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1.0 INTRODUCTION

1.1 General

1.1.1 Metro-North Railroad (MNR) operates and maintains the New Haven Line (NHL) in Connecticut under contract to the Connecticut Department of Transportation (ConnDOT).

1.1.2 The New Haven Line right of way between Greenwich and New Haven Connecticut is owned by the State of Connecticut.

1.2 Project Background

1.2.1 This project will include installation design, procurement, installation, and testing of signal and communications systems components from CP-229 in Greenwich, CT to CP-241 in Norwalk, CT. The project is part of a multi-phase replacement of the NHL signal and communications infrastructure. The project includes:

- Aerial cables and ducts
- Aerial messenger strand
- Underground cables and ducts
- Site Preparation for installation of pre-wired houses and cases including excavation, backfill, grading, foundations, and retaining walls
- Installation of signal houses and cases (the houses and cases with the exception of snow melter panels will be furnished by MNR)
- Support platforms, access platforms, and stairs
- Signal power transformers
- Snow melter panels

1.2.2 The Work will be performed on a section of the NHL extending from Greenwich, CT (CP-229) to Norwalk, CT (CP-241). The work area is an overall distance of approximately 12.7 miles.

Under this project, aerial cables, underground cables, signal houses, signal cases, and related equipment will be installed from CP-229 to CP-241.

1.2.3 The work area is four track mainline territory which is entirely electrified, utilizing 13,000 Volt 60 Hertz AC overhead catenary.
1.3 Summary of the Work

1.3.1 This solicitation is an Invitation for Bids (IFB). Refer to Section 2.2, “Bid Requirements.”

1.3.2 This Section is a summary of the Work to be performed by the Contractor in the execution of this Contract. This summary is intended to supply the Contractor with an overview of the Work. Comprehensive details of the Work are presented within these Technical Specifications, the Contract Terms and Conditions, and the Contract Drawings. Refer to Section 2, “Contractor Requirements,” for additional information.

1.3.3 The Contractor shall provide all services, facilities, personnel and equipment necessary to execute the Work in accordance with the requirements of these Technical Specifications, the Contract Drawings, and Contract Terms and Conditions. The Work shall include, but not be limited to:

a. Installation design for aerial cables. This includes cables attached to catenary structures, poles, buildings, and other structures.

b. Installation design for conduits, raceways and direct burial cable. The contract drawings depict proposed routings and proposed raceways. The Contractor shall determine final raceway configurations, numbers and sizes of all conduits, and the final size of all cable troughs and cable trays.

c. Project management, installation planning, material procurement, fabrication and assembly, installation, testing and commissioning, documentation, and quality control.

d. Temporary field offices, storage, work areas, and parking areas will be required. State of Connecticut property will not be available to the Contractor. The Contractor shall procure any and all field office locations, material storage, staging, parking areas, etc. required for the completion of the work at the Contractor’s expense.

e. On-track (high-rail) and off track vehicles, equipment and machinery. No Metro-North owned equipment will be made available for use by the Contractor.

f. Personnel necessary to perform the Work in accordance with the Contract Documents, to include but not be limited to a Project Manager, an Outside Plant (OSP) Engineer and an Installation Manager. Metro-North will provide flagmen and Force Account
personnel as required.

g. The procurement and installation of self-supported figure 8 one and one quarter-inch (1-1/4") aerial duct.

h. The procurement, installation and testing of 144-strand fiber optic longitudinal (express) cables and 144-strand and 24-strand fiber optic drop cables.

i. The procurement and installation of aerial messenger strands to support aerial cables.

j. The procurement and installation of 6-pair No. 14 AWG signal cables, and other non-fiber signal cables to be spun to the messenger strand and installed as longitudinal (express) cables.

k. The procurement and installation of signal power transformers to be installed on the catenary support structures and other locations shown in the plans including all hardware, cables, and accessories.

l. The procurement, installation, and testing of snowmelter panels and related equipment. Pre-wired snowmelter panels are procured by the Contractor for this project. All other materials, foundations, conduits, junction boxes and cables required for installation of snowmelter panels will also be furnished and installed by the Contractor including runs from snowmelter unit substations to the new snowmelter panels and runs from new snowmelter panels to rail heaters. The existing snowmelter unit substations will remain in place and it is intended that the unit substations will be reused. Additional snowmelter power transformers will be installed only in special cases where specifically called for on the Contract Drawings.

m. The installation of wayside signal houses and cases. Pre-Wired wayside signal houses and signal cases are being procured directly by Metro-North. Houses and cases (only) will be supplied to the Contractor for installation. The Contractor is advised that Metro-North’s procurement of Pre-wired houses and cases will be conducted during the same timeframe as the Contractor’s work. See Section 7.0 for additional information. All other materials, foundations, raceways, and cables required for the installation of Pre-Wired houses and cases will be furnished and installed by the Contractor.

n. The procurement, fabrication and assembly, and installation of equipment support platforms and employee access platforms and stairs.
o. The procurement and installation of temporary and permanent retaining wall structures.

1.3.4 Metro-North Force Account staff will perform the following work:

a. All fiber optic cable splicing and terminations.

b. Splicing new 25pr. copper communications drop cables installed by the Contractor to existing 25pr. communications express cables.

c. Installation of selected wayside equipment and final connections to selected wayside equipment as specifically identified elsewhere in these specifications or in the contract drawings. (see Work Responsibility Matrix Plan Sheet)

d. Railroad flagging and the services of Class A linemen.

1.4 Project Schedule

1.4.1 The Contractor shall adhere to the schedule outlined in Table 3.3.1 and Section 3.3, “Track Outage Plan,” of these Technical Specifications.
2.0  CONTRACTOR REQUIREMENTS

2.1  General

2.1.1  This Contract requires the procurement, installation, and testing of outside plant (OSP) communications and signal infrastructure. The Contract includes the installation of wayside houses and cases furnished by MNR.

2.1.2  Additional details of the Work are provided in Section 3, “Work Requirements,” and elsewhere in these Technical Specifications, Contract Drawings and Contract Terms and Conditions.

2.1.3  The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work. These Contract Documents shall be construed to include all work necessary to produce the intended results. If any portion of the Contract Documents is in conflict with any other portion, the Engineer shall determine the governing Document.

2.1.4  The details, means and methods for providing the Work described herein shall be determined and guaranteed by the Contractor, subject to the requirements of these Contract Documents and the written approval of the Engineer.

2.1.5  The Contractor shall furnish all material and personnel required to complete the Work of this Contract with the exception of signal houses and cases furnished by MNR for installation by the Contractor.

2.1.6  Reference to “days” in these Technical Specifications shall mean calendar days unless otherwise defined. Reference to “days” designated for MNR review shall mean working days.

2.1.7  Work acceptance will be in accordance with the Contract Documents and subject to the approval of the Engineer.

2.2  Bid Requirements

2.2.1  This solicitation is an Invitation for Bids (IFB). All references to “Bid”, “Bidder” or “Contractor” are references to the respondents to this IFB.
2.2.2 Bidders shall supply the documents or information required in this Section with the Contract Bid, in addition to meeting all applicable requirements of the Contract Terms and Conditions.

2.2.3 Metro-North at their option may schedule a site visit for prospective bidders that will include representative locations along the Railroad right-of-way.

2.2.4 The bidders shall submit a list of similar past projects performed for railroads or utility companies within the last five (5) years, of comparable size and complexity to this project.

2.2.5 For each project listed, the bidders shall provide complete references for each, to include bid price, agency, current contact name, address, telephone number and e-mail address.

2.2.6 The bidders shall respond to each Section and subsection of this Technical Specification with a written compliance statement as part of the Bid. Any exceptions or deviations shall be so noted by the bidder.

2.2.7 Bidders shall submit, with the Bid, a detailed staffing plan for all aspects of the Project, as described within these Contract Documents. This shall include an organization chart showing all staff, linemen, engineers, checkers, designers and quality assurance staff. A narrative shall be supplied that indicates the functions of each member of the bidder’s proposed team along with detailed resumes of related work experience. The bidders shall submit, with the Bid, resumes of key personnel.

2.2.8 Bidders shall clearly show the intended use of any subcontractors or contract employees who are not full time employees of the Contractor.

2.2.9 Bidders shall demonstrate in the Bid, to the satisfaction of the Engineer, that the full range of services required can be furnished as specified, and that the bidder has successfully and satisfactorily completed comparable contracts on time and within budget for other North American railroads or public utilities.

2.2.10 A total of 10 copies of the complete Bid shall be submitted by the bidder to Metro-North.

2.3 Service to be Provided by the Contractor
2.3.1 This Section summarizes the requirements for the planning, organizing, and carrying out the Work. These requirements include but are not limited to the following categories:

a. Management and Administration including but not limited to Coordination, Scheduling, Meetings, Staging, and Phasing. (Refer to Section 2.5, “Management and Administration.”)

b. Contractor Personnel. (Refer to Section 2.6, “Project Team.”)

c. Installation Planning and Design. (Refer to Section 2.10, “Installation Planning.”)

d. Mobilization. (Refer to Section 2.11, “Mobilization.”)

e. Demobilization. (Refer to Section 2.12, Demobilization.”)


g. Permits. (Refer to Section 2.15, “Permits.”)

h. Utility Coordination. (Refer to Section 2.16, Utility Coordination.”)

i. Work Restrictions. (Refer to Section 2.17, Work Restrictions.”)

j. Maintenance and Protection of Street Traffic. (Refer to Section 2.19, “Maintenance and Protection of Street Traffic.”)

k. Requirements for Work Affecting the Railroad. (Refer to Section 2.20, “Requirements for Work Affecting the Railroad.”)

l. Protection of Railroad Facilities. (Refer to Section 2.21, “Protection of Railroad Facilities.”)

m. Contractor Use of the Worksite. (Refer to Section 2.22, “Contractor Use of Worksite.”)

n. Temporary Work and Facilities. (Refer to Section 2.23, Temporary Work and Facilities.”)

o. Requirements of Regulatory Agencies. (Refer to
Section 2.24, “Requirements of Regulatory Agencies.”)

p. Temporary Utilities. (Refer to Section 2.25, “Temporary Utilities.”)

q. Field Offices. (Refer to Section 2.26, “Engineer’s Field Offices for Metro-North.”)

r. Field Office Equipment. (Refer to Section 2.27, “Field Office Equipment.”)

s. Discontinuance, Changes and Removal. (Refer to Section 2.28, “Discontinuance, Changes and Removal.”)

t. Track Outage Planning (Refer to Section 3.3, “Track Outage Plan”)

u. Safety, Health and Environmental Control. (Refer to Section 4, “Safety, Health and Environmental Control”)

v. Testing. (Refer to Section 9, “Testing”)

y. Quality Control. (Refer to Section 10, “Contractor’s Quality Program”)

w. Drawings and As-Built Plans. (Refer to Section 11, “Drawings and As-Built Plans”)

x. Submittals. (Refer to Sections 12, “Submittals” and 13, “Contract Data Requirements List”)

2.4 Metro-North Responsibilities

2.4.1 Certain work has been identified in these Contract Documents as being performed by Metro-North. The Contractor shall coordinate Contract Work with any work to be performed by Metro-North.

2.4.2 Metro-North will schedule a site visit for prospective bidders that will include representative locations along the Railroad right-of-way.

2.4.3 State of Connecticut property will be not be available for temporary field offices, yards, and work areas.

2.4.4 Metro-North will furnish the services of all flagmen, pilots,
ground men and other protective personnel, at the locations required by Metro-North, to protect the operation and safety of train traffic and construction, throughout the duration of this Contract.

2.4.5 Metro-North Force Account will perform selected fiber optic and copper cable splicing and termination where identified in the contract documents.

2.4.6 Metro-North will attend meetings as appropriate, including but not limited to the Pre-Construction Meeting and Project Progress Meetings.

2.4.7 Metro-North will provide safety training as appropriate, including but not limited to Metro-North Power Department Blue Sticker Training. The Contractor is responsible to cover any of its cost related to attending any Metro-North supplied training.

2.4.8 Metro-North will inspect Contractor’s high-rail equipment at the Bridgeport, CT MOW facility. Required inspection forms will be provided to the Contractor by Metro-North at the inspections.

2.4.9 Metro-North at its discretion will arrange track outages. Refer to Section 3.3, “Track Outage Plan.”

2.4.10 Metro-North at its discretion will arrange power outages, including but not limited to de-energizing signal power lines.

2.4.11 Metro-North will participate in the Contractor’s coordination of work required in station areas so that passenger access to trains and other applicable Metro-North facilities is maintained at all times.

2.4.12 Metro-North at its discretion will witness testing.

2.5 Management and Administration

2.5.1 The Contractor shall be responsible for management of their activities over the entire project, including the management of all manufacturers, vendors, and sub-contractors utilized by the Contractor.

2.5.2 The Engineer will schedule the initial job meeting, referred to as the Pre-Construction Meeting, within ten (10) days of the Notice-to-Proceed and will notify all parties concerned of the time and place of the meeting.

   a. The Pre-Construction Meeting will be conducted by MNR and the
Engineer and will address the conduct of the job, lines of communications, and similar concerns.

b. The Contractor’s Project Manager, OSP Engineer, Installation Manager and an officer of the Contractor shall attend, along with the Engineer and other Metro-North representatives.

2.5.3 Beginning at Notice to Proceed through all phases of the Project including but not limited to installation planning and review, fabrication, assembly, installation, testing, final acceptance and warranty period, the Contractor’s Project Management Team shall document, monitor and facilitate the creation of the Work. The Contractor shall use the following methods at minimum to document, monitor and facilitate the creation of the Work:

a. Project Progress Meetings
b. Progress Report
c. Work Plan
d. Look Ahead Schedule
e. Track Meetings and Track Outage Schedules

2.5.4 The Engineer and Metro-North will schedule and conduct Project Progress Meetings. Project Progress Meetings shall be held in the Engineer’s Field office. The Contractor’s Project Manager shall attend each Project Progress Meeting. Other Contractor key team members shall attend Project Progress Meetings as required by the Engineer. The Contractor shall provide updated written versions of the Progress Report, Work Plan and Look Ahead Schedule at each Project Progress Meeting. The Progress Report, Work Plan and Look Ahead Schedule documentation shall address, but not be limited to, the following items and each of the following shall be discussed at each Project Progress Meeting:

a. Safety, Health and Environmental Control.
b. Quality Control.
c. Installation Planning, including Installation Drawing Review.
d. Submittals and Procurement.
e. Fabrication and Assembly.
f. Scheduling including but not limited to issues affecting progress of the Work and coordination with Railroad activities.

g. Proposed track usage and proposed requirements for railroad flagging, Class A linemen, and power outages.

h. Test Plan development and implementation.

2.5.5 The Contractor shall develop a written Work Plan that describes the Contractor's plan and approach for the Work of the Project including but not limited to details such as the proposed number of Contractor installation crews, use and location of on-track high-rail vehicles, and Metro-North flagging and Force Account staff. The initial version of the Work Plan shall be submitted to the Engineer prior to the first scheduled Project Progress Meeting. The Work Plan shall be updated monthly and submitted to the Engineer by the 10th of each month for the duration of the project.

2.5.6 The Contractor shall develop a detailed Critical Path Method (CPM) style Schedule, demonstrating how the Contractor proposes to schedule, phase and stage the Work. All items addressed in the Work Plan shall be included in the Schedule, including but not limited to the proposed number of Contractor installation crews, use and location of on-track high-rail vehicles, Metro-North flagging and Force Account staff. The initial version of the Schedule shall be submitted to the Engineer prior to the first scheduled Project Progress Meeting. The Schedule shall be updated monthly and submitted to the Engineer by the 10th of each month for the duration of the project. At each submittal, the upcoming one-month period shall be detailed to the greatest extent practicable, serving as a one-month Look-Ahead Schedule.

2.5.7 The Contractor shall develop a written Progress Report that describes the Contractor’s progress in the Work of the Project, including but not limited to adherence to the approved Work Plan and Schedule. The Progress Report shall identify all issues affecting the Work and their impact to the Work Plan and the Schedule. The Contractor shall submit the first Progress Report to the Engineer prior to the first scheduled Project Progress Meeting. Subsequently the Contractor shall develop a Progress Report each month and shall submit it to the Engineer by the 10th of each month for the duration of the project.

2.5.8 Safety training of the Contractor’s forces shall be required for any employee entering Railroad right-of-way property. The Railroad will provide safety training to the Contractor’s forces at Railroad facilities free of charge. Basic Safety Training will last one-half day in duration. The
Contractor is responsible for all costs related to attending Metro-North supplied training. Also, Metro-North Power Department Blue Sticker Training is required for all IBEW Journeymen linemen.

2.6 Project Team

2.6.1 The Contractor shall provide all personnel required to perform the Work that is required in these Contract Documents.

2.6.2 The Contractor shall provide a Project Management Team that shall be responsible for the implementation of the elements of the Contract as defined herein.

2.6.3 A dedicated Project Team shall be assigned to the project until final Metro-North acceptance. The Project Team shall include but not be limited to the following members, referred to herein as key personnel or key members: the Project Manager, Outside Plant (OSP) Engineer and an Installation Manager.

2.6.4 As part of the Contract Bid, The Contractor shall submit resumes of key personnel, their responsibilities for this Contract and all other assignments for these individuals external to this Contract. The resumes shall demonstrate how each person is qualified to perform the duties and meet the requirements of each key position.

2.6.5 Once approved by the Engineer, key personnel shall not be removed from this project without the written approval of the Engineer.

2.6.6 Of the key members, the Project Manager and Installation Manager shall be assigned to this project at full-time level for the duration of this project.

2.6.7 As part of the Contract Bid, Key personnel shall submit references for a minimum of five comparable projects conducted over the last ten years, inclusive of project title, description (to include project location, installation length, types of cable installed and methods and means used for installation), owner, address, contact telephone and e-mail address.

2.6.8 Any and all design and engineering tasks shall be performed under the direction and responsibility of qualified key personnel. Checking processes shall be performed by others within the Contractors magnitude to this project.

2.6.9 The Contractor shall submit a listing and organization chart for all personnel necessary for completion of this Contract prior to any
installation work.

2.7 Project Manager

2.7.1 The requirements of the Contractor’s Project Manager shall include, but not be limited to, the following:

a. Shall be a full-time employee of the Contractor.

b. Shall have a minimum of 10 years experience in the management of large and complex engineering projects to include outside plant fiber optic and copper cable design, procurement and installation for a railroad or public utility.

c. Shall have the authority to make both engineering and contractual commitments and decisions that are binding on the Contractor.

d. Shall interface with the Railroad to coordinate all project activities.

