessible. If conflicts occur necessitating departures from the plans, the Contractor shall submit details of departures and reasons therefore shall be submitted as soon as practicable for written approval of the Engineer. Contractor shall ensure any rerouting required does not adversely affect the system.

Substitutions of products and materials of other Sections may affect cabinet size, layout, and equipment required in the cabinets. Contractor shall ensure all substitutions are coordinated with the design and the installation conforms to all Contract requirements and local codes.

Make field inspections necessary in order to prepare accurate shop drawings in accordance with existing conditions. Submit shop drawings coordinated with existing conditions and all other work for approval prior to performing any installation. Include plans, elevations, sections, details, and attachments as needed. Drawings should indicate site specific installation details including showing the exact equipment locations, mounting details, conduit runs, conduit entry, riser diagrams, wiring diagrams, and other details necessary for complete review. No cabinet shall be installed without an approved layout, wiring diagrams, and other associated shop drawings.

Mounting and other modifications shall not affect the NEMA 4X rating of the enclosure.

All mounting hardware shall be stainless steel and all installation methods shall conform to the requirement set forth in Connecticut DOT Standard Specifications Form 816 and other

specification sections.

All materials labor and incidentals to install the cameras and other items specified shall be included in these items, including foundations, excavation, drilling, surface preparation, channels, hardware and other items required for a complete installation.

Assembly

Elevator Demarcation Box Cabinets shall be assembled in a controlled environment and factory tested before being delivered to the work site and installed. Refer to "NOTICE TO CONTRACTOR - Acceptance Testing" for additional information.

Testing:

Refer to "NOTICE TO CONTRACTOR – Acceptance Testing" for overall testing requirements and additional information. Testing shall include all components including cameras, fully interfaced to the system, and wires installed in the cabinet and also the installation of the cabinet itself comply with contract specification and approved drawings.

Training:

Refer to "NOTICE TO CONTRACTOR – Training" for overall training requirements and additional information.

Method of Measurement:

Elevator Demarcation Box will be measured for payment by the number of "Each" complete furnished, installed, inspected, and tested.

Basis of Payment:

The work under this item shall be paid for at the contract unit price per each "Elevator Demarcation Box" furnished and installed, which price shall include all material, tools, equipment, labor, and work incidental thereto.

Pay Item	**Pay Unit**
Elevator Demarcation Box	Each

ITEM #1113998A – COMMUNICATION CABLE

Description:

This work shall consist of furnishing all labor, tools, and equipment necessary for installing copper Communication Cable in conduits as indicated on the plans or as directed by the Engineer. The Communication Cable is to be used for connecting equipment and providing interfaces with devices such as CCTV cameras, switches, media converters, workstations and other equipment as shown in the Plans. Patch cables shall be paid as part of the rack or enclosure they are installed in, but shall follow the same requirements of this section.

Materials:

The Communication Cable shall be Category 5e (Cat 5e) 100Ω copper twisted pair cabling conforming to ANSI/TIA/EIA-568-C.2. All cable shall be shielded unless shown otherwise on the Plans.

The cable sheath shall be clearly marked Cat 5e by the manufacturer.

All materials shall conform to the requirements of the National Electrical Code.

Cat 5e cables shall be 24 AWG solid copper conductor, rated for applications of at least 100 MHz, and color coded per ANSI/EIA/TIA T568B standard. Maximum DC resistance unbalance shall be 5% as measured by ASTM 4556 (Note: This requirement is equivalent to 2.5% when measured in accordance with IEC 61156-1).

Shielded cable shall have an aluminum/polyester overall foil shield providing 100% coverage and a 24 AWG tinned copper drain wire.

All Communication Cable provided under this Contract shall be from the same manufacturer and shall be the same type, model number and specification.

Cable jackets shall be available in various colors.

Outdoor Cable

Furnish and install outdoor Cat 5e cables in locations where the cable is subject to moisture and temperature extremes.

Outdoor cables shall be sunlight resistant, oil resistant, and polymer gel waterblocked for use in harsh/industrial environments and listed for CMX-Outdoor.

Maximum Outer Diameter: 0.280 inches

Outdoor cable shall have operating temperature range of -40°C to 60°C and an installation temperature range of -20°C to 60°C.

Indoor Cable

Furnish and install indoor Cat 5e cables in locations/rooms where the cable is not exposed to moisture or temperature extremes.

Indoor cables shall be Plenum or Riser rated cable as required by the application.

Indoor cable shall have operating temperature range of -20°C to 60°C.

Maximum Outer Diameter: 0.280 inches

Patch Cable
Cat 5e patch cables shall be similarly be indoor or outdoor rated based on installation locations.

Product Data: Submit Manufacturer's literature and catalog cuts for all products/materials to the Engineer for review and approval.

Construction Methods:

Communications cable installed under this item shall form a continuous circuit between the proper equipment terminals. No splicing will be permitted.

Installation shall conform to requirements of the National Electrical Code and National Electrical Safety Code.

The installation shall be accomplished by workmen skilled in this type of work. Cable shall be handled with care. It shall not be pulled along the ground and shall be taken from the reel only as it is placed. Bends of small radii and twists shall be avoided. When the sheath or jacket is deformed in handling the cable, the deformed section of the sheath or jacket shall be removed, the insulation and conductors shall be examined and if damaged shall be repaired as directed by the Engineer. The opening in the sheath or jacket shall then be closed by means of a suitable enclosure or sealing compound. Repairs so made shall be done in accordance with appropriate specifications. Follow manufacturer's guidelines for installation.

All Category 5e cables shall be terminated with a RJ-45 type connector in rooms, cabinets, and field locations utilizing ANSI/EIA/TIA T568B wiring scheme, unless otherwise directed by the Engineer. At the camera locations, Cat 5e cables shall be terminated per camera manufacturer's

recommendations and requirements. Shielded cables shall be terminated with shielded RJ-45 connectors. One end shall be grounded.

Cable shall be carefully inspected by the Contractor prior to and during installation to be certain that it is free of defects. Damaged cables shall be replaced at no additional cost.

The plans indicate the extent and the general location and arrangement of the work. The Contractor shall study the plans and details so that the work will be properly located and readily accessible. If conflicts occur necessitating departures from the plans, the Contractor shall submit details of departures and reasons therefore shall be submitted as soon as practicable for written approval of the Engineer. Contractor shall ensure no Ethernet link exceeds 300ft. Ethernet extenders/repeaters are not acceptable unless otherwise directed by the Engineer.

Make field inspections necessary in order to prepare accurate shop drawings in accordance with existing conditions. Submit shop drawings with conduit layouts, coordinated with existing conditions and all other work for approval prior to performing any installation. Should field conditions result in an Ethernet link longer than 300ft, notify the Engineer prior to starting any work.

Testing:

All work shall be performed in accordance with these guidelines, current industry testing standards, and the test equipment manufacturer's recommendations.

Category 5e cables shall be tested and certified to conform to TIA-568-C.2 standards.

Cable testing equipment shall be NRTL certified for ANSI/TIA-1152 specification and to the manufacturer's specifications. Testing equipment shall have valid calibration certificate.

Tester shall be a trained and experienced person with Cat 5e cable certification. Contractor shall supply all test equipment required for testing.

Cables shall be tested at the manufacturer's facility prior to shipping to the field that they meet the contract specification, specifications contained in the manufacturer product data, and other requirements specified herein. Cable may be shipped only after all required factory tests have been successfully completed and the results have been approved.

All Category 5e cables shall be tested after installation and cable termination. The following parameters will be tested: insertion loss (IL), Near-end crosstalk (NEXT), Power Sum Near End Crosstalk (PSNEXT), Far-end crosstalk (FEXT), Attenuation to Crosstalk Ratio – Near End (ACRN), Power Sum Attenuation to Crosstalk Ratio – Near End (PSACR-N), Equal level far-end crosstalk (ELFEXT), Attenuation to Crosstalk Ratio – Far end (ACRF), Power Sum Attenuation to Crosstalk Ratio – Far End (PSACRF), return loss (RL), wire map, length, propagation delay, and delay skew.

In addition, cable channels shall be tested for DC resistance unbalance after installation and termination. Maximum DC resistance unbalance shall be 3% or .20 ohms between conductors in accordance with IEEE 802.3 for Power over Ethernet applications, when measured by IEC 61156-1.

Cables shall be tested from both ends of the cable. Tests shall be based on each pair of conductors and not the aggregate multiple pair results.