2.7.2 Project Management responsibilities of the Project Manager shall include but not be limited to, the following:

a. Preparation of all project reporting and correspondence documents in accordance with the Terms and Conditions and these Technical Specifications.

b. Attendance at all coordination and project meetings in conformance with the Contract Terms and Conditions and this Scope of Work.

c. Management of all submittals called for or inferred in the Contract Documents, in accordance with Section 12, “Submittals,” to the Engineer for approval.

d. Supervision of all Contractor activities as defined.

e. Development of work plans and timetables for project completion.

f. Development, update and submittal of overall monthly project schedules.

g. Development and management of procedures regarding submittals.

h. Conduct of regular meetings to review project progress and modifications.
i. Provision of process for design review.

j. Provision and coordination of a system of securing, maintaining and distributing documents.

2.7.3 The Project Manager shall be responsible for supervision of ongoing work to include but not be limited to:

a. Submittals.

b. Coordination with Railroad activities.


d. Technical plans and drawings.

e. Provisioning tables.

f. Engineering calculations.

g. Cost estimates.

h. Schedules.

i. Documentation.

j. All Deliverables.

k. Quality Control measures.

2.8 Outside Plant Engineer

2.8.1 The Outside Plant (OSP) Engineer shall be responsible for confirmation of the design as presented in these Contract Documents and to certify that the Contractor can perform the installation as required. Any exceptions or proposed alternatives shall be submitted in writing to the Engineer, complete with all necessary calculations and design changes as may be required by the Contractor’s proposed alternatives.

2.8.2 The OSP Engineer shall be a registered professional Engineer (PE) in the State of Connecticut and shall have no less than five years of experience as an engineer on projects of similar complexity for a railroad or a utility. The OSP Engineer shall be required to certify the design prior to installation and to perform any engineering services consequential to Contractor proposed alternatives or unexpected field conditions.
2.9 Installation Manager

2.9.1 The Installation Manager shall be a full time employee of the Contractor. The Installation Manager shall have at least ten (10) years of experience in the day-to-day management, supervision, and oversight of the field installation of similar installation projects for railroads or utilities. The Installation Manager shall have experience in the management, supervision and oversight of installation projects that include railroad applications such as train control, railroad communications systems, etc.

2.9.2 The Installation Manager shall have day-to-day responsibility for the management, supervision and oversight of the installation work of this Project.

2.10 Installation Planning

2.10.1 No less than 30 days before beginning field work; the Contractor shall submit to the Engineer for approval detailed Working Plans and Installation Plans. Working Plans and Installation Plans shall be comprised of plans and drawings depicting all detailed information required for the Work of this Project, including but not limited to execution, installation and routing of all aerial duct, fiber optic and copper cables, and all related hardware. Working plans shall also be prepared to detail the numbers, sizes, and installation of above grade and underground conduits, cable troughs, cable trays, and cables. These plans shall demonstrate, to the satisfaction of the Engineer, that the Contractor has planned the placement of fiber optic and copper cable in each area of the project. Additional requirements for Working Plans and Installation Plans are included in Section 11, “Drawings and As-Built Plans.”

2.10.2 Installation Drawings shall include but not be limited to the following items:

a. Detailed cable installation and routing drawings. Drawings submitted shall include installation and placement plans for all required conduit, raceways, aerial duct, and other hardware as proposed. Drawings shall depict all work sites and provide details for each type of installation.

b. Pulling plans, including pulling tension and sag calculations, the placement of temporary back-guys to counter all pulling tension against the catenary structure or pole, and the Contractor’s proposed method for monitoring pulling tension during cable installation. Pulling plans, including but not limited to tension and sag calculations and the use of temporary back-guys shall be shall be sealed by a Professional Engineer (PE) licensed in the State of Connecticut. Refer to Section 5.8,
"Sag and Tension for Aerial Duct and Copper Cable.

c. Cable length and placement plans for pulling, including proposed reel lengths for pulling cable between drop sites. Every effort shall be made by the Contractor to install the longitudinal fiber optic cable runs in a continuous uninterrupted fashion, without splices, for the length of the installation. Any non-continuity in the longitudinal fiber optic cables shall be submitted to the Engineer for approval.

d. Cable bending radius plans demonstrating minimum bending radius compliance both during and after installation.

e. Utility survey drawings indicating all utilities in the vicinity of the construction and buried cables in the vicinity of excavations.

f. All other Installation Drawings and details specified elsewhere within these Contract Documents, such as Installation Drawings for Signal Power Transformers (refer to Section 6, "Signal Power Transformers") and Signal Equipment Sites (refer to Section 7, "Signal Equipment Sites").

2.10.3 The Contractor shall review, survey, and inspect the Project work areas prior to preparing Installation Drawings. Representatives of the Engineer and/or Metro-North will participate in all inspections unless otherwise directed by the Engineer. Through these inspections the Contractor shall confirm the installation details, and shall supply the Engineer with Installation Drawings, schedules, and materials lists before mobilizing installation crews. The Contractor shall assess potential conflicts and address the conflicts in the installation plans. Within five days of the completion of the inspection, any deviations or exceptions to the design as presented in these Contract Documents and/or design changes approved by the Engineer shall be noted in writing and submitted to the Engineer for approval and disposition.

2.10.4 The Contractor is solely responsible to determine and supply the quantities of material required to complete the Project from "take offs" performed by the Contractor from the Contract Documents.

2.10.5 As part of Installation Planning the Contractor shall develop and submit a Material List, and a Schedule and Work Plan meeting the requirements of these Contract Documents.

2.11 Mobilization

2.11.1 Immediately upon receipt of Notice to Proceed, the Contractor shall begin mobilization in accordance with the Contract Documents.
Mobilization shall consist of, but not be limited to, all one-time costs necessary to initially set up a functional construction plant, including all insurance, bonds and permits, staging and storage areas, the Contractor's Field Office, and the Engineer's Field Office as described herein. No construction activity shall be initiated until the Engineer's Field Office and the Contractor's Field Office are fully mobilized, and deemed functional by the Engineer, unless otherwise approved by the Engineer. Mobilization shall also include recurrent costs, such as maintenance of office machines, all utility charges for heat, lighting, water and sewer, cleaning services, bottled water, and maintenance of sanitary toilet facilities within the offices, supplied with toilet paper, paper towels, soap and other necessary supplies for both the Contractor's Field Office and Engineer's Field Office. The work required for mobilization shall be done in a safe and workmanlike manner and shall confirm to any pertinent local or State law, regulation or code. Good housekeeping consistent with safety shall be maintained. Mobilization and preparatory work shall include but not be limited to the following:

a. Mobilization of construction equipment, materials, supplies, appurtenances and the like, manned and ready for commencing and continuing the work for each work site and work location.

b. Personnel services required prior to commencing actual site work for each work site.

c. All other preparatory work required for the commencement of the actual work on construction items.

d. Sanitary facilities at each work site. The Contractor shall provide portable sanitary facilities (i.e., port-a-potty, or equivalent). Facilities shall be maintained according to the provider’s schedule.

e. Trash pickup and Removal for each work site. The Contractor shall maintain the site in a clean and orderly manner. At the end of each work day, The Contractor shall pickup and legally dispose of all trash generated by the Contractor through the course of the day.

2.12 Demobilization

2.12.1 Upon completion of the Work the Contractor shall demobilize in accordance with these Contract Documents. Demobilization shall entail the removal from each work site of said equipment, appurtenances and the like.

a. Office equipment including computers, printers, fax, printer, etc. will
remain the property of Metro-North at the end of this Contract. The Contractor shall retire and remove all other construction plant, equipment, materials, supplies, field offices, facilities and other items.

b. The Contractor's Field office and Engineer's Field Office shall be maintained by Contractor until thirty (30) days after completion of the Work. The termination of lease agreements, repairs to offices, removal of equipment, furniture, utilities, etc., shall be at the Contractor's expense.

2.13 Construction Tools and Equipment

2.13.1 The Contractor shall provide all equipment and tools to perform the Work that is required in the Contract Documents, including but not limited to all on-track (high-rail) and off-track vehicles and machinery.

2.13.2 All construction equipment shall be maintained in good working order during the course of the project. Poorly maintained or unsafe equipment shall not be used.

2.13.3 All tractors and similar construction equipment shall be equipped with a roll bar or roll cage.

2.13.4 All construction equipment shall be equipped with spark arresters.

2.13.5 All construction equipment shall meet or exceed the safety requirements of OSHA, Metro-North, and all other appropriate federal, state, county, municipal, and permitting agency regulations.

2.13.6 The Contractor shall supply machinery and equipment adequate in design, capacity, state of repair, and operating condition to perform all work safely and efficiently.

2.13.7 The Contractor shall provide a sufficient number and type of tools, including hand tools.

2.13.8 Self-propelled equipment in the Work, whether moving alone or in combination, shall be equipped with backup lights and a backup alarm. The backup alarm shall conform to the requirements of the most recent version of SAE J994. The use of the alarm shall be in addition to requirements for workmen signaling the movement.

2.13.9 No Railroad-owned equipment is available for use by the Contractor.
2.14 High-rail Equipment Requirements

2.14.1 The Contractor is advised that where required and as approved by the Engineer, the Contractor may use high-rail equipment (boom and bucket trucks, material trucks, trailers, etc.) for installation activities and movement of equipment and/or materials to or from specific work sites. No Contractor or Metro-North work trains, engines or railcars shall be permitted. Only high-rail vehicles are permitted.

2.14.2 Contractor’s high-rail equipment shall be inspected and approved by the Engineer and appropriate Metro-North maintenance personnel at the Bridgeport, CT MOW facility prior to use on the Railroad, and at least every 90 days thereafter. Appointments are required for inspection. Required inspection forms will be provided to the Contractor by Metro-North at the inspection.

2.14.3 The Contractor shall submit all on-track equipment dimensions to the Engineer for review and approval prior to the start of construction.

2.14.4 Use of high-rail mounted equipment shall be governed by the Rules of the Railroad, including but not limited to piloting of high-rail equipment by qualified Metro-North employees.

2.14.5 High-rail equipment is a subset of construction equipment and shall comply with all applicable requirements stated for construction equipment.

2.15 Permits

2.15.1 The Contractor shall obtain and pay all costs for all permits required for the construction activities and for installation of temporary facilities. The Contractor shall meet with all parties as may be necessary, including city, state, local, utility entities, and community groups or residents. Any and all costs for police shall be the responsibility of the Contractor. The Contractor shall provide all drawings, sketches, engineering, authorizations, seals and whatever other material may be required to secure the necessary permits.

2.15.2 The Contractor shall submit copies of all permits described in paragraph 2.15.1 to the Engineer prior to commencement of work for which permit is required.

2.15.3 Metro-North will provide copies of all permits acquired by the Railroad for the project. The Contractor shall comply with all
requirements of these permits.

2.15.4 Work shall not commence in areas requiring permits prior to issuing of said permits from authorities having jurisdiction. The Contractor shall coordinate with regulatory agencies to assure the issuance of all required permits.

2.16 Utility Coordination

2.16.1 Work to be performed under this Contract is located on the Metro-North Railroad right-of-way. There may be circumstances where cables to be installed or removed by the Contractor pass over a roadway bridge in parallel with existing Metro-North cables or cross other existing utilities. In all such circumstances where such installations or removals are in close proximity to utilities owned or operated by entities other than Metro-North Railroad (e.g. electric company, telephone, cable TV, etc.) it shall be the Contractor’s sole responsibility to coordinate all such installation and/or removal activities with the utilities directly, and in advance of commencing any work in those areas. The Contractor shall submit to the Engineer a written notification of each and every coordination or application to any utility. The Contractor shall submit to the Engineer for approval written notification of the completed coordination and/or approved application a minimum of one week in advance of commencing the work at any applicable location.

2.16.2 The Contractor shall take necessary precautions to identify, locate, avoid contact with, and protect existing public, private, and Metro-North Railroad facilities. The Contractor shall provide for the location of Metro-North’s facilities in accordance with the requirements of “Article 1.00 PROTECTION OF UNDERGROUND METRO-NORTH RAILROAD FACILITIES” attached to these specifications as Appendix B.

2.17 Work Restrictions

2.17.1 The work area, being an active railroad operating twenty-four (24) hours per day, seven (7) days per week, will require that the Contractor in coordination with Metro-North perform certain work during restricted late evening and early morning hours of low and restricted train activity.

2.17.2 The Contractor is advised that during the course of the Work, Railroad protective personnel (Flagman, pilots, Power Department Class A Groundmen, etc.) will be required for work at specific locations, in accordance with the requirements of this Section.
2.17.3 Metro-North will furnish the services of all flagmen, pilots, ground men and other protective personnel, at the locations required by Metro-North, to protect the operation and safety of train traffic and construction, throughout the duration of this Contract. There will be no charge to the Contractor for protective personnel provided the Contractor notifies Metro-North in writing fourteen (14) days in advance of the work. The requirement for protective personnel will be at the sole discretion of Metro-North.

2.17.4 A separate flagman is required for each stationary work crew that is concurrently performing work for which flagging is required. Separate Power Department Class A ground men may also be required depending on work proximity to energized lines.

2.17.5 If the Contractor fails to notify Metro-North before the deadline noted above, the availability of protective personnel cannot be assured. If protective personnel are available, the cost for the personnel shall be borne by the Contractor.

2.17.6 Cancellation of requests for protective personnel shall be received by Metro-North a minimum of ninety-six (96) hours prior to the scheduled work. Failure to notify Metro-North of work cancellation prior to this deadline shall result in the Contractor bearing all costs for protective personnel and related Metro-North costs. Flagging costs for this purpose shall be calculated as follows:

a. $700 for 8 hours Monday through Friday
b. $1,000 for 10 hours Monday through Friday
c. $1,300 for 12 hours Monday through Friday
d. $1,100 for 8 hours Saturday or Sunday
e. $1,400 for 10 hours Saturday or Sunday
f. $1,600 for 12 hours Saturday or Sunday

2.17.7 If protective personnel are scheduled to work and no work is performed by the Contractor, the costs for the protective personnel and related Metro-North costs shall be borne by the Contractor. The Contractor shall reimburse Metro-North for the above-noted charges within a reasonable time as determined by Metro-North. Failure to reimburse Metro-North will result in deduction of the charges from any monies due the Contractor under this or any other contract with Metro-North.
2.17.8 No charges will be incurred by the Contractor for scheduled protective personnel unable to work due to cancellation of the work for reasons beyond the Contractor’s control.

2.17.9 The Contractor is notified that certain construction operations may require obtaining a track outage from the Railroad. The Contractor shall assume that any and all operations which foul the operating New Haven Line tracks will require a track outage. Fouling of track is defined elsewhere in these Contract Documents. If the Contractor’s operation is not fouling the adjacent live track, then the requirement for a track outage shall be determined by the Engineer.

2.17.10 Requests for track closures or outages, if required, shall be made in accordance with the Contract Terms and Conditions and Section 3.3, “Track Outage Plan.”

2.17.11 A track outage shall constitute the removal of a track from service by the Railroad.

2.17.12 In the event of emergencies, the Contractor shall immediately vacate the work area, or restrict work, as directed by the Railroad.

2.18 Work on the New Haven Line, Catenary Territory

2.18.1 The Contractor shall comply with the following requirements regarding catenary traction power territories:

2.18.2 Overhead wires and substation apparatus shall be considered energized at all times except when it is known that they have been de-energized and properly grounded. Third rail shoes and related equipment on M-2, M-4, M-6, M-8 or other Metro-North dual-mode (third rail and catenary) vehicles shall be considered energized at all times, even in catenary territory.

2.18.3 Until wires are de-energized, tested for potential, properly grounded, and proper protection afforded by a qualified Power Department employee, all unqualified persons shall not approach closer than 10 feet to transmission wires, catenary system, and signal power wires. Contact with third rail shall be avoided.

2.18.4 Contractor employees and subcontractors shall not work within 10 feet of railroad wires without proper authorization and protection by a Metro-North Class A employee, who will take necessary precautions for their safety before starting and during the progress of the
2.18.5 PROTECTING CONTRACTOR LINEMAN - Persons other than Metro-North employees requesting to work closer than 10 feet to any transmission system wires, catenary system, signal power wires, or apparatus, must either work under the protection of a Metro-North Class “A” employee or meet the following conditions:

a. Employee is qualified in the electrical trade as a “Journeyman Lineman” and has successfully completed “Contractor Lineman Orientation Training” provided by Metro-North Power Department.

b. The following prerequisites must be met prior to employee attending “Contractor Lineman Orientation Training.” Employee must provide a copy of his/her apprenticeship program to the Power Department Manager Field Operations. Employee must provide a copy of a current certificate stating that he/she is a “Journeyman Lineman” to the Power Department Manager Field Operations. Employee’s employer must provide a copy of his/her company’s protective procedures to the Power Department Manager Field Operations.

c. After successfully completing “Contractor Lineman Orientation Training,” employee will be issued a numbered "Blue Tag" identification sticker which shall be applied to the back side of his/her hard hat. The "Blue Tag" identification sticker must be visible while employee is working as a Journeyman Lineman.

2.18.6 The following procedure for obtaining and releasing clearances when offering outage protection to Contractor Lineman authorized to work on Metro-North’s Power System shall be followed:

a. Contractor Representative contacts Metro-North and requests outage.

b. Metro-North Class “A” Employee: Obtains outage with clearance and properly grounds circuit. Indicates to the Contractor Representative the circuit that has been de-energized and the location of the grounding devices applied. Obtains on the Metro-North Clearance Form (MP260) the signature of the Contractor Representative, indicating that he has been instructed and will confine Contractor work within the limits outlined to him by Metro-North.

c. Contractor Representative: Implements his company’s protective procedures. Explains the limits of the Clearance to his own forces. Instructs authorized linemen that they must stay at least 3 feet away from any transmission systems wires, catenary system or signal power...
wires not listed on the Clearance. Can delegate authority to journeyman lineman to obtain additional signatures and give appropriate job briefings. (Not the Clearance.) Instructs all other contract employees (lineman apprentice, helper, etc.) that they must not approach within 10 feet of any exposed energized transmission systems wires, catenary system or signal power wires, until such wires are de-energized, tested for potential, properly grounded, and proper protection afforded by a qualified Power Department Class “A” employee.

d. Metro-North Class “A” Employee retains Clearance Form for the duration of the outage.

e. Contractor Representative: Notifies Metro-North upon completion of all work subject to the extended outage. Informs Metro-North that all work is completed, all workmen’s grounds are removed, all men are clear. Shall present to the Metro-North Class “A” Employee, the Contractor’s properly completed Daily Clearance Form.

f. Metro-North Class “A” Employee: Obtains on the Metro-North Clearance Form (MP260) the signature of the Contractor Representative, indicating that he has been advised that the wires will be energized and all his forces shall remain at a safe distance from the wires. Removes Metro-North applied grounds. Contacts the Power Control Center to cancel the Clearance.

2.18.7 The Contractor shall comply with all current Metro-North Power Department requirements. In the event of a conflict between requirements stated herein and current Metro-North Power Department requirements, the Power Department requirements will govern.

2.19 Maintenance and Protection of Street Traffic

2.19.1 The Contractor shall comply with these requirements regarding the provision, relocation and removal of all temporary barricades, barriers, detour signing, etc., as required for the maintenance and protection of traffic in streets and for maintenance of traffic to existing commercial facilities at or adjacent to the Project Site:

2.19.2 The Contractor shall contact local authorities having jurisdiction over pedestrian and vehicular traffic. He shall cooperate with them in providing any temporary controls or devices required to eliminate or minimize congestion or obstruction of local pedestrian and vehicular traffic caused by the Work.
2.19.3 Also included is the required coordination with affected Cities and other agencies and adjacent property owners.

2.19.4 All work performed shall conform to the FHWA Manual of Uniform Traffic Control Devices (MUTCD) and ConnDOT Standards.

2.19.5 Materials except as otherwise specified or indicated shall comply with the requirements of MUTCD or ConnDOT Form 816 Standard Specifications.

2.19.6 Materials for temporary maintenance and protection of traffic, including re-used materials, shall be in accordance with ConnDOT Form 816 Standards.

2.19.7 For each item, at least 30 days prior to intended activity, the Contractor shall submit certifications of compliance for materials to be utilized.

2.19.8 The Contractor shall be responsible for all charges associated with the maintenance and protection of traffic such as local municipality charges for police flagging protection of the street. All costs associated with this work are to be included in the Contractor's price; there will be no separate payment or reimbursement for any costs associated with this work.

2.20 Requirements for Work Affecting the Railroad

2.20.1 The Contractor is hereby advised that portions of this project involve an operating railroad and as such the Contractor shall be required to coordinate all of its operations with those of Metro-North. While every effort will be made to minimize interruptions, tracks to be occupied for construction and the adjacent track (where applicable) may not be available to the Contractor at certain times due to Metro-North needs.

2.20.2 Metro-North Force Account work will be performed in conjunction with the Work of the Contractor, in accordance with the requirements of the Contract Documents. The Contractor shall coordinate with Metro-North through the Engineer, to avoid disruption of, or interference with, Metro-North operations.

2.20.3 The need for protective personnel (flagmen) or track outages shall be at the discretion of Metro-North, in accordance with these Contract Documents.
2.20.4 Any damage caused by the Contractor to rails, ties, embankment, signal and/or communication equipment, or other Railroad facilities shall be repaired by Metro-North forces (or others, at Metro-North’s sole discretion), at the Contractor’s expense.

2.20.5 Use of explosives is prohibited.

2.21 Protection of Railroad Facilities

2.21.1 The Contractor shall direct the course of all construction operations to safeguard the tracks, rolling stock and other equipment and appurtenance of the Railroad from being damaged in any manner and shall accept full responsibility of any and all damages to Railroad property and facilities caused by Contractor operations.

2.21.2 When the operating track, or a power, communication or signal line of the Railroad is or may be fouled or affected, in the course of performing the Work, the Contractor shall not undertake the operation until at least fourteen (14) days advance notice has been given to the Engineer, so that the Railroad may arrange to supply special supervisory and protective forces. Further, no such work may actually commence until the Engineer affirmatively advises the Contractor that the necessary protective forces are stationed and then it may proceed.

2.21.3 The Contractor shall notify the Engineer in the monthly look-ahead schedule that he intends to do work in an area where cables may be located. The Engineer will endeavor to have Metro-North personnel locate any cables in the identified area so that the Contractor will not disturb them.

2.21.4 Except as otherwise provided for in these Contract Documents, the Contractor shall not store materials or equipment upon Railroad right-of-way without first obtaining written permission of the Engineer.

2.21.5 If, during the progress of the work, trains, tracks or other facilities of the Railroad are endangered, the Contractor shall immediately do the necessary work as ordered by the Engineer, to restore the operation to a safe condition. Such work, if necessitated by the Contractor’s actions, shall be at no cost to the Railroad. Should the Contractor fail to carry out the Engineer’s order immediately, the Railroad, at the expense of the Contractor, may take whatever steps it deems necessary to restore the operation to a safe condition.
2.21.6 Without regard to the requirements specified in this Section, whenever any part of the Work may affect the safety or movement of trains, the method of doing the same shall first be submitted to the Engineer for approval and may not be performed without such approval. The approval of the Engineer shall not release the Contractor from any of its obligations under this Contract.

2.22 Contractor Use of Worksite

2.22.1 The Contractor shall confine worksite operations to areas permitted by the Railroad, ordinances and permits, and to areas for which the Contractor has obtained easements. The Contractor will not be allowed to use any other areas of the site to perform these functions unless approval has been received from the Engineer.

2.23 Temporary Work and Facilities

2.23.1 The Contractor shall supply any temporary facilities necessary to accomplish the Work, including but not limited to field offices, material storage facilities, and all related temporary services and utilities, in accordance with these Contract Documents.

2.23.2 The Contractor shall procure any and all temporary facilities, including but not limited to parking areas, work areas, staging areas, storage space, etc., at no additional cost to Metro-North. The Contractor shall provide temporary storage containers, offices, tool houses and other facilities as required for his own use. All temporary facilities used by the Contractor shall be maintained in a clean and neat manner. The areas shall be restored to their original condition prior to the completion of the Work.

2.23.3 The Contractor shall pay all costs associated with temporary facilities including the cost of easements as may be required.

2.23.4 Temporary structures shall be maintained in satisfactory condition and in a neat appearance.

2.23.5 Upon completion of all other work under this Contract, or when directed by the Engineer, the temporary structures shall be removed from the site and disposed of by the Contractor.

2.24 Requirements of Regulatory Agencies

2.24.1 The Contractor shall obtain and pay all costs for all permits.
required for installation and maintenance of temporary facilities and shall maintain such permits in force as long as required by the Work. The Contractor shall comply with all applicable Federal, State, local regulations, codes and utilities from whom services are obtained. In the event of a conflict between agencies requirements the most stringent provisions will govern.

2.25 Temporary Utilities

2.25.1 The Field Offices required in these Technical Specifications shall be connected to utilities (power, telephone, sewer, etc.) by the Contractor. The Contractor shall bear all costs associated with this work. The Contractor shall be responsible for obtaining any necessary permits. The electric service shall be of sufficient size to adequately provide power to lights, cool and heat the Contractor’s and Engineer’s Field Offices utilizing wall mounted A/C units and electric baseboard heating furnished with the offices which will provide the specific illumination level and ambient temperature inside the offices. No Metro-North power is available.

2.25.2 The Contractor shall engage the appropriate local utility company to install temporary service or connect to existing service. Where the utility company provides only part of the service, the Contractor shall provide the remainder with matching, compatible materials and equipment, and comply with the utility company recommendations.

2.25.3 The Contractor shall furnish telephone service for the duration of the Project consisting of at least one separate business line for each telephone and fax machine provided in the field offices.

2.25.4 The Contractor shall furnish Internet service for the duration of the Project serving all of the field office computers. A minimum download speed of 25 Mbps is required.

2.25.5 Prior to starting Work, the Contractor shall furnish adequate toilet and sanitary facilities for use by all persons engaged in the Work. Facilities shall comply with the requirements and regulations of the applicable jurisdictional agencies of the locale in which the Work is being performed, and shall be maintained in a thoroughly sanitary condition at all times.

2.25.6 The Contractor shall make arrangements for all temporary water service as required for the Work, and shall pay all costs in incurred in obtaining and supplying temporary water.
2.25.7 The Contractor shall arrange with the utility company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.

2.25.8 The Contractor shall provide adequate capacity at each stage of construction. Prior to temporary utility availability, the Contractor shall provide trucked-in services.

2.25.9 The Contractor shall obtain easements to bring temporary utilities to the site, where the existing easements cannot be used for that purpose.

2.25.10 The Contractor shall pay all Cost of Use Charges. The Cost of Use Charges for temporary facilities is the responsibility of the Contractor, and will not be accepted as a basis of claims for a Change Order.

2.26 Engineer’s Field Offices for Metro-North

2.26.1 The Contractor shall furnish and install the Engineer’s Field Offices within thirty (30) days after the Notice of Award, and shall bear all monthly costs associated with the maintenance of the field office. The Contractor will not be permitted to start any construction activity until the field offices are fully furnished and operational.

2.26.2 The Engineer’s Field Offices shall be two approved weatherproof buildings or mobile trailers. One building/trailer shall be designated for office use, the second for meetings. The structures shall have a minimum ceiling height of 7 feet and shall be provided with weatherproof windows and weatherproof doors each equipped with adequate locking devices. Each window shall have a minimum area of eight square feet, shall be screened and of a type that will open and close to provide adequate ventilation.

2.26.3 The Engineer’s Field Office designated for office use shall provide a minimum 720 square feet of floor space with two outside doors and eight windows.

The office shall be partitioned to provide two rooms with an adjoining door. The smaller room shall be not less than 96 square feet in net floor area and shall contain two of the eight windows. Doors and windows shall be provided with high security bars and grills.
2.26.4 The Engineer’s Field Office designated for meeting use shall provide a minimum 400 square feet of floor space with two outside doors and four windows. Doors and windows shall be provided with high security bars and grills.

2.26.5 The Field Offices furnishings shall be as follows, applying to both offices unless designated otherwise:

a. LIGHTING. Electric light, non-glare type luminaries to provide a minimum illumination level of 100 ft.-candles at desk height level.

b. HEATING AND COOLING. Adequate equipment to maintain an ambient air temperature of 70 degrees F ± 5 degrees.

c. POTABLE WATER. From local municipal waterline and/or bottled water with refrigerator unit - hot/ cold water.

d. FIRST AID KIT. The Contractor shall keep the kit properly stocked with appropriate first aid supplies at all times.

e. TOILET. A separately enclosed room, properly ventilated and complying with applicable sanitary codes. The Contractor shall provide all lavatory amenities, necessary paper and soap products, hot and cold running water and a flush-type toilet. Water for toilet use shall be obtained from local municipal waterline or from a water tank provided at the jobsite by the Contractor. The Contractor shall replenish the water supply as required. Sewage shall be disposed of in accordance with all local or municipal requirements.

f. LOCKER. A metal locker with lock of sufficient size for storage of surveying instruments and testing equipment. Approximately 72" high by 36" wide by 18" deep.

g. FIRE EXTINGUISHER. Non-toxic dry chemical, fire extinguisher meeting Underwriters Laboratories, Inc., approval for Class A, Class B and Class C fires with a minimum rating of 2A: 10B: 10C and water fire extinguisher. One (1) per room.

h. FIRE RESISTANT CABINET. A quantity of two fire resistant, 4 drawer, legal size file cabinet with lock and 2 keys, meeting the requirements for “Insulating Filing Devices, Class 350-1 Hour (D)” of ANSI/UL 72 or the Class D rating of the original Underwriters Laboratories specification for insulated filing devices.

i. THERMOMETER. A minimum-maximum thermometer.
j. SIGNS/BULLETIN BOARD. The Contractor shall furnish and install necessary signs to locate and identify the Project Engineer’s Office. The Contractor shall furnish and install a 4’ x 8’ weatherproof Bulletin Board in front of or adjacent to the Project Engineer’s Office. This Board may also be attached to the Office on an outside wall that is easily accessible and clearly visible.

k. POST OFFICE BOX. A post office box shall be provided at the nearest U.S. Post Office.

l. OFFICE FURNITURE. For the Engineer’s Field Office designated for office use provide 3-each office desks with drawers and locks not less than 2.5’ x 5.0’ each. For the Engineer’s Field Office designated for meeting use provide a conference table and chairs for 20 persons.

m. FREE STANDING DESKTOP COMPUTER WORKSTATIONS. Provide 2 each Desktop Computer Workstations. With a 60" long by 30" wide work surface and height of 27". The workstations shall include an adjustable shelf approximately 12” wide and not less than 30” long. The workstations shall be fully assembled and be provided with an antistatic tabletop mat; approximately 10” long by 24” wide.

n. ERGONOMIC MICROCOMPUTER WORKSTATION CHAIR. Provide 6 chairs with arms, five (5) legs w/casters and adjustable from approximately 17” to 23” height by pneumatic gas cylinder. The chairs shall be fully assembled.

o. DRAFTING TABLE Provide 1-each drafting type table: 3.0’ x 6.0’ and supported by wall brackets and legs and 2-each draftsman’s stools.

p. VERTICAL FILING PLAN RACK – 1-each for 12 sets of plans.

q. ROLL FILE UNIT – 1-each with twelve 6” x 6” compartments for twelve cross-section rolls each 22 inches long.

r. OFFICE TABLE – 4-each office tables, not less than 3.0’ x 6.0’.

s. MAINTENANCE. The Contractor shall maintain all facilities and furnished equipment in good working condition. The Contractor shall provide and make available for Metro-North use an on-call Information Technology (IT) service to set up and maintain the office equipment.
The Contractor shall provide telephone service and DSL or better Internet service to each of the three provided computers for the Contract duration. The Contractor shall provide office supplies with a minimum of $300 start-up allowance and $150 allowance for each month thereafter for the Contract duration. The Contractor shall furnish daily janitorial services for the Engineer’s Field Offices, toilets, storage buildings and areas, etc., and perform any required maintenance of facilities as deemed necessary by the Engineer during the entire life of the Contract.

2.27 Field Office Equipment

2.27.1 The Contractor shall furnish and install all of the following field office equipment exclusively for the Engineer’s use within 30 days after the Notice of Award, and shall bear all monthly costs associated with the maintenance of the field office equipment:

a. Two (2) Desktop Computers – Equipped with the most current version of the Windows operating system and meeting specifications to be provided by Metro-North.

b. One (1) laptop computer – Equipped with the most current version of the Windows operating system and meeting specifications to be provided by Metro-North.

c. Each Desktop Computer will be provided with two (2) LCD 24” monitors equipped to work in dual monitor mode with the Computer supplied. Each laptop computer will be equipped with a docking station and two (2) 24” monitors equipped to work in dual monitor mode with the Computer supplied. The laptop computer shall also be provided with a 4G Wireless Internet device and the Contractor shall pay all initial fees and monthly charges for wireless internet access.

d. Two (2) printers – One Laser printer for 8/12” x 11” monochrome printing, one color inkjet or similar printer for 11” x 17” color printing, equipped to work with the desktop and laptop supplied.

e. One flat bed document scanner, with USB connection for 81/2” x 11” paper and required operating software, equipped to work with the desktop and laptop supplied.

f. Each computer shall be equipped with the latest available versions
of application software – to include, but not be limited to Adobe Acrobat Professional (Full Edition), AutoDesk DWG TrueView (AutoCAD Viewer), and Microsoft Office Standard Edition that shall minimally include Word, Excel, Outlook, and PowerPoint. Each computer shall also be provided with a USB type portable hard drive with a minimum of 1 TB storage capacity.

g. The Contractor shall supply all required interface cables for the computers, monitors, and printers.

h. TELEPHONE. The Contractor shall supply five (5) phones for the exclusive use of the Engineer. The phones shall have RJ-11 modular jacks at the wall and phone and be adaptable to electronic communications. All phones shall be configured for two-line operation. Phones shall be installed at locations as directed by the Engineer. One two-line phone shall be equipped with a 25-foot cord. The Contractor shall pay all installation, repair, and service bills for the Engineer’s telephone and fax usage including long distance calls.

i. TELEPHONE ANSWERING DEVICE. An FCC-approved automatic answering device capable of recording messages of 60 seconds long and receiving a minimum of 40 incoming messages of 60 seconds duration. The unit shall include a message mark so you can hear new messages without erasing old messages. The unit shall include remote programming of playback, backspace, and outgoing message re-record. The unit shall include computer-generated voice marking of time and day of each message received. The unit shall allow for the retrieval of messages by users from outside the office.

j. TELEPHONE FAX MACHINE. The Contractor shall provide the following fax machine exclusively for the Engineer’s use during the project:

1. DOCUMENT SIZE – up to 11” x 17”
2. SPEED - less than 20 seconds per page
3. COMPATIBILITY - Group G3
4. RESOLUTION - Standard, with 16-Shade Gray Scale
5. RECEIVING – Automatic
6. DOC. FEEDER - Automatic - 5 Sheets minimum
7. AUTO DIALER - 10 Phone Number Memory with automatic redial and on-hook dialing
8. TRANSMIT - Page Number, Sender’s Phone Number, and Name
9. TERMINAL ID
10. OUTPUT DOCUMENT – Plain paper up to 11” x 17”.
k. COPIER/PRINTER/SCANNER - Freestanding, heavy duty, network laser COPIER/PRINTER/SCANNER machine. The machine shall be capable of accepting 8.5" x 11", 8.5" x 14", and 11" x 17" sheets. The copy function shall be capable of sorting, collating, and stapling at least twelve (12) documents automatically. An adequate continuous supply of 20 lb. copy paper in the three (3) sizes shall be provided. The supply of copy paper toner and other supplies shall be replenished by the Contractor as required by the Engineer. The copy machine shall be set up as a wired network black & white/color printer and scanner to each furnished computer with capability of scanning to create a PDF file. Xerox WorkCentre 5945 or approved equal.

l. DIGITAL CAMERA. The Contractor shall supply a digital camera with removable digital media (Secure Digital - SD and Secure Digital High Capacity - SDHC) no less than 8 gigabytes in size that is directly compatible with a PC operating Windows. An Engineer approved interface shall be supplied with the camera for downloading the picture files from the camera removable digital media to the PC. The camera shall have no less than 16 megapixel resolution, and shall be equipped with both a 3" TFT-LCD and a mechanical viewfinder, suitable for outdoor use in bright sunlight. The camera shall be equipped with a carrying case, arm and neck strap. The camera shall be a Canon – PowerShot ELPH-340 16.0-Megapixel Digital Camera or Engineer approved equal.

m. COMMUNICATIONS DEVICES. The Contractor shall provide the Engineer with six communications devices using the Contractor’s preferred method of communications so that the Engineer and his representatives can communicate directly with the Contractor on the Contractor’s own system. If the Contractor is using two-way radios the Engineers shall be provided with 6-each two-way radios. If the Contractor is using cell phones with a 2-way radio feature then the Engineer shall be provided with 6- each cell phones with a 2-way radio feature on the same system.

n. TELEVISION/VCR. The Contractor shall provide a 40 inch minimum LCD Television and DVD player on site for Metro- North’s safety training of Contractor’s employees.

o. PENCIL SHARPENER. Provide one automatic (powered) pencil sharpener. FAX SUPPLIES. The Contractor shall provide all copier and fax supplies including paper, toner and maintenance for the duration of the Project at no additional cost.

p. DRY ERASE BOARD. Provide on 4’ x 5’ dry erase board.
q. COPY OF NATIONAL ELECTRIC CODE. Provide one copy of the latest NEC to remain as Metro-North property at conclusion of Project.

r. RANGE METER. Provide one Hilti PD 42 Handheld Laser Range Meter.

2.28 Discontinuance, Changes and Removal

2.28.1 All temporary services required by the Contract shall be discontinued when so directed by the Engineer. The discontinuance of any such temporary service prior to the completion of the Work shall not render the Railroad liable for any additional cost entailed thereby and the Contractor shall thereafter furnish, at no additional cost to the Railroad, any and all temporary services.

2.28.2 The Contractor shall remove and relocate such temporary facilities as directed by the Engineer without additional cost to the Railroad, and restore the site and the Work to a condition satisfactory to the Engineer.
3.0 WORK REQUIREMENTS

3.1 General

3.1.1 This Section describes and specifies the Requirements of the Work to be furnished under this Project, including a summary of the major items of Work to be provided, a list of the Contract Drawings, and requirements for the Track Outage Plan.

3.1.2 Additional details and requirements are provided in other Sections of these Technical Specifications, the Contract Drawings and the Contract Terms and Conditions.

3.1.3 The Contract Documents indicate the anticipated installation methodology at all locations. Obstructions, where known, have been shown on the Contract Drawings, however, the Contractor is advised that field conditions may impact the installation.

3.1.4 The Contractor shall use all new material for the Work of this Project. The use of reconditioned or previously used material is prohibited.

3.1.5 The Contractor shall procure, install and test fiber optic and copper cables throughout the Project area as shown in the Contract Drawings.

3.1.6 Longitudinal runs of 144-strand fiber optic cable in aerial duct shall be installed on both the north and south sides of the tracks throughout the Project Area. Slack loops shall be provided at various locations. Longitudinal runs of fiber optic cable shall be continuous lengths, ending only at specified locations.

3.1.7 The Contractor shall install 144-strand and/or 24-strand fiber optic drop cables between the longitudinal cables and the locations to be served, such as signal houses, signal cases, node houses, etc. Based upon field conditions and the Contract Drawings, at drop locations sufficient slack shall be coiled to accommodate future termination by Metro-North forces.

3.1.8 Longitudinal runs of 25-pair and 100-pair copper communication cable are existing and their installation is not part of this contract. This contract includes new drop cables that will be attached to the existing copper communications cable.

3.1.9 The Contractor shall install 25-pair copper communications drop cables from the longitudinal cable to the new signal house.
locations to be served. At drop locations sufficient slack will be coiled to accommodate future splicing and termination by Metro-North forces.

3.1.10 The Contractor shall install longitudinal runs of copper signal cable, and runs of copper signal power cable between signal houses and signal power transformers. Copper signal cables include 6-pair twisted pair cable. Copper signal power cables include 3-conductor No. 1/0 AWG power cable, 3-conductor No. 2, and 2-conductor No.4 power cable. Slack shall be provided in these cables at various locations to accommodate future splicing and termination by Metro-North forces. Longitudinal runs of copper communications cable shall be continuous lengths, ending only at specified locations. No splicing of copper communications cable shall be performed or permitted by the Contractor.

3.1.11 The Contractor shall install runs of aerial messenger strand. The aerial messenger strand shall be the primary support for all copper cables installed under this Project, including communications cables, signal cables and signal power cables. The copper cables shall be double “spun”, or double lashed, to the aerial messenger using approved methods as described in these Contract Documents. Any reference to “lashing” in the Contract Documents shall be interpreted as double lashing.

3.1.12 At drop locations the Contractor shall route and install various combinations of fiber optic drop cables, copper drop cables, copper signal power cables, and the ends of longitudinal copper signal and communications cables to the locations to be served, such as signal houses, signal cases, node houses, etc. Routing and installation shall include a combination of duct, conduits, cable troughs and other raceways as shown on the Contract Drawings. Drop cables and the ends of longitudinal cables shall sometimes cross the tracks lashed to messenger strand or inside an aerial duct supported on a catenary structure.

3.1.13 The Contractor shall fabricate, procure and install various hardware, supports, conduit, attachments, etc. to be used by the Contractor in installing aerial duct, aerial messenger strand and cables. This includes but is not limited to attachments to various types of catenary structures, attachments to walls, attachment to wood poles, attachment to bridges, attachment to high tension towers, attachment of conduit to various types of catenary structures, attachment of conduit to walls and station platforms, transitions from conduit to cable trough, from messenger and duct to conduit, and mid-span drops.

3.1.14 Underground or buried cable work shall be performed by the Contractor.
3.1.15 Refer to Section 5, “Installation,” for additional information and requirements regarding the installation of cables. Refer to Section 8, “Materials” for additional information and requirements regarding the cable and associated material to be installed.

3.1.16 The Contractor shall procure, install and test Signal Power Transformers and associated equipment, cabling, materials and hardware. Refer to Section 6, “Signal Power Transformers,” for additional information and requirements regarding the Signal Power Transformers.

3.1.17 The Contractor shall prepare and submit test plans for approval for testing the integrity of the cables, shall conduct the tests, and shall submit test reports documenting the results of the tests, in accordance with Section 9, “Testing,” of these Technical Specifications. The Contractor shall test Signal Power Transformers in accordance with Section 6, “Signal Power Transformers.”

3.2 Contract Drawings

3.2.1 The Contract Drawings depict the Work of this Contract.

3.2.2 Aerial Cable Routing Plans are a series of scaled plan view drawings that show the routing of the longitudinal (express) cables installed under this project. Each Drawing shows a geographical portion of the project.

3.2.3 Site Civil Drawings are a series of scaled and non-scaled plan sheets showing the installation of raceways, local cables, houses, cases, retaining walls, steel platforms, access stairs, and related features.

3.2.4 Signal Power Drawings provide information for the installation of transformers mounted on Catenary Structures in the locations designated on the Site Civil Drawings and as described in Section 6.0.

3.2.5 Snowmelter Drawings provide information for the installation of conduits, cables, other raceways, snow melter panels and related materials in the interlockings.

3.2.6 Cross Bonding Drawings provide information for the installation of Ground Buss cases, cross bonding cabling, and connections to provide step-and-touch security in accordance with Metro-North’s standards.

3.2.7 Details to be applied to each category of the work are included in the Contract Drawings.
3.3 Track Outage Plan

3.3.1 Portions of the Work of this Project will require track outages. Certain portions of the Contractor’s Work shall be limited as to the time when the work can be performed in order to minimize the effect on train operations. Track outages shall be considered on Contractor need, not convenience. The Contractor’s work schedule shall be governed by the requirements of this Section. The following Table 3.3.1 presents the order in which segments of the Work shall be accomplished. The Contractor shall complete the work outlined for each segment before beginning work in the next segment. The Contractor shall complete the work outlined for each segment by the date indicated in the column entitled “To Be Completed By.”
<table>
<thead>
<tr>
<th>Order</th>
<th>Segment Description</th>
<th>Work Description</th>
<th>Duration</th>
<th>To Be Completed By</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CP-229 Interlocking</td>
<td>Prepare Signal Equipment Sites and install raceways and cables. Install Pre-Wired Houses and Cases supplied by MNR.</td>
<td>NTP + weeks.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>CP-229 to CP-230 Including EL 293</td>
<td>Install aerial fiber and 6PR#14 express cables. Prepare Signal Equipment Site and install raceways and cables. Install Pre-Wired Case supplied by MNR.</td>
<td>NTP + weeks.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CP-230 Interlocking for Drawbridge</td>
<td>Prepare Signal Equipment Sites and install raceways and cables. Install Pre-Wired Houses and Cases supplied by MNR.</td>
<td>NTP + weeks.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CP-232 and CP-233 Interlockings</td>
<td>Install new Fiber Optic and Copper Cables with drop cables ready for termination by MNR</td>
<td>NTP + weeks.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>CP-234 Interlocking</td>
<td>Prepare Signal Equipment Sites and install raceways and cables. Install Pre-Wired Houses and Cases supplied by MNR.</td>
<td>NTP + weeks.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>CP-234 to CP-235 Including EL 337 and EL 340</td>
<td>Install aerial fiber and 6PR#14 express cables. Install Pre-Wired Cases supplied by MNR.</td>
<td>NTP + weeks.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>CP-235 Interlocking</td>
<td>Install new Fiber Optic and Copper Cables with drop cables ready for termination by MNR</td>
<td>NTP + weeks.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>CP-235 to CP-240 Including Intermediate Signal Locations</td>
<td>Install aerial fiber and 6PR#14 express cables. Prepare Signal Equipment Sites and install raceways and cables. Install Pre-Wired Houses and Cases supplied by MNR.</td>
<td>NTP + weeks.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>CP-240 Interlocking</td>
<td>Install new Fiber Optic and Copper Cables with drop cables ready for termination by MNR</td>
<td>NTP + weeks.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>CP-241 Interlocking Including Drawbridge</td>
<td>Prepare Signal Equipment Sites and install raceways and cables. Install Pre-Wired Houses and Cases supplied by MNR.</td>
<td>NTP + weeks.</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.3.1 – Ordering of Work Segments

3.3.2 Track outages cannot occur in adjacent blocks (CP to CP) simultaneously, and are only permitted in one block at a time, and for one track at a time.
3.3.3 Track outages and power outages do not always coincide. Track
outages, power outages, and protective personnel must be coordinated
at weekly meetings.

3.3.4 Permissible track and power outages are subject to coordination
with outages for other projects.

3.3.5 The Contractor shall dedicate sufficient time during each track
outage period to clear the tracks to allow track(s) to be restored to service
by the times indicated.

3.3.6 In the event of emergencies, the Contractor shall immediately
vacate the work area or restrict the work as instructed by the Railroad.

3.3.7 If power outages for feeder or catenary wires are required to
support the Work, the Contractor shall allow an additional 45 minutes at
the start and the end of a track outage period for placement / removal of
equipment grounds, as well as restoring power to the systems.

3.3.8 Track and power outages will be required as determined by
Metro-North and in accordance with OSHA regulations 1910.33(c).
(Generally any work that has an extended reach potential to be within 10
feet of any energized wire)

3.3.9 Feeder outages may not be available during inclement
weather.

3.3.10 Feeder outages are restricted to one side only (North or South)
for each work period of occurrence.

3.3.11 At the discretion of the Flagman the Contractor may be allowed
to foul tracks under flag protection and in accordance with all applicable
Metro-North Operating Rules provided there is no impact to rail traffic.
Railroad sidings and all tracks, whether or not they appear to be in use, are
not to be used by the Contractor for staging, high-rail access, or other use.
No track is to be fouled without flag protection and/or a track outage.

3.3.12 When required for the Contractor’s Work, Metro- North forces
will de-energize signal power lines. The north and south signal power lines
will not be de-energized simultaneously; therefore there will be no impact
to rail traffic or the train control system.

3.3.13 The following tables list the types of track outages available to
the Contractor by track section. The Contractor shall request these
outage types in preparing the Track Outage Plan for approval by Metro-
North.

Track Outages

Continuous Track Outages:
No continuous track outages are available for this project.

Peak Track Outages:
No peak track outages are available for this project.

Off Peak Track Outages:
Note: (Only one track outage option is available for each work shift, select one. Refer to paragraph 3.3.2, which limits the Contractor to having outages in one block (CP-CP) at a time.)

**CP 229 – CP-230**

Off Peak Night Outage Options:
- Track 3: 0030 hrs – 0530 hrs
- Track 4: 0030 hrs – 0530 hrs
- Tracks 2 and 4
- Tracks 1 and 3

**CP 230 - CP-232**

Off Peak Night Outage Options:
- Track 3: 0030 hrs – 0530 hrs
- Track 4: 0030 hrs – 0530 hrs
- Tracks 2 and 4
- Tracks 1 and 3

**CP 232 - CP-234**

Off Peak Night Outage Options:
- Track 3: 0030 hrs – 0530 hrs
- Track 4: 0030 hrs – 0530 hrs
- Tracks 2 and 4
- Tracks 1 and 3
CP 234 - CP-235

Off Peak Night Outage Options:

- Track 3: 0030 hrs – 0530 hrs
- Track 4: 0030 hrs – 0530 hrs
- Tracks 2 and 4
- Tracks 1 and 3

CP 235 - CP-240

Off Peak Night Outage Options:

- Track 3: 0030 hrs – 0530 hrs
- Track 4: 0030 hrs – 0530 hrs
- Tracks 2 and 4
- Tracks 1 and 3

CP 241

Off Peak Night Outage Options:

- Track 3: 0030 hrs – 0530 hrs
- Track 4: 0030 hrs – 0530 hrs
- Tracks 2 and 4
- Tracks 1 and 3

3.3.14 The Contractor shall be governed by the following regarding high rail inspections and the use of rail mounted equipment:

a. All high rail / rail mounted inspections shall be scheduled at least 2 weeks in advance.

b. All inspections shall be performed by Metro-North at the Connecticut DOT Bridgeport Maintenance of Way Facility, 989 Union Avenue, Bridgeport, CT.

c. The Contractor shall be required to have a vehicle/equipment operator present during inspections to operate the equipment.

d. All high rail / rail mounted equipment shall be used, maintained and be in compliance with the current 49 CFR part 214, State of NY Railroad law including section 76C and Bill A6722, and shall pass a quarterly Metro-North inspection. If high rail equipment is removed from Metro-North property for any reason, a re-inspection shall be required prior to use.
e. Rail mounted equipment shall be inspected for clearance requirements as outlined in FRA Plate “C”.

f. High rail / rail mounted equipment shall only be permitted to push / pull one pushcart (6’ x 20’) subject to Metro-North approval.

g. Amount of load / weight transported on pushcarts and or high rail / rail mounted equipment shall be subject to approval by Metro-North pending submission of equipment specifications and braking capacities.

h. All high rail / rail mounted cranes shall pass a Metro-North crane inspection.

3.3.16 The Contractor shall prepare the Track Outage Plan based upon their actual work plan. The Contractor shall submit the Track Outage Plan to Metro-North for approval in advance of mobilization as an integral element of the Contractor’s overall Work Plan.

3.3.17 The installation of cross track cables attached to the catenary structures is part of this contract. Track and power outages to permit the installation of these cable crossovers shall be coordinated with Metro-North. Cable crossovers cannot be installed across all 4 main line tracks during a single outage and must be installed utilizing two or more separate track and power outages. Additional outages may be required within the interlockings in those locations where catenary structures span additional tracks.

3.4 Access to Work Site

3.4.1 The Contractor’s access the work site shall be from property owned by the State of Connecticut and from public streets. The contractor may submit alternate access plans for approval prior to construction. It will be the Contractor’s responsibility to obtain permission, make and pay for arrangements with all private property owners and municipalities to access the work area from property not owned by the State of Connecticut.

3.4.2 Access to the work area is restricted by private property, structures, retaining walls, embankments, special trackwork, and other obstructions. The Contractor must perform his work on-track utilizing track mounted equipment for construction operations. The Contractor will enter the railroad right of way and access work sites on the project from defined high rail access locations.
3.4.3 The following list represents high rail access locations existing at the time these Technical Specifications were prepared. The Contractor is responsible for determining high rail access locations at the time of construction and developing work plans accordingly:

a. Greenwich - Hamilton Ave. Rubber pads on track 3 & 1, Timber and stone pad on track 2 at Catenary Structure 258.

b. Cos Cob - Indian Field Rd.: Rubber pads on track 4 & 2 at Catenary Structure 298A.

c. Cos Cob Yard west end of station track 3 side: Siding track to track 3 near Catenary Structure 303.

d. Cos Cob – Rubber pads on all four tracks east of station at Catenary Structure 309.

e. Riverside Station - East End: Rubber pads on tracks 4 & 3, timber and stone pads on tracks 1 & 2 located between Catenary Structures 320 and 321.

f. Old Greenwich Station - East End: Rubber pad on track 3, timber and stone pad on track 1 at Catenary Structure 341

g. Stamford - 375 Fairfield Ave. behind industrial buildings: Rubber pad on track 4, timber and stone pad on track 2 at Cat Structure 347 with access ramp to private property (industrial park).

h. Stamford – Stamford Station – West End: Rubber pad on siding Track 7 with access ramp from South State Street at Catenary Structure 366A.

i. Stamford – Stamford Station – East End: Rubber pad on Track 4 with access ramp from Station Place at Catenary Structure 370A.

j. Stamford – East of Courtland Avenue – Rubber pads Tracks 3, 1, and 2 with access ramp from Taylor Reed Place at Catenary Structure 418A. Rubber pad Track 4 with access ramp to private property (industrial park) at Catenary Structure 418A.

k. Darien – Noroton Heights Station – East End: Rubber pads on Tracks 3 and 1 with access ramp from Station Parking Lot at Catenary Structure 437. Rubber pads on Tracks 4 and 2 with access ramp to Station Parking Lot at Catenary Structure 440.
I. Darien – Darien Station – West End: Tracks 4 and 2 with access ramp to Station Parking Lot at Catenary Structure 458.

m. Darien – Darien Traction Power Substation: Rubber pads on Tracks 3, 1, and 2 with access ramp from Mechanic Street at Catenary Structure 466.

n. Darien – 76 Tokeneke Road: Rubber pads on Tracks 4 and 2 with access ramp crossing private property from Tokeneke Road at Catenary Structure 469A.

o. Norwalk – Rowayton Station - East End: Rubber pads on Tracks 4 and 2 with access ramp to station parking lot at Catenary Structure 489. Rubber Pads on Tracks 3 and 1 with access ramp to station parking lot at Catenary Structure 490.

p. Norwalk – South Norwalk Station – East End: Asphalt pad on Pocket Siding Track 6 at Catenary Structure 521 with access ramp to station parking lot. Rubber pads and asphalt grade crossing section across Tracks 4, 2, 1, and 3 between Catenary Structures 521A and 522

4.0 SAFETY, HEALTH AND ENVIRONMENTAL CONTROL

4.1 General

4.1.1 The Contractor shall be responsible for ensuring that the most stringent provisions of the applicable statues and regulations of the State of Connecticut and the United States Department of Labor-Occupational Safety and Health Administration provisions pertaining to the safe performance of the Work, are observed. Further, that the methods of performing the Work do not involve undue danger to the personnel employed thereon, the public and public or private property. Should charges of violation of any of the above be issued to the Contractor in the course of the Work, a copy of each charge and resolution thereof shall immediately be forwarded to the Engineer.

4.1.2 Please refer to Appendix A of these Technical Specifications titled "Section 01 33 60 Safety, Health, and Environmental Control". Appendix A contains detailed Safety, Health, and Environmental requirements for all Contractor activities. Please note that a full time Safety Engineer is specified for this project.
4.1.3 The Contractor’s work shall also be conducted in accordance with Connecticut DOT Form 816 Section 1.10 Environmental Compliance including Best Management Practices.

4.2 Submittals

4.2.1 General Submisson requirements are listed in Section 12, “Submittals,” of these Technical Specifications.

4.2.2 The Contractor shall issue, implement and submit to the Engineer for approval all items required under Appendix A.

4.2.3 Any review, acceptance or approval of the Contractor's Safety, Health and Environmental Control Plan shall be construed merely to mean that the Railroad is unaware of any reasons at the time to object thereto. Approval by the Engineer of the Safety, Health and Environmental Control Plan shall not impose any liability upon the Railroad, nor shall any such approval relieve the Contractor of any responsibilities under the Contract.

4.3 Safety, Health and Environmental Control Plan Requirements

4.3.1 The Contractor’s Safety, Health and Environmental Control Plan shall include the following:

a. A Site-Specific Compliance Program in accordance with 29CFR 1926.62, “Lead,” paragraph (e)(2). This program shall be supported by the Contractor’s written Respiratory Protection Program, Medical Surveillance Program, Training Program, Hazardous Communication Program, and any other program relevant to the de-leading of work.

b. Safety and Health Training including the Contractor's plan for regular scheduled safety meetings and other training to ensure safe practices. Meetings shall be held weekly with workers at the site to discuss specific safety issues.

c. First Aid and Medical Emergencies to include equipment available at site and its accessibility for use.

d. Housekeeping.

e. Description of emergency measures, equipment, personal protective equipment and monitoring to address hazards created by the onsite presence or use of materials by the Contractor. Emergency phone numbers and location of nearest medical facility.
shall be included.

f. Policy of Contractor concerning Safety and Scope of Safety policy as it applies to the Work.

g. Safety Organization. The Contractor shall designate an individual in his organization who is responsible for Safety and has the background and authority to know what constitutes safe practices and direct their implementation at the site.

h. Special Provisions for Project Safety and Health Programs, if applicable. Example: scaffolding, trenching, welding, hoists, cranes, maintenance and protection of traffic, etc.

i. Reporting and Record Requirements to include posting of emergency numbers and information and liaison with the Engineer.

j. Sanitation and Drinking Water.

k. Vermin Control.

l. Personnel Protective Equipment to include hard hats, safety shoes, harnesses, gloves, goggles, safety belt, hearing protectors, safety vests, etc.

m. Electrical Safe Practices to include lighting, temporary circuits, insulated tools, ground fault interruption, tag and lockout procedures for electrical equipment.

n. Industrial Hygiene to include Right to Know: Material and Safety Data sheets (MSDS) issued by OSHA.

o. Environmental Protection to include protection of the Public, Contractor and Railroad personnel, prevention of air, water and soil contamination.


q. List of known safety or health hazards at the jobsite and provision of a Hazardous Communications Policy.

r. Railroad Safety Program, by reference, in the Safety and Health Plan. The Railroad Safety Program is available for inspection by bidders, and a copy will be provided to the Contractor.
4.4 Safety and Fire Protection Assurance

4.4.1 The Contractor shall comply with the Occupational Safety and Health Standards issued by the Secretary of Labor pursuant to the Williams-Steiger Occupational Safety and Health Standards, part 1970 and part 1926.

4.4.2 The Contractor shall implement Safety and Fire Protection Plans. The Safety and Fire Protection Plans shall be submitted in accordance with the Contract Terms and Conditions.

4.4.3 The Contractor shall take adequate precautions against fire throughout all operations. The Contractor shall keep flammable material at an absolute minimum and properly handle and store such material in Underwriters Laboratories, Inc. listed safety containers in conformance with the National Board of Fire Underwriters recommendations.

4.4.4 Except as otherwise provided herein, the Contractor shall not build fires or use open salamanders in any part of the Work.

4.4.5 The Contractor shall not conduct welding or burning operations, except as approved by the Engineer. If such actions are approved by the Engineer, the Contractor shall provide a fire watch employee(s) with the necessary equipment to extinguish fires.

4.5 Additional Safety Requirements

4.5.1 The Contractor is advised that lead-based paint may be present on steel bridges, steel poles and catenary structures included in this project. The Contractor shall not disturb existing paint, and shall notify Metro-North prior to doing so if in performing the work this becomes necessary.

4.5.2 All products and materials used in connection with this project must remain asbestos free.

4.5.3 Contractor shall immediately notify the Project Engineer if during the course of the Project there is a discovery of any undetermined substance or suspected asbestos containing materials (ACM).

4.5.4 The Contractor shall take the responsibility to ensure that this Project is provided with the adequate safeguards, including but not limited
to the proper safety rigging, safety nets, fencing, barricades, scaffolding and ladders, that are necessary for the protection of its employees, as well as the public and Railroad employees. All rigging and scaffolding shall be of good and sound materials, of adequate dimensions for its intended use, and substantially braced, tied or secured to insure absolute safety for those required to use it, as well as those in its vicinity.

4.5.5 If any emergency condition develops during the entire Project, the Contractor shall immediately notify the Engineer of each and every occurrence. The Contractor shall also recommend any appropriate courses of action to the Engineer, and subsequently implement them upon the Engineer’s approval.

4.5.6 The Contractor shall provide all employees with personal protective equipment suitable for the work and individual tasks being performed. The Contractor is responsible for holding an on-site “tool box” meeting prior to the start of work. The project supervisor shall be familiar with the MSDS and personal protective equipment required for the individual tasks being performed and the products being utilized. Employees shall be informed as to the products they are using and the personal protective equipment required for each of the tasks being performed. MSDS sheets for all products to be used shall be submitted to the Metro-North Safety department prior to commencement of work and shall be readily available on the job site.

4.6 Pollution Abatement Controls

4.6.1 The Contractor shall comply with the following regarding Environmental Protection:

a. All facilities which will be used to perform work shall not be used unless such facilities are designed and equipped to limit water and air pollution in accordance with all applicable Federal, State, or local regulations and codes.

b. Work that is conducted as a result of this project shall be in compliance with the following provisions, all of which are incorporated herein by reference. All the applicable requirements of Section 114 of the Clean Air Act, 42 U.S.C. 7414, and Section 308 of the Federal Water Pollution Control Act, 33 U.S.C. 1318 as amended and all regulations issued there-under shall be enforced. No facilities listed on the List of Violating facilities of the Environmental Protection Agency (EPA) shall be used.

c. The Contractor shall notify the Engineer as soon as it or any
subcontractor receives any communication from the EPA indicating that any facility is under consideration to be listed on the EPA’s List of Violating Facilities.

d. Spillage of oil, paint, or hazardous substance is specifically prohibited by Section 311 of the Federal Water Pollution Act, as amended in 1972. Protection measures shall be used, including proper maintenance of construction equipment, arrangement for fuel handling areas so as to permit spills to be contained before reaching the waterway, instructing personnel not to dispose of oil or other such materials into drains or into the waterway directly, as well as other procedures that shall be planned to prevent spillage.

4.6.2 The Contractor shall conduct operations in a manner to minimize pollution of the environment by every means possible. Specific controls shall include but not be limited to the following:

a. The Contractor shall provide any and all Pollution Abatement Controls and/or any other Environmental Protection Plans that might be required by Federal, State, or local authorities.

b. Material transport trucks leaving the site and entering paved public streets shall be cleaned of mud and dirt clinging to the body and the wheels of the vehicles. Trucks arriving at and leaving the site with materials shall be loaded in a manner that will prevent dropping of materials or debris on the streets. Spills in public areas shall be removed immediately at no additional cost to Metro-North.

c. No waste materials shall be allowed to enter natural waterways or man-made water or sewage removal systems. The Contractor shall develop methods for control of waste that shall include such means as filtration, settlement, and manual removal to satisfy the above requirements.

d. The Contractor shall not dispose of machinery lubricants, fuels, coolants, and solvents at the site. Any hazardous waste materials generated shall be labeled, stored, and disposed of in accordance with all applicable Federal, State, and local regulations and codes.

e. Burning of waste shall not be allowed.

f. The Contractor shall take every action possible to minimize the noise caused by his operation. All operations shall comply with any existing regulations. Noise producing work shall be performed in less sensitive hours of the day or week as directed by the Engineer or local
ordinance.

g. The Contractor shall, at all times, control generation of dust by his operations in the construction and storage areas, using methods approved by the Engineer.

4.7 Protection of Persons and Property

4.7.1 Generally, the Contractor will be permitted to conduct work in the most expeditious manner possible, having due regard for the safety of persons and property, and under such instructions as the Engineer may give from time to time.

4.7.2 All of the Work shall be prosecuted in the manner, according to local conditions, best calculated to promote rapidity in progress, to secure safety to life and property, and to reduce any interference with the public to a minimum.

4.7.3 The Contractor shall be responsible to insure that the most stringent provisions of applicable statutes and regulation of political subdivisions in which the Work is being performed, and the United States Department of Labor Occupational Safety and Health Administration provisions pertaining to the safe performance of the Work are observed. Further, that these methods of performing the Work do not involve undue danger to the personnel employed thereon, to the public, and to public, private and Railroad property.

4.7.4 Should charges of violations of any of the above be issued to the Contractor in the course of the Work, a copy of each charge shall immediately be forwarded to the Engineer. The Contractor shall, at his own expense, immediately correct all charged violations to the complete satisfaction of the governing regulatory agency. The Contractor shall pay all fines and penalties levied against him.

4.7.5 The Contractor shall take all reasonable precautions for the safety of, and shall provide protection to prevent damage, injury, or loss to other property at the site or adjacent thereto, including personal property, pavements, roadways, structures, trees, shrubs and utilities not designed for removal, relocation, or replacement during the course of the Work. Any damaged items shall be restored to their original condition by the Contractor, to the satisfaction of the Engineer, at no additional cost to Metro-North.

4.7.6 The Contractor shall immediately report in writing to the Engineer all accidents whatsoever arising out of or in connection
with the performance of the Contract, whether on or adjacent to the construction site, which result in death, injuries, or property damage, giving full details and statements of witnesses.

4.7.7 The Contractor shall provide at the construction site such equipment and medical facilities as are necessary to supply first aid services, in case of accident, to any who may be injured in the progress of the Contract. He shall have standing arrangements for the removal and hospital treatment of any person who may be injured while engaged in the performance of the Contract.

4.7.8 The Contractor shall maintain a secure work site, protecting Metro-North’s interests and property from claims arising from trespass, theft, and vandalism.

4.7.9 During construction operations of the Contractor, certain areas may be disturbed or otherwise damaged. The restoration of these areas shall be a part of the Work required of the Contractor and shall be made at no additional cost to the Railroad. Verification shall be made by before-and-after photos taken by the Contractor. In the event of a conflict, the Engineer shall have the final decision.

4.7.10 The Contractor shall comply with the following requirements regarding Community Relations:

a. The Contractor shall be responsible for establishing and maintaining a continuing liaison with persons occupying property or doing business in the immediate areas of Work for the purpose of minimizing inconveniences resulting from the Work.

b. The Contractor shall contact those residents and businesses who might reasonably be expected to be affected by the Work to make known to them the name of the Contractor’s representative on the job site with the responsibility for community relations and to explain the means by which the representative can be contacted expeditiously.

c. The Contractor shall assign this responsibility to a competent employee with the authority to act on receipt of valid requests or complaints and shall notify the Engineer of his name and telephone number. The Contractor shall report to the Engineer within 3 days all requests or complaints and actions taken thereon.
5.0 INSTALLATION

5.1 General

5.1.1 The Contractor is solely responsible for the means and methods by which they perform the Work described herein. Any presentation of means or methods in the Contract Documents is provided only to supply the Contractor with guidance, standards, existing conditions, constraints, and requirements to which the Contractor must adhere, and expectations of Metro-North for the finished product.

5.1.2 The Contractor shall inspect any and all material to be installed as part of the Work of this Contract, both upon receipt from the manufacturer and before installation, for visual signs of damage. Material to be inspected shall include, but not be limited to, reels of aerial duct, copper and fiber optic cables, reels of aerial messenger strands, and spools of lashing wires. All inspections shall meet the requirements of Section 10, “Contractor’s Quality Assurance Program.” The Contractor shall verify that copper and fiber optic cable ends are sealed with Engineer approved Heat Shrink Cable End Caps to prevent moisture entry into the cores of the cables during transportation, in storage, during placement and after testing in place upon installation completion.

5.1.3 After installation the Contractor shall inspect all installed materials over the entire length of the project, including, but not limited to, aerial duct, cables, aerial messenger stands, lashing wires, conduits, ground wires, dead ends and back guys, etc. to ensure that the materials have not been damaged during installation and to verify that proper cable sags and tensions have been maintained throughout the Project Area.

5.1.4 No splicing of any fiber optic or copper cables shall be performed by the Contractor. Metro-North will perform all fiber optic and copper cable splicing and termination.

5.1.5 The Contractor will install all conduits, ducts, cable trays, cable troughs and other raceways required for routing cables installed under this Project. The Contractor will determine the size and number of all raceways ducts and cable troughs in accordance with the requirements of

5.1.6 The Contractor shall protect reeled and stored cable from theft, vandals or other sources of possible damage at all times, whether in the Contractor’s direct control or placed on Metro-North property. Damaged or missing cable shall be the responsibility of the Contractor. The Contractor
shall submit to the Engineer for approval the methods by which the Contractor shall secure the cable and prevent theft within 30 days of NTP. The Contractor shall replace damaged and/or vandalized sections of cable without adding splices and at no additional cost to Metro-North.

5.1.7 The Contractor is prohibited from subjecting any cable to excessive pulling tension, sharp bends, or crushing forces that exceed the manufacturer’s recommended practices. As part of the Work Plan the Contractor shall state the methods to be used to assure compliance with manufacturer’s practices.

5.1.8 The Contractor shall protect cable ends using Heat Shrink Cable End Caps as specified in Section 8.8, “Miscellaneous Hardware,” to prevent water ingress due to long-term exposure to moisture. Other means of protecting cable ends such as tape, banding, etc. are prohibited. The Heat Shrink End Caps shall remain on the cable ends throughout the Project and upon completion of the Project. The Contractor shall immediately replace any and all Heat Shrink End Caps that are removed from cable ends for testing or other procedures.

5.1.9 The Contractor shall identify any work required in station areas and shall coordinate such work with Metro-North prior to commencement of all such work so that passenger access to trains and other applicable Metro-North facilities is maintained at all times.

5.1.10 Whenever ty wraps are used in the Project, ty wraps shall be doubled, i.e. two ty wraps shall be installed.

5.1.11 There are areas indicated on the Contract Drawings where the contractor must remove and dispose of vegetation in order to make the required installations. In these areas and other areas as required to perform the Work of this Contract, the Contractor shall remove and dispose of vegetation at the Contractor’s expense, meeting the following requirements:

a. The Contractor shall remove and dispose of all vegetation, trees, shrubs and/or plants that interfere with any installation required in the Work of this Contract.

b. The Contractor shall protect all trees, shrubs and plants that do not interfere with the Work and are not to be removed.

c. The Contractor shall repair injuries, abrasions and other damage to plants by cleanly removing broken members, loose and torn bark, and shape edges in order to permit drainage of rain water from wounds. The Contractor shall paint wounds with tree wound paint.
d. The Contractor shall dispose of all vegetation removed off site, including but not limited to trees, limbs, brush, rotten wood, rubbish, and all debris generated by the removal, meeting all applicable requirements stated elsewhere in these Technical Specifications. Burning or burying vegetation or debris on the Connecticut DOT/Metro-North Right-of-Way is prohibited.

e. The Contractor shall perform all work in accordance with Connecticut DOT Form 816 Section 1.10 Environmental Compliance.

f. Clearing and grubbing shall be performed in accordance with Connecticut DOT Form 816 Section 2.01 Clearing and Grubbing. Costs shall be included in the Contractor’s Lump Sum bid and Form 816 Method of Measurement and Basis of Payment provisions do not apply.

5.2 Installation of 1-1/4” Figure 8 Aerial Duct

5.2.1 The Contractor shall install figure 8 aerial duct with an integral messenger (hereinafter referred to as Aerial Duct) as shown on the Contract Drawings. As depicted in these drawings the Contractor shall attach the aerial duct to existing catenary support structures, telephone poles, concrete and stone walls and other structures.

5.2.2 The aerial duct shall be installed in accordance with the Contract Documents and with the approved aerial duct manufacturer’s installation practice. The Contractor shall introduce one “twist” or rotation of the aerial duct between attachment points if the span between attachment points exceeds 50 feet. Before beginning any installation the Contractor shall obtain the most recent published version of the manufacturer’s installation practice directly from the manufacturer and submit to the Engineer for approval.

5.2.3 The Contractor is permitted to splice aerial duct with the following restrictions:

a. It is not the intent of this Contract to allow splicing of multiple short sections of aerial ducts between drop sites. Unless otherwise approved by the Engineer a maximum of one aerial duct splice shall be permitted between drop sites. No aerial duct splicing is permitted when the distance from drop site to drop site is less than 2500 feet.

b. When the distance from drop site to drop site is greater than 2500 feet the Contractor shall install one aerial duct splice near the midpoint.
c. Aerial duct splices shall be located only at a catenary support structure. No mid-span splices are permitted.

d. At each aerial duct splice the integral messengers of the aerial duct shall be dead-ended. Splicing the aerial duct’s integral messenger is prohibited.

e. At each aerial duct splice the Contractor shall install couplings as specified in Section 8.5, “Figure 8 Aerial Duct and Related Products,” or Engineer approved equal. Use of adhesive applied splicing sleeves is not permitted. The Contractor shall install the couplings in accordance with the coupling manufacturer’s installation guidelines. The Contractor shall submit the most recent edition of the manufacturer’s installation guidelines before beginning any fieldwork.

5.2.4 The aerial duct integral messenger shall be dead-ended at each drop site, and at locations between drop sites as may be necessary to facilitate the installation of the duct between drop sites in order to maintain the required sag and tension of the duct. The Contractor may propose alternative methods to the Engineer for approval.

5.2.5 The aerial duct tensioning shall comply with the requirements of Section 5.8, “Sag & Tension for Aerial Duct and Copper Cable.”

5.2.6 When tensioning aerial duct the insulation over the support strand shall not be damaged. If tensioning is accomplished by means of grips placed over the insulated support strand the Contractor shall insure that such tensioning can be accomplished without rupturing the insulation.

5.2.7 The Contractor shall bond the aerial duct integral messenger to the structural steel of the catenary support structures in accordance with Contract Drawing. Drilling procedures for attaching grounding studs to catenary structures shall be submitted to the Engineer for approval prior to beginning any installation. The Contractor shall refer to Section 8.6, “Messenger Bonding,” for materials to be used in bonding aerial duct integral messenger to catenary support structures, including but not limited to non-insulated ground wire. A separate wire shall be used to bond each messenger, “daisy-chaining” of bonds is prohibited.

5.2.8 Dead-ending and/or splicing aerial duct to meet the requirements of these Technical Specifications, including but not limited to accommodating the end of aerial duct reels and meeting sag and tension requirements, are part of this Contract and shall be installed at the Contractor’s expense.
5.3 Installation of Fiber Optic Cable

5.3.1 The Contractor shall install Fiber Optic Cable within the aerial ducts as shown in the Contract Drawings. The Contractor shall install Fiber Optic Cable in complete accordance with the manufacturer’s installation practices. The Contractor shall submit the manufacturer’s installation practices for approval by the Engineer before beginning any installation.

5.3.2 The Contractor shall install continuous lengths of Fiber Optic Cable as shown and described in the Contract Drawings. The Contractor is not permitted to cut or end the cable at any location not specifically designated on the Contract Drawings such as the locations designated by the “144 Fiber Splice Location (Future Drop)” and the “144 Fiber Splice Location (Drop)” symbols on Contract Drawings. The Contractor may propose modifications to the installed cable lengths by submitting the proposed changes, along with justification for the modifications, to the Engineer for approval before beginning any cable installation.

5.3.3 The Contractor is prohibited from exceeding the Fiber Optic Cable’s maximum tensile load or pulling tension as specified by the manufacturer. The Contractor shall submit proposed method for monitoring tensile load / pulling tension for approval by the Engineer before beginning any installation. The Contractor’s method for monitoring tensile load / pulling tension shall be in compliance with the approved manufacturer’s recommendations.

5.3.4 The Contractor is prohibited from exceeding the minimum cable bend radius as specified by the manufacturer, both loaded (during installation) and installed (after installation). Unless specified otherwise by the manufacturer, the working bend radius for cable installation shall be 15 times the Fiber Optic Cable outside diameter. Unless specified otherwise by the manufacturer, the minimum diameter requirement for pull wheels or rollers shall be double the minimum working bend radius.

5.3.5 The Contractor shall use the “figure-eight” configuration to prevent kinking or twisting when the cable must be unreeled or back fed, in conformance with the manufacturer’s recommended practices. Fiber Optic Cable shall not be coiled in a continuous direction for lengths greater than 30 m (100 ft). Automated figure-eight machines that coil fiber optic cable on a drum may result in cable design limit violation by exceeding torsion, tension, and bend radii limitations. If the Contractor uses automated figure-eight machines such use shall be submitted to the Engineer for approval as being within the manufacturer’s recommended practices and specifications before use of machine is permitted.
5.3.6 The Contractor shall install fiber optic cable in innerduct whenever placed into existing Metro-North cable trough or buried conduit. Innerduct is specified in Section 8.8, “Miscellaneous Products.” The Contractor shall note that innerduct characteristics differ from those of aerial duct, including but not limited to innerduct not having an integral messenger. Where multiple fiber optic cables are housed in the same trough or conduit, each fiber optic cable shall be installed in separate innerducts of differing colors.

5.3.7 During innerduct placement, the Contractor shall take care to avoid excessive tension and deformation of the innerduct by following the innerduct manufacturer’s installation instructions and monitoring pulling tensions during installation. The Contractor shall submit the most recent version of the innerduct manufacturer’s installation instructions before beginning any installation.

5.3.8 Continuous spans of innerduct shall be used. No splicing of innerduct shall be permitted.

5.3.9 After placement and pulling of the fiber optic cable within, the Contractor shall cap or plug all innerducts to prevent moisture or foreign matter from entering.

5.4 Installation of Aerial Messenger Strand

5.4.1 Aerial messenger strand is specified in Section 8.4, “Messenger, Lashing and Related Products.”

5.4.2 All aerial messenger strand shall be bonded to the structural steel of the catenary support structures, in accordance with Contract Drawings. Drilling procedures for attaching grounding studs to catenary structures shall be submitted to the Engineer for approval prior to beginning any installation. The Contractor shall refer to Section 8.6 “Messenger Bonding,” for materials to be used in bonding aerial messenger strand to catenary support structures, including but not limited to non-insulated ground wire. A separate wire shall be used to bond each messenger, “daisy-chaining of bonds is prohibited.

5.4.3 The Contractor shall comply with the following requirements regarding aerial messenger strand tensioning:

a. The aerial messenger strand tensioning shall comply with the requirements of Section 5.8, “Sag & Tension for Aerial Duct and Copper Cable.”
b. The Contractor shall use a shunt type dynamometer in aerial messenger strand tensioning. Dynamometer measurements shall be made in accordance with the manufacturer’s instructions.

c. The serial messenger strand shall be tensioned using either a strand puller attached to a winch line or by a block and tackle. The tension shall be slowly applied while the entire length of the strand being installed is observed for evidence of snagging or failure to slip through temporary attachments.

d. The aerial messenger strand shall be anchored at a dead end structure or pole before the first section of strand is tensioned and terminated by the use of boltless guy clamps. Successive pulls shall be made from the end of the first pull. The ends of the aerial messenger strand tails shall be secured using either stainless lashing wire wrapped around the strand or by guy wire clips.

e. The aerial messenger strand’s maximum practicable installation length shall be payed out from the reel in one pull.

f. When cutting of the aerial messenger strand is required the Contractor shall first wrap a double layer of friction tape around the strand for a length of 3.0 in. (76 mm) to prevent the spreading of individual strand wires and/or flying of metal particles. The Contractor shall then cut the strand at the mid-point along the tape. The strand shall be cut using either a strand cutter or a hacksaw. Other methods and safety precautions for cutting the aerial messenger strand may be used as approved by the Engineer.

5.4.4 The Contractor is prohibited from installing any splices in the aerial messenger strand. The Contractor shall dead end the aerial messenger strand at the beginning and end of strand reels and at every cable drop site or slack location.

5.4.5 It is not the intent of this Contract to allow the use of multiple short sections of aerial messenger strand between drop sites or slack locations. Except where necessary to meet the requirements of Section 5.8, “Sag & Tension for Aerial Duct and Copper Cable,” unless otherwise approved by the Engineer a maximum of one location where the messenger is dead-ended shall be permitted between drop sites or slack locations located near the mid-point, and no dead-ending of aerial messenger strand between drop sites or slack locations is permitted when the distance between sites is less than 2000 feet.

5.4.6 Dead-ending of aerial messenger strand to meet the requirements of these Technical Specifications, including but not limited to
accommodating the end of strand reels and meeting sag and tension requirements, are part of this Contract and shall be installed at the Contractor's expense.

5.5 Installation of Aerial Copper Cables

5.5.1 Copper cables shall be double lashed to the aerial messenger strand. Any reference to “lashing” in the Contract Documents shall be interpreted as double lashing.

5.5.2 The Contractor shall use a purpose built double lashing machine in accordance with the manufacturer’s recommended practices. Before performing any cable, the Contractor shall review the Contract Documents to determine the largest bundles of cables to be lashed in order to assure the lashing machines are sufficiently sized. The lashing machine specifications shall be submitted to the Engineer for approval prior to use.

5.5.3 Cables shall be double lashed to the aerial messenger stand wire with a minimum average of one 360-degree spiral per lashing wire foot for each of the two lashing wires.

5.5.4 Stainless steel lashing wire as specified in Section 8, “Materials,” shall be used to lash cables to the aerial messenger strand.

5.5.5 If the Contractor uses temporary clamps in lashing, the temporary clamps are to be removed after the permanent clamps are installed.

5.5.6 No splicing of lashing wires shall be permitted.

5.5.7 The Contractor shall monitor the cables at all times during the lashing process to insure that cable minimum bending radii and maximum pulling tensions are not exceeded at any time, and that the cables are protected from bends, kinks or abrasion during the lashing installation. Unless specified otherwise by the manufacturer, the working bend radius for copper cable installation shall be 10 times the outside diameter. Unless specified otherwise by the manufacturer, the minimum diameter requirement for pull wheels or rollers shall be double the minimum working bend radius.

5.5.8 Upon installation copper cables are not permitted to be under tension.
5.6 Coordinated Installation of Drop Cables with Metro-North Force Account

5.6.1 Drop cables to be coordinated with Metro-North Force Account shall include, but not be limited to, 24-strand and 144-strand fiber optic cable, 25 pair No 19 AWG copper communications cable. The 6 pair No. 14 AWG copper signal drop cables terminated within existing in-service signal enclosures at locations described in paragraph 5.6.3 shall also be coordinated with Metro-North Force Account. The Contractor will install drop cables, conduits, and raceways for all drop cables.

5.6.2 At all sites where 24-strand and 144-strand fiber optic cable and 25 pair No 19 AWG copper communications drop cables shall be installed, the Contractor shall coil, secure and protect the drop cable at the top of the structure, in line with the longitudinal cables installed. UV rated ty-wraps or other Engineer approved methods shall be deployed for securing the drop cable to the structure.

5.6.3 At the following locations, 6 pair No. 14 AWG copper signal drop cables will be terminated in the existing in-service signal enclosures by Metro-North.

- CP-232
- CP-233
- CP-235
- CP-240

The Contractor shall install all raceways and cables pulled into the existing signal enclosures. The Contractor shall coil and secure the drop cables in the existing signal enclosures for termination by Metro-North Force Account. The Contractor will terminate 6 pair No. 14 AWG drop cables at all other locations consisting of new signal enclosures installed as part of this project and not in service at the time cables are terminated.

5.7 Cable Pulling

5.7.1 Cable grips shall be used for pulling cable. All cable pulling grips must satisfy the written specifications of the manufacturer of the cable being pulled.

5.7.2 The Contractor shall submit catalog cuts of swivel pulling eyes with information showing how the Engineer can confirm the 600-pound breakaway rating by visual inspection.
5.7.3 The fiber optic cable shall be installed using swivel-pulling eyes with a 600-pound breakaway or other manufacturer recommended practice for the installation of fiber optic cables.

5.7.4 Where it is necessary to use the stationary reel method of installation of aerial duct, messenger support strand or cables, they shall be strung through rollers under a sufficient amount of tension to avoid excessive bending and to prevent cables from contacting the ground or obstructions between poles. During such pulls, the Contractor shall observe and maintain the cable slack to prevent any fouling of the tracks by the cables or messengers. When using this installation method the maximum pulling tension and minimum bend radius of the cable shall not exceed the manufacturer’s recommendations. Care shall be exercised to prevent continuous spiraling occurring in the cables when installed using the stationary reel method.

5.7.5 Cable pulling machines capable of generating readings for pulling tension, or with pre-calibrated bypass systems, or electronic units with automatic stops shall be the only accepted method of pulling cables. The Contractor may request of the Engineer a waiver of this requirement for special locations where hand pulling may be advantageous.

5.7.6 During installation no cable bend shall be less than 15 times the cable diameter. For permanent storage no cable bend shall be less than 30 times the cable diameter.

5.7.7 During installation the minimum area required for “figure-eighting” fiber optic cable is five feet by fifteen feet (5' x 15').

5.7.8 If the cable is to be wrapped around a drum, head, or capstan for pulling the drum must meet the cable manufacturer's requirements and in no case shall its diameter be less than 15 times the cable diameter.

5.7.9 Sufficient numbers and types of cable shoes, cable guides, pull-wheels, pulleys and chutes shall be available prior to the start of the cable pull to complete the entire pulling operation.

5.7.10 A power take-up reel will be required for each job.

5.7.11 Cable feeder chutes shall be the split-type to permit removal after the cable pull without damage to the cable or chute.

5.7.12 All cable reel trailers shall be commercially manufactured and adequate to support the largest reels (in weight and diameter) to be
handled during the project.

5.7.13 During cable reel loading and unloading, the Contractor shall use a spreader bar to reduce pressure on the reel and cable.

5.7.14 The Contractor shall use spacers to prevent reel sliding or slippage during transportation.

5.8 Sag and Tension for Aerial Duct and Copper Cable

5.8.1 Prior to installation the Contractor shall perform, and submit to the Engineer for approval, sag and tension calculations for each type of span to be installed, whether using the materials specified in the Contract Documents or using alternative products proposed by the Contractor and approved by the Engineer. Sag and tension calculations shall include, but not be limited to, all longitudinal cable installations and cable installations crossing tracks attached to catenary bridge structures. The use of Contract Document specified products or an Engineer approved alternative does not relieve the Contractor from this requirement. The Contractor shall utilize the engineering resources of the product manufacturers to perform such calculations. The Contractor shall have a Professional Engineer (PE) registered in Connecticut certify that the sag and tension calculations submitted to the Engineer meet all industry standard practices, is within all safe margins and tolerances for the installation, and that the installation shall safely support the cables as intended in the Contract Documents. Refer to Section 2.10 “Installation Planning”.

5.8.2 The entire work area is located in National Electric Safety Code (NESC) Heavy Storm loading district for Sag & Tension.

5.8.3 The initial sags and tensions for cables installed at various temperatures in the heavy NESC storm loading district shall be obtained from the cable manufacturer.

5.8.4 All ducts, messenger strand and cables installed in any span between structures, telephone poles or attached to walls shall be installed in a manner that maintains as best practicable each duct, messenger strand or cable in parallel to the existing cables in that span. All cables shall be installed a minimum of 12 inches at any point from existing cables.

5.8.5 During pulling and after installation, no cables shall be permitted to come into direct contact with any catenary support structure, pole, wall or other structure that may lead to abrasion or damage to the cable. If such contact is unavoidable due to the specific site installation, the Contractor shall notify the Engineer for approval to install a cable
chafe guard at that site to prevent such contact.

5.8.6 In the event that existing cables or obstructions do not permit the new duct or cables to be maintained in parallel to the existing cables, the Contractor may propose alternative methods to protect the cables from abrasion, including the use of an additional short span of aerial messenger strand to provide mid-span intermediate support of the cable or duct above the normal span sag points, as shown on the Contract Drawings.

5.8.7 If the Contractor proposes alternative products or methods to the Engineer for approval for the aerial duct, aerial messenger strand, fiber optic cable or copper cables, the Contractor shall submit sag and tension calculations specific to the products being proposed to the Engineer for approval at the time the product alternatives are submitted for approval and before any installation commences.

5.8.8 When cables are lashed at temperatures below 30 degrees F (-1.1°C), the Contractor shall adjust the lashing wire tension appropriately higher than that used at higher temperatures in order to prevent bowing in hot weather by causing cables to be lashed snugly against the strand.

5.8.9 Aerial duct, messenger strand and cables shall be tensioned with the aid of series dynamometers. The cable shall be temporarily supported at each pole in rollers until after the cable has been tensioned and the tensioned equalized in all spans of the section being tensioned. Tension shall be applied slowly while the entire length of cable being installed is observed for evidence of snagging or failure to move freely through its temporary supports at the poles.

5.9 Back Guys

5.9.1 Installation and tensioning of duct, messenger strand and cables shall only begin after all temporary and or permanent back guying has been completed in a section of line to be tensioned.

5.9.2 Temporary Back Guys. Wherever the aerial duct or messenger strand is dead-ended, a false dead end is installed or the Contractor will tension the cable, the Contractor shall install a temporary back guy from the structure against which tension is applied to the immediate adjacent structure to insure that all applied forces to the structure or pole are correspondingly countered, in full, by the back guy. Once all forces applied to any structure are equalized, and only upon completion of tensioning of that section and the permanent securing of the aerial duct or messenger is completed in the span, shall the temporary back guy be removed. No temporary back guys installed by the
Contractor shall remain after the work in a single span is complete.

5.9.3 **Permanent Back Guys.** At any location where a new aerial duct or messenger strand with lashed cables is dead ended to a structure or pole, and where a new or previously installed cable or messenger strand of the same configuration installed by the Contractor is not attached to the opposite side of the structure or pole that will counter all applied forces created by the new aerial duct or messenger strand, a permanent back guy shall be installed to the structure or pole to insure that all applied forces to the structure or pole by the new aerial duct or messenger strand are correspondingly countered, in full, by the permanent back guy. Attachment hardware for the back guy to the anchoring structure or pole shall be the same type as that used for a dead-end, as shown on the Contract Drawings.

5.9.4 At all locations where a new aerial duct or messenger strand with lashed cables is attached to a structure or pole, and the angle of the exit of the aerial duct or messenger strand cable exceeds thirty (30) degrees from the entry, the Contractor shall install a permanent back guy unless an existing back guy is in place that is suitable to counter all applied forces caused by the Contractor installed aerial duct or cables. The Contractor may submit to the Engineer for approval a written request for relief prior to installation, to include calculations and rationale, based upon the site installation circumstances, on a case-by-case basis.

5.9.5 **Back Guy Markers.** At all temporary or permanent back guy locations, the Contractor shall install a purpose built, highly visible, rugged, weather proof and well affixed back guy marker/shield at the base of any temporary back guy. The marker/shield shall be placed to alert personnel to the presence of the back guy, and to prevent accidental injury caused from direct contact to the back guy. Markers and/or shields shall be installed on all temporary or permanent back guys that are placed at heights less than eight (8) feet above top of rail. Use of Mylar “caution” marker tape is not permitted.

5.10 **Installation of Raceways and Miscellaneous Hardware**

5.10.1 **Split Duct Chafe Guard.** After any cable has been installed (longitudinal or drop cable) a split duct chafe guard shall be installed at each and every location where the cable is in contact with, or in close proximity (within three feet) to any structure, other cable or any item that may cause potential abrasion or wear to the installed cable. The split duct chafe guard shall be of sufficient length to exceed the area of exposure to potential abrasion by at least twelve (12) inches on each
end of the exposed area. The split duct chafe guard shall be secured to the cables and the structure with UV rated ty-wraps, or other Engineer approved methods, at periodic distances, not to exceed twelve (12) inches, to prevent the split duct chafe guard from opening or moving longitudinally along the cable to which it is attached.

5.10.2 **Unistrut.** Hot-dipped galvanized Unistrut Model P 1000, or Engineer approved equal, shall be used at locations shown on the Contract Drawings. Only purpose made hardware and appurtenances manufactured by supplier of the Unistrut (or approved equal) shall be used with the Unistrut. Unistrut may be field cut to length as required, however each field cut exposed end shall be field treated immediately after any field cutting is performed, prior to installation. The Contractor shall field treat all damaged galvanizing and/or uncoated areas in accordance with ASTM A 780. Products meeting requirement of ASTM A 780 include ZIRP ® by Duncan Galvanizing, Galvilite ® by ZRC Worldwide and approved equal. Apply product in strict accordance with the manufacturer's recommendations. Field cut Unistrut treatment performed after installation shall not be acceptable, and shall be replaced prior to acceptance.

5.10.3 **Rigid Galvanized Steel (RGS) Conduit.** RGS conduit shall be installed at each drop site and in other locations as shown on the Contract Drawings. Each conduit shall be secured to the structure with purpose made conduit straps for the Unistrut installed on the structure. Purpose made conduit sealing bushings shall be installed at all exposed conduit ends where any cables may transition into the conduit. The bushings shall prevent direct cable contact with the abrasive conduit end. After the cables are installed into the conduits, the conduits shall be sealed with conduit sealing bushings or engineer approved material to prevent the entry of water, rodents or any foreign material into the conduit.

a. Conduit shall be installed as specified on the plans and in accordance with the National Electrical Code (NEC) and the National Electrical Safety Code (NESC).

b. Care shall be exercised when handling conduit. Damaged conduit must not be used.

c. Sweeps may be field bent and shall have a minimum bend radius of 3-feet. All bends in conduit shall be made without kinking, flattening or appreciably reducing the internal diameter of the conduit. A hydraulic or power pipe bender shall be employed for all bends in steel conduit.

d. Any evidence of destruction of the protective coating will be cause for rejection. All connections in metallic conduit shall be tight and free from
defects that may permit entry of water. Ends of conduit shall be reamed to remove burrs and rough edges. All conduits installed shall be tested for clear bore and correct installation by the Contractor. All empty conduit after testing shall be immediately sealed by the Contractor with an Engineer approved sealant.
e. Conduits shall not be installed within two (2) feet of the edge of railroad tie.

5.10.4 **Epoxy Drill-in Anchors.** The Contractor shall use Epoxy Adhesive Anchoring Systems, specified in Section 8.8, “Miscellaneous Hardware,” in the installation of all hardware mounted to walls, station platforms, stone or masonry.

a. Verify that surfaces are sound and ready to receive work. Do not proceed until surfaces are made acceptable to the Engineer.

b. Clean surface. It may be dry or damp, but free of standing water. Remove dust, laitance, grease, curing compounds, impregnations, waxes, foreign particles, disintegrated materials, and all other substances that might affect bond.

c. Drill-in anchors shall be drilled and installed in strict compliance with the manufacturer’s instructions using the equipment, procedures and materials as directed by the Manufacturer.

5.11 **Installation of Signal Power Transformers**

5.11.1 The transformers and associated equipment shall be installed in accordance with the approved manufacturer’s shop drawings, manufacturer’s instructions and nationally recognized regulations and standards, including, but not limited to, the NESC. The secondary supply feeders shall be installed to the signal house by cables as detailed on the Contract Drawings.

5.11.2 The Contractor shall control erection tolerance requirements so as not to impair the strength, safety, serviceability, or appearance, as approved by the Engineer.

5.11.3 Exercise special care during installation to avoid overloading any part of the structure. Repair or replace any item damaged due to overloading to the sole satisfaction of the Engineer.

5.11.4 The Contractor shall refer to Section 6, “Signal Power
Transformers” for additional requirements, including but not limited to KVA ratings and quantities to be installed.

5.12 No Drop Zone

5.12.1 If there are wetlands within the area of Work, the Contractor is directed that the entire area under each segment of work in that area is designated as a “No Drop Zone.” The Contractor shall therefore be required, in addition to complying with the Federal, State, and Local Laws and Regulations and the requirements contained in the Contract Documents pertaining to the safety and health of individuals and the protection of property and the environment, to provide, maintain, and remove tarpaulins or other protective devices and enclosures and take all other means necessary to prevent any debris, structural steel, bolts, paint, tools, etc., from falling in the river below.

5.12.2 All materials used for the protective device or enclosures shall be fire retardant in conformance with applicable laws and regulations. All nets shall be provided with a liner of equal strength and of small mesh so sized as to prevent small objects such as nuts and bolts from falling through them.

5.12.3 The Contractor shall exercise every precaution to see that no construction debris or equipment falls into the waterway.

5.12.4 Demolition shields, nets, etc., shall be provided below the work area as required at all times. Demolition shields, nets, etc., shall be relocated as required, as work progresses.

5.12.5 If, at any time during construction, the Engineer deems that adequate protective devices and measures are not being employed, that the protective devices are not providing the desired level of protection or that the Contractor has failed to properly maintain the devices, all work at the affected locations shall cease until corrective measures acceptable to the Engineer are instituted.

5.13 Bridge and Catenary Support Attachments

5.13.1 The Contractor shall fabricate and shop-assemble the work in accordance with applicable requirements of the AREMA Manual for Railway Engineering, Chapter 15, Part 3. Installation hardware and materials including but not limited to those fabricated by/for the Contractor shall conform to the requirements of Section 8, “Materials.” Where required by the Contract Drawings, materials and hardware shall
be stainless steel as specified in Section 8, “Materials.” Fabrication, assembly and installation shall conform to approved Installation Drawings and Shop Drawings as specified in Section 2.10, “Installation Planning,” and Section 11, “Drawings and As-Built Plans.”

5.13.2 Members shall be straight and shall fit closely together, and the finished work shall be free from burrs, twists, bends, open joints and other imperfections.

5.13.3 All attachments shall be true and plumb.

5.13.4 The Contractor shall align and adjust members forming parts of a complete assembly after assembly and before tightening.

5.13.5 The Contractor shall submit proposed adjustments to compensate for discrepancies in elevations and alignment to the Engineer for approval, no less than 30 days before beginning any field work.

5.13.6 The Contractor may drill holes in the existing catenary structure only for the attachment of bonding lugs to bond the aerial messenger strand to the catenary structure. For this drilling the Contractor shall use a magnetic bit to contain filings from dropping to the ground. The Contractor shall not drill any other holes in existing bridge, catenary support or other members, unless directed otherwise by the Engineer. All other attachments shall utilize beam clamps, J-Bolt clamps, Unistrut or thru bolt assemblies with fabricated hardware as shown on the Contract Drawings.

5.13.7 When drilling holes for attaching bonding lugs or while fabricating materials, the Contractor shall factory ream or drill sub-punched or sub-drilled holes 1/16th inch larger than the nominal size of the bolt, after assembly.

5.13.8 The Contractor shall repair all damaged galvanizing and/or uncoated areas in accordance with ASTM A 780. Damage to galvanizing may be the result of welding, cutting, drilling, burning, or rough handling during shipping or installation. Products meeting requirement of ASTM A 780 include ZIRP® by Duncan Galvanizing, Galvilite® by ZRC Worldwide and approved equal. Apply product in strict accordance with the manufacturer’s recommendations.

5.13.9 The Contractor shall not use gas cutting torched or electric arc welding in the field for correcting fabrications errors.

5.13.10 Immediately after tightening all nuts, the Contractor shall
touch-up nuts using the field galvanizing method specified in this Section.
6.0 SIGNAL POWER TRANSFORMERS

6.1 General

6.1.1 This Section describes requirements for the design, procurement and installation of signal power and hotel power transformers at locations shown below and on the Contract Drawings. All transformers shall be single phase, fluid oil filled, pole mounted, including cross arm mounting bracket, Type CSP Class A with a 12 KV primary and a 240/120Volt secondary. Signal Power transformers shall operate at 100 Hz. Hotel power transformers shall operate at 60 Hz. Signal power or hotel power transformers shall be provided and installed at each location listed in Table 6.1.1 below and as shown on the Contract Drawings. Transformers shall be installed on the north and south sides of the tracks, mounted on catenary structures or other poles below the signal power and catenary power feeders generally as represented on the Contract Drawings. Each transformer primary will be fed from a signal power or catenary feeder located on the same side of the tracks as the transformer.

6.1.2 Furnish signal power transformers, mounting assemblies, including cross arm bracket, cable, conduits, grounding materials, ground rods, high-voltage bushings, arrestors, fuse cutouts, fuse links, copper compression stirrups, connecting hardware and terminations and any other work or material necessary to furnish and install a fully operational redundant signal power system. Furnish hotel power transformers, mounting assemblies, including cross arm bracket, cable, conduits, grounding materials, ground rods, high-voltage bushings, arrestors, fuse cutouts, fuse links, copper compression stirrups, connecting hardware and terminations and any other work or material necessary to furnish and install a fully operational redundant hotel power system.

6.1.3 The design, material, manufacture, testing and performance of the oil-filled transformer shall meet the requirements of the applicable sections of the latest revisions of American National Standards Institute (ANSI), National Electrical Manufacturers Association (NEMA), Institute of Electrical and Electronics Engineers (IEEE), National Electrical Code (NEC), and American Society for Testing and Materials (ASTM).

   a. The transformer shall be suitable for use as described under the “usual service conditions” found in ANSI C57.12 (General Requirements for Liquid- Immersed Distribution, Power and Regulating
6.1.4 Transformers shall be provided at the following locations and as shown on the Contract Drawings:

<table>
<thead>
<tr>
<th>Catenary Bridge</th>
<th>Signal Location</th>
<th>Qty</th>
<th>Signal Power Transformer</th>
<th>Hotel Power Transformer</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB-294 A</td>
<td>CP-229 CIL</td>
<td>2</td>
<td></td>
<td>10 KVA</td>
</tr>
<tr>
<td>CB-295 A</td>
<td>CP-229 CIL</td>
<td>2</td>
<td>37.5 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-308</td>
<td>CP-230 LOC B</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-309</td>
<td>CP-230 LOC B</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-316</td>
<td>CP-230 CIL</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-317</td>
<td>230 CIL</td>
<td>2</td>
<td>37.5 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-335</td>
<td>ML-312</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-346</td>
<td>ML-318</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-370A (N. SIDE)</td>
<td>CP-234 LOC B</td>
<td>1</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-370A (N. SIDE)</td>
<td>CP-234 LOC B</td>
<td>1</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>WP* (S. SIDE)</td>
<td>CP-234 LOC B</td>
<td>1</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>WP* (S. SIDE)</td>
<td>CP-234 LOC B</td>
<td>1</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-373</td>
<td>CP-234 CIL</td>
<td>2</td>
<td>37.5 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-376</td>
<td>CP-234 LOC F</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-376A</td>
<td>CP-234 LOC F</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-421</td>
<td>ML-354</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-432</td>
<td>ML-360</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-449</td>
<td>ML-369</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-464</td>
<td>ML-379</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-475</td>
<td>ML-384</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-490</td>
<td>ML-393</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-522</td>
<td>CP-241 LOC A</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-522A</td>
<td>CP-241 LOC A</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-527</td>
<td>CP-241 CIL</td>
<td>2</td>
<td>37.5 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-528</td>
<td>CP-241 CIL</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-531</td>
<td>CP-241 LOC C</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
<tr>
<td>CB-532</td>
<td>CP-241 LOC C</td>
<td>2</td>
<td>10 KVA</td>
<td></td>
</tr>
</tbody>
</table>

Table 6.1.1 – Transformer List
(WP* = New Wood Pole 1 ea. installed at CP-234 Location B)

6.1.5 The contract drawings identify locations where the Contractor is responsible for installing new signal power transformers. The Contractor is also responsible for removing existing signal power transformers to permit the installation of new transformers on the same structure if required. The
Contractor shall make provisions to temporarily feed the existing in service signal house at each of those locations from the new transformer as well as providing new power drops shown for new equipment. Retired signal power transformers shall be turned over to Metro-North at the Connecticut DOT Bridgeport Maintenance of Way Facility, 989 Union Avenue, Bridgeport, CT. New signal power transformers shall be installed and tested prior to setting new signal houses and cases. The contractor shall route new power cables to houses and cases and leave new power cables coiled at the cable entry chute with sufficient slack for final connection in the house or case location by Metro-North.

6.1.6 The transformer manufacturer shall not have less than five (5) years experience in the design, production and assembly of oil-filled transformers similar in scope.

   a. Workmanship shall conform to the best modern practices in the manufacture of a rugged, durable and safe product for use in a public transportation system. Materials used shall be new and of the highest industrial grade as specified.

6.1.7 Product data to be submitted for approval shall consist of manufacturer’s standard catalog cuts, descriptive literature and diagrams, in 8½” X 11” format, and in sufficient detail so as to clearly indicate compliance with all specified requirements and standards. Details shall include fully dimensioned equipment layout and spacing between all components.

The Contractor shall also submit the following documentation:

   a. Product Certification: Signed by manufacturer certifying that products comply with the specified specification requirements.


   c. Maintenance data including parts list for materials and products.

6.1.8 The manufacturer shall warranty the pole-type, oil-filled transformer to be free from defects in workmanship and material for a period of one (1) year from the date of acceptance. During this period, the vendor shall replace all items or components, which fail due to defects in workmanship and/or material at no additional cost to Metro-North.

6.2 Transformers
6.2.1 The 10 KVA step-down signal power transformers shall be 10 KVA Part #A101BD10XQ as manufactured by ABB or approved equal. The transformers shall be furnished with copper primary and secondary windings and rated as follows:

<table>
<thead>
<tr>
<th>KVA Rating:</th>
<th>10 KVA Single Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impedance:</td>
<td>4.5% maximum</td>
</tr>
<tr>
<td>HV:</td>
<td>12000V, 100 Hz</td>
</tr>
<tr>
<td>HV BIL:</td>
<td>125 kV</td>
</tr>
<tr>
<td>HV Taps:</td>
<td>2, 2.5% FCAN, 2, 2.5% FCBN</td>
</tr>
<tr>
<td>LV:</td>
<td>240-120V, 100 Hz</td>
</tr>
<tr>
<td>LV BIL:</td>
<td>30 kV</td>
</tr>
</tbody>
</table>

Table 6.2.1 – 10 KVA Transformers

6.2.2 The Central Instrument Location step-down signal power transformers shall be 37.5 KVA Part # A101BD37XQ as manufactured by ABB or approved equal. The transformers shall be furnished with copper primary and secondary windings and rated as follows:

<table>
<thead>
<tr>
<th>KVA Rating:</th>
<th>37.5 KVA Single Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impedance:</td>
<td>4.5% maximum</td>
</tr>
<tr>
<td>HV:</td>
<td>12000V, 100 Hz</td>
</tr>
<tr>
<td>HV BIL:</td>
<td>125 kV</td>
</tr>
<tr>
<td>HV Taps:</td>
<td>2, 2.5% FCAN, 2, 2.5% FCBN</td>
</tr>
<tr>
<td>LV:</td>
<td>240-120V, 100 Hz</td>
</tr>
<tr>
<td>LV BIL:</td>
<td>95 kV</td>
</tr>
</tbody>
</table>

Table 6.2.2 – 37.5 KVA Transformers

6.2.3 The step-down hotel power transformers shall be 10 KVA Part #A101BD10XQ as manufactured by ABB or approved equal. The transformers shall be furnished with copper primary and secondary windings and rated as follows:

<table>
<thead>
<tr>
<th>KVA Rating:</th>
<th>10 KVA Single Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impedance:</td>
<td>4.5% maximum</td>
</tr>
<tr>
<td>HV:</td>
<td>12000V, 60 Hz</td>
</tr>
<tr>
<td>HV BIL:</td>
<td>125 kV</td>
</tr>
</tbody>
</table>
HV Taps: 2, 2.5% FCAN, 2, 2.5% FCBN
LV: 240-120V, 100 Hz
LV BIL: 30 kV

Table 6.2.3 – 10 KVA Transformers

6.2.4 The Contractor shall provide two (2) fully insulated high voltage bushings with eye bolt terminals per NEMA standards. Fuse cutouts as manufactured by Cooper Power Systems or approved equal and fuse links as manufactured by McGraw-Edison or approved equal. Cutouts and fuse links shall be compatible and sized in accordance with the NEC. Cutouts shall be left in the open position and will be closed by Metro-North Railroad at the time the signal power system is placed in-service. Copper compression stirrups and hotline clamps as manufactured by Anderson or approved equal.

6.2.5 The Contractor shall provide three (3) fully insulated low voltage bushings with eye bolt terminals, secondary overload circuit breaker and neutral grounding strap per NEMA standards.

6.2.6 The Contractor shall provide a primary protective link mounted in each high voltage bushing, two primary arresters and a secondary circuit breaker with externally mounted operating handle with emergency overload reset and overload signal light in accordance with NEC standards. Signals power transformers shall be self-protected.

6.2.7 The transformer shall be mineral oil filled and shall be constructed in accordance with the latest edition of the NEC and the following:

a. The transformer shall carry its continuous rating with average winding or temperature rise by resistance that shall not exceed 65 degrees C rise, based on an average ambient of 30 degrees C over 24 hours with a maximum of 40 degrees C.

b. The transformer shall be designed to meet the sound level standards for liquid transformers as defined in NEMA TR-1 and ANSI Standards.

c. The main transformer tank and attached components shall be designed to withstand pressures 25% greater than the required operating design value without permanent deformation. Construction shall consist of carbon steel plate reinforced with external sidewall braces as necessary. All seams and joints shall be continuously
welded.

d. The entire tank assembly shall receive a leak test before tanking. A final six-hour leak test shall be performed.

e. Provide lifting hooks for transformer handling. The bottom of the transformer shall be undercoated to prevent corrosion.

f. Transformer shall be supplied with a welded main tank cover and be of a sealed-tank construction designed to withstand a pressure of 7 psig without permanent distortion.

g. The transformer manufacturer shall certify that the transformer is non-PCB containing no detectable PCBs. Do not provide nonflammable transformer liquids including askarel and insulating liquids containing tetrachloroethylene, perchloroethylene, chlorine compounds, or halogenated compounds.

h. Full capacity high-voltage taps (±2 X 2½ %) shall be provided with a tap changing mechanism designed for de-energized operation. The tap changer shall be externally operated.

i. The core material shall be high-grade, grain-oriented, non-aging silicone core steel with high magnetic permeability, low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below saturation to allow for a minimum of 10 percent overvoltage excitation. The cores shall be properly annealed to reduce stresses induced during the manufacturing processes and reduce core losses.

j. The core frame shall be designed to provide maximum support of the core and coil assembly. The core frame shall be welded or bolted to ensure maximum short-circuit strength.

k. The core and coil assembly shall be designed and manufactured to meet the short-circuit requirements of ANSI C57.12.90.

l. Transformer shall be vacuum-filled with the appropriate fluid as indicated above. The process shall be of sufficient vacuum and duration to insure that the core and coil assembly is free of moisture prior to filling the tank.

m. Provide a one inch drain plug, a one inch fill plug, an automatic pressure relief device, and an oil level gauge in the low voltage compartment of the transformer.
n. An anodized aluminum laser engraved nameplate meeting the requirements of ANSI C57.12.00 shall be screw mounted in the low voltage compartment.

o. The overall transformer paint color shall be ANSI 61 gray.

6.2.8 The Contractor shall supply high voltage metal oxide elbow surge arresters with 10% spare fuses.

6.2.9 The transformers and associated equipment shall be constructed and installed in accordance with the approved shop drawings, manufacturer’s instructions, nationally recognized regulations and standards and the following:

a. 100 Hz power and 60 Hz power shall be derived from the new signal power and hotel power transformers via new cables installed between the primary feeds and the fuse cut-outs and between the transformer taps and the signal house. The Contractor shall leave fuse cut-outs in the open position and coordinate powering and testing of transformers with Metro-North Railroad.

b. The installation of signal power cables into the house shall be coordinated with Metro-North.

c. Signal power transformers shall be wired and color coded as shown in the following figures. All final connections, high-voltage and low-voltage, shall be by Metro-North.
TRANSFORMER CONNECTIONS FOR SIGNAL CIRCUITS
12,000V/120V/240V
WHEN H1=S1 AND H1=S2

NORTH SIDE

SIGNAL 3
SIGNAL 1

H1
H2
X1 (RED)
X3 (BLUE)
X2 (WHITE)

SOUTH SIDE

SIGNAL 4
SIGNAL 2

H1
H2
X1 (RED)
X3 (BLUE)
X2 (WHITE)

100BX-N
100NX-N
100SX-N

100BX-S
100NX-S
100SX-S

Figure 6.2.1 – Transformer Connections
d. Control erection tolerance requirements so as not to impair the strength, safety, serviceability, or appearance as approved by the Engineer.

e. Exercise special care during installation to avoid overloading any part of the structure. Repair or replace any item damaged due to overloading to the satisfaction of the Engineer.

6.2.9 Factory and field tests shall conform to ANSI C57.12.90. Include routine tests as defined by ANSI C57.12.00, manufacturer’s recommendations, Metro-North Railroad and the following tests:

a. Impedance voltage and load loss.
b. Dielectric tests.

c. Short circuit capability.
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7.0 SIGNAL EQUIPMENT SITES

7.1 General

7.1.1 The Contractor shall perform site preparation, grading, installation of retaining walls, installation of steel structures, access walkways, driveways, and stairs. The construction of signal equipment sites also includes installation of conduits, cable trough, and other raceways for routing cables. The Contractor shall install Pre-wired houses and cases supplied by MNR and snow melter panels furnished by the Contractor. The location and proposed arrangements of Signal Equipment Sites are provided in the Contract Drawings. The Contractor shall prepare signal equipment sites with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein.

7.1.2 Work of this Section includes but is not limited to the following:

a. Clearing and debris removal.

b. Excavation, backfill, site grading, and crushed stone site pads.

c. Retaining walls.

d. Structural steel platforms, stairs, and railings including platform foundations and connections to existing steel structures where required.

e. Structural steel framing, foundations, landing slabs, bracing, treads and railings for access stairs.

f. Fencing and gates

g. Gravel walkways and driveways. Crushed stone pads for houses and cases including snow melter panels.

h. Electrical bonding and grounding including ground buss cases.

i. Above grade and underground cables and conduits.

j. Cable trough, cable tray, and cable entry chutes for houses and cases

k. Pull boxes and handholes
l. Foundations for signal houses and cases, snow melter panels, and Ground Buss Cases.

m. Installation of signal houses and cases furnished by MNR. The Contractor is advised that Metro-North’s procurement of Pre-wired houses and cases will be conducted during the same timeframe as the Contractor’s work. The sizes and general arrangement of individual houses and cases depicted in these contract documents is preliminary, and will be finalized as part of the Pre-wired Equipment Vendor’s final design. The Contractor shall not fabricate or install foundations, steel platforms, raceways, and cables for Pre-Wired houses and cases until final sizes, foundation requirements, house, and case layouts are received from MNR. The Contractor shall coordinate site installation as required and shall make appropriate adjustments to accommodate the final sizes, foundation configurations, and cable entry arrangements of Pre-wired houses and cases furnished by MNR.

n. Temporary sheeting, shoring, protective scaffolding, and protective measures. The Contractor shall comply with Metro-North Construction Specification I&C (Appendix C) and provide submissions in accordance with Section 11 of these Technical Provisions.

o. Installation of Snowmelter Panels, junction boxes, conduit and cable, and connections to existing snowmelter unit substations.

p. See Work Responsibility Matrix included in the Contract Drawings for additional information.

7.2 References

7.2.1 Steel Structures shall comply with the latest provisions of the following references except as otherwise indicated. Steel structures shall be galvanized in accordance with ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. Fasteners for steel structures shall be galvanized in accordance with ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Hardware.

a. Connecticut Department of Transportation Form 816 – Standard Specifications for Roads, Bridges, and Incidental Construction (Method of Measurement and Basis of Payment sections do not apply to this project).

b. AREMA, Chapter 15 - Steel Structures.
c. AISC - Code of Standard Practice for Steel Buildings and Bridges.

d. AISC - Specifications for Structural Steel for Buildings and including the Commentary and Supplements thereto as issued.

e. AISC - Specification for Structural Joints using ASTM A325 or A490 Bolts approved by the Research Council on Structural Connections of the Engineering Foundation.

f. AWS D1.1 - Structural Welding Code

7.2.2 Concrete work, retaining walls, permanent and temporary sheeting, and incidental construction shall comply with the latest provisions of the following references except as otherwise indicated.

a. Connecticut Department of Transportation Form 816 – Standard Specifications for Roads, Bridges, and Incidental Construction (Method of Measurement and Basis of Payment sections do not apply to this project).

b. AISC – Steel Construction Manual

c. ACI 318 - Building Code Requirements for Structural Concrete


e. ASTM A615 – Standard Specification for Deformed and Plain Billet Carbon-Steel Bars for Concrete Reinforcement

f. ASTM A706 – Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

g. ASTM A709 - Standard Specification for Structural Steel for Bridges

h. ASTM A767 – Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

i. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

j. ASTM A996 - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
k. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

l. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field

m. ASTM C33 – Standard Specification for Concrete Aggregates

n. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

o. ASTM C88 – Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate


r. ASTM C138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

s. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete

t. ASTM C150 – Standard Specification for Portland Cement

u. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete

v. ASTM C192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

w. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete

x. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

y. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete


bb. Deformed reinforcing bars shall conform to A615, A706 or A996.

c. AWS D1.4 – Structural Welding Code - Reinforcing Steel

d. AASHTO/AWS D1.5 – Bridge Welding Code

e. CRSI – Concrete Reinforcing Steel Institute - Manual of Practice and CRSI 63 - Recommended Practice For Placing Reinforcing Bars

ff. Metro-North Railroad Company – Contractor Requirements for Work Affecting the Railroad, Construction Specification – I&C Section A

7.2.3 Clearing and Grubbing, Earthwork, Excavation and Backfill shall comply with the latest provisions of the following references except as otherwise indicated.

a. Connecticut Department of Transportation Form 816 – Standard Specifications for Roads, Bridges, and Incidental Construction Division II (Method of Measurement and Basis of Payment sections do not apply to this project).

7.2.4 Electrical Bonding shall comply with the latest provisions of the following references except as otherwise indicated.

a. ANSI C33.8/UL6467 Grounding and Bonding Equipment, Safety Standard

b. NFPA 70-2005 National Electrical Code (NEC)

c. ASTM B3 Soft or Annealed Copper Wire
d. NESC 9 Grounding

7.2.5 Environmental Compliance and procedures for handling Controlled and Hazardous Materials shall be in accordance with Connecticut Department of Transportation Form 816 Section 1.10.

7.3 Quality Assurance

7.3.1 Steel Structures shall comply with the following requirements except as otherwise indicated:

a. Fabricator shall be certified under the AISC Quality Certification
Program and must maintain an AISC type 1 certification for simple steel buildings. Evidence of current certification shall be submitted to the Engineer before beginning fabrication.

b. Qualify welding processes and welding operators in accordance with AWS D1.1, AWS D1.5 and AREMA Chapter 15

c. Provide certification that all welders to be employed in the work have satisfactorily passed AWS qualification tests within the previous 12 months. If recertification of welders is required, retesting will be the Contractor's responsibility.

d. Provide certification that all welders have a current AISC certification for positions 1, 2, 3, & 4.

e. Materials and fabrication procedures are subject to inspection and tests in the mill, shop, and field. Such inspections and tests will not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

f. Non-destructive testing and inspection shall be performed in accordance with AREMA Chapter 15, Parts 1 and 3. Testing shall be performed by an independent testing agency, included in the bid price.

g. The structural fabrication shall be shipped with the minimum number of pieces to reduce the amount of site assembly required, and as shown on the Contract Drawings.

h. Site assemblies shall be bolted as per the Contract Drawings and approved Shop Drawings. Field welding is not permitted unless specifically indicated on the drawings or if emphasized on submitted Shop Drawings and approved. Field welding, if required and approved, shall be kept to a minimum.

i. All steel components, assemblies, fabrications and rebar shall be galvanized, unless otherwise indicated.

j. The guardrail/fence frame shall be all shop welded construction with the exception of bolted mounting onto the stair stringers. Jointed components must be bolted, riveted with internal pipe sleeves as shown or as otherwise appropriate.

k. Stair stringers, stair railing, access door frames and stair support frame (modular units) shall be bonded with #4/0 AWG copper to catenary structure.
I. Field Cutting and field drilling is not permitted unless specifically indicated on the Contract Drawings or if emphasized on submitted Shop Drawings and approved.

7.3.2 Concrete Construction shall comply with the following requirements except as otherwise indicated:

a. The Contractor shall engage the services of an independent testing laboratory to perform services required by these specifications, subject to the Engineer’s approval.

b. Design mixes shall be Class “F” in accordance with Connecticut DOT Form 816.

c. The testing laboratory will perform the following services as directed by the Engineer:

- Conduct strength tests of the concrete during construction by securing samples, molding, curing and testing specimens in accordance with applicable ASTM procedures. The number of cylinders taken shall be as indicated below. One set of samples, for strength test of each strength class of concrete, shall be taken not less than once a day nor less than once for each 25 cubic yards of concrete or once for each major pour.

- Compression strength tests shall be made as follows: Two (2) at three (3) days, two (2) at seven (7) days, two (2) at twenty-eight (28) days, and two (2) in reserve.

- Each strength test result shall be the average of the two cylinders tested from the same set.

- Be present during concrete placement to determine air content, slump and temperature of concrete from each batch in which cylinders have been taken for strength testing or any other batch as directed by the Engineer. Information shall be obtained in accordance with applicable ASTM standards or as ordered by the Engineer.

- Submit written test reports confirming results of all tests and inspections. Reports shall be made promptly with three copies to the Engineer and one copy to the Contractor.

- Concrete will be accepted or rejected by the Engineer in accordance with Connecticut DOT Form 816 and the provisions of “Building Code Requirements for Structural Concrete” (ACI...
7.3.3 Soldier Pile and Lagging Walls shall comply with the following requirements, except as otherwise indicated:

a. Manufacturer: Precast panels shall be plant-fabricated. The manufacturer of the precast panels shall be regularly engaged in the production of such products, shall have furnished such products for five (5) similar projects that have been in service for not less than three (3) years, and shall be subject to the approval of the Engineer. Work on the precast panels shall not proceed until the proposed manufacturer has been approved by the Engineer.

b. Provide the Engineer with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.

c. Working drawings, order lists and bending diagrams shall be submitted to the Engineer, and approved, before ordering material.

7.4 Submittals

7.4.1 The Contractor shall submit shop drawings, catalog cuts, material data sheets, certifications, and samples in accordance with the applicable sections of the Connecticut DOT Form 816 and Section 11.0 of these Technical Specifications:

a. Structural steel – Form 816 Section 6.03.

b. Retaining walls – In addition to the requirements of Form 816 Section 5.06, the Contractor shall submit complete shop drawings and layouts for each individual signal equipment site where retaining walls will be installed.

7.4.2 Concrete: The Contractor shall submit a delivery ticket from the concrete supplier with each batch delivered to the site including the following information:

a. Name of supplier

b. Name of batching plant and location c. Serial number of tickets

d. Date
e. Truck number and batch number

f. Specific job designation (Contract number and location)

g. Volume of concrete (cubic yards)

h. Specific class of concrete

i. Time loaded and amount of water added

j. Type and brand of cement

k. Maximum size of aggregates

l. Weights of coarse and fine aggregates, respectively

m. Maximum permissible amount of water to be added at the site, if any

n. Type and amount of admixtures and

o. Mix design designation

7.4.3 Soldier Pile and Lagging Wall: At least 30 calendar days prior to commencement of work the Contractor shall submit to the Engineer for approval, the following:

a. Precast Panels: Submit shop drawings, indicating fabrication details of the precast panels and necessary details for construction of the soldier pile and lagging retaining wall work to be performed. Shop drawings shall include:

1. Panel or unit length, size and designations.
2. A numbered panel layout for fabrication and erection purposes.
3. Typical panels, as well as special panels, such as at bends; dimensions necessary to construct the member; the location of reinforcement steel in the member; and the location of reinforcement attachment devices that are embedded in the panels.
4. Type of finish, finish texture, and color.

b. Product Data: Manufacturer's catalog cuts, specifications, and installation instructions for precast panels and accessories. List and size of proposed equipment including cranes, drilling equipment, compressors, etc.

c. Soldier Piles:
1. The contractor shall conduct a field survey prior to the submittal of shop drawings. Contractor shall notify the Engineer in writing of any discrepancies with the Contract Drawings.

2. Submit detailed shop drawings of structural steel work, showing sizes; details of fabrication and construction; methods of assembly; locations of hardware, anchors, and accessories; and erection sequence and details. Include procedures for heavy lifts and rigging.

3. Shop drawings shall include member identity, welding technique, cuts, copes, gussets, connections, holes, fasteners, camber, fabrication and erection tolerances, type of finish, coating system, weights of members, and critical clearances.

4. Welds, both shop and field, shall be indicated by standard welding symbols of AWS A2.4.

5. Drawings shall show the size, length, and type of each weld. Indicate individual welders’ identification (I.D.) on project record drawings.

6. Test Boring Logs: Provide test boring logs, signed by a geotechnical engineer licensed in Connecticut, of the borings performed at each wall location. The boring logs shall be prepared in accordance with the ConnDOT Geotechnical Engineering Manual, Chapter 5.

7. Soldier Pile Drilled Shafts: Maintain a drilling record for the predrilled holes and submit it to the Engineer upon completion of drilling. On the record indicate the following, for each predrilled hole:
   a. Type and rating of drilling equipment, including tooling used.
   b. Any unusual conditions encountered during drilling.
   c. Bottom of shaft elevation.
   d. Method used for cleaning out bottom of shaft.
   e. Bar Lists.
   f. Manufacturer’s Compliance Certificate: Certify that products meet or exceed specified requirements.
   g. Manufacturer’s Qualifications Data: Name and experience of precast concrete panel manufacturer.
7.4.4 Working Drawings and Installation Drawings: To include submissions called for in Appendix C, Metro-North Construction Specification I&C.

7.5 Delivery, Storage and Handling

7.5.1 Deliver materials to the site at such intervals as will insure uninterrupted progress of the work. Deliver anchorage devices in ample time to not delay that work.

7.5.2 Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other suitable supports. Protect steel members and packaged materials from corrosion and deterioration; keep them free from dirt, grease and other foreign matter. Do not store materials on the structure in a manner that might cause distortion or damage to the members or the supporting structures.

7.5.3 Structural steel members shall be loaded, hauled, and unloaded in such a manner that they will not be deformed, damaged, or subjected to stresses in excess of those provided for in the design.

7.5.4 Avoid bending, scraping, and overstressing the steelwork. Block with wood, or otherwise protect, projecting parts which may be bent or damaged.

7.5.5 Load, transport, unload, and store structural steel materials in such a manner that the metal is kept clean and free from injury.

7.5.6 The precast concrete wall panel units shall not be transported and delivered until 70% of the minimum 28-day compressive strength has been attained. Provide galvanized handling devices according to ASTM A123 or as approved in the shop drawings. Care shall be taken to not damage or crack the precast units during transportation, handling and erection. Wooden blocks shall be placed between panels while they are stored in order to separate them and avoid direct contact stresses. Replace or repair units damaged by improper storing, transporting, or handling at the Contractor’s own expense.

7.6 Fabrication

7.6.1 The Contractor shall comply with the following requirements regarding Shop Fabrication and Assembly:
a. Fabricate and assemble components in the shop to minimize, to the greatest extent possible, field assembly.

b. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

c. Where finishing is required, complete the assembly, including cutting, welding and drilling, before start of finishing operations. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.

d. No splices will be permitted except where indicated on the plans, or the approved Shop Drawings