Any cable failing the certification test (Fail, Fail* or, Pass*) or DC resistance unbalance test must have remedial work done to provide a full pass test result. Remediation may include re-termination or replacement of the cable at the Contractor's expense. No cables passing within tolerance only (Conditional Pass*) will be accepted.

Method of Measurement:

The Communications Cable shall be measured for payment by the number of "Linear feet" furnished, installed, tested, and accepted.

Basis of Payment:

The work under this item shall be paid for at the contract price per linear foot for "Communication Cable" and shall include all labor and materials necessary to complete the work. Payment will be made under:

Pay Item	**Pay Unit**
Communication Cable	Linear Feet

ITEM #1115204A – 2” POLYVINYL CHLORIDE CONDUIT

Description:

This work shall consist of installing 2” Polyvinyl Chloride Conduit including all necessary fittings and materials required to effect a complete installation at the location shown on the plans and/or as directed by the Engineer. The intent of this specification is to include installation of conduit above grade surface mounted.

Materials:

Materials shall be Schedule 80 Grade and conform to Section M 15.09, Electrical Conduit, of The Connecticut Standard Specifications for Roads, Bridges and Incidental Construction, Form 816, Dated 2004, merged with Supplemental Specifications Dated July, 2015.

Construction Method:

All conduit installation shall conform to the requirements of Section 10.08,03, Construction Methods, of the Connecticut Standard Specifications, Form 816 and as directed by the Engineer.

Method of Measurement:

Payment will be made for the actual length of 2” Polyvinyl Chloride Conduit installed above grade and measured from end to end through fittings.

Basis of Payment:

This work will be paid for at the contract unit price per linear foot of 2” Polyvinyl Chloride Conduit installed above grade and accepted.

This price shall include all necessary tools, labor, equipment and materials for the complete installation of the conduit surface mounted. This shall include but not be limited to fittings, joint cement, cradles, sealant, caps, hanger supports, mounting clamps, expansion fittings, screws, nuts bolts, washers and any other hardware necessary for a complete installation above grade.

This price shall also include the required above grade conduit wall schedule.

Pay Item	Payment
2” Polyvinyl Chloride Conduit	Linear Feet

ITEM #1206036A – REMOVE AND RELOCATE SIGN

Description:

This work shall consist of the removal of designated existing station signs and their relocation and/or adjustment to a new location and height to facilitate the area and line of sight for proposed security cameras.

Signs that are clamped to the canopy structure that need to be relocated shall be considered incidental to mounting the camera and will not be paid under this item. Signs that are bolted or otherwise permanently attached to the canopy structure and need to be relocated shall be relocated at the direction of the Engineer and will be paid under this Item.

Materials:

Materials for this work shall conform to applicable sections of Section M.06, Metals and Section M.07, Paint.

Construction Methods:

Signs and supports shall be carefully removed to eliminate the possibility of any damage. The new sign locations or height adjustments shall be as determined by the Engineer. Sign support brackets shall be modified to provide the required adjustments to the sign locations. Provide new nuts, bolts, washers and other hardware necessary to complete the work. Existing supports and brackets shall be modified and reduced in length as needed and as directed by the Engineer. Drilling of the canopy framing members required for sign relocation or adjustment shall be approved by the Engineer. Welding to the canopy framing will not be allowed. Sign dimensions, sign face or inscription shall not be modified or altered.

All new or bare metal shall be thoroughly cleaned, one coat of primer applied and two finish coats of paint color applied to match existing surfaces.

Method of Measurement:

This work will be measured by the number of each completed and accepted sign removed and relocated.

Basis of Payment:

This work will be paid for at the Contract unit price for each "Remove and Relocate Sign" which price shall include all labor, materials, equipment, tools, miscellaneous hardware, modification to the existing support brackets, additional steel support material and painting. It shall also include any trial and error work necessary for final sign adjustment.

Pay Item	**Pay Unit**
Remove and Relocate Sign	Each

PERMITS AND/OR SUPPLEMENTAL TO FORM 816 AND REQUIRED PROVISIONS

The following Permits and/or Supplemental to Form 816 and Required Provisions follow this page and are hereby made part of this Contract.

- **PERMITS AND/OR PERMIT APPLICATIONS**

  CT DEEP Certificate of Permissions Pending

- **SUPPLEMENTAL SPECIFICATIONS TO STANDARD SPECIFICATIONS FORM 816**

- **Construction Contracts - Required Contract Provisions (State Funded Only Contracts)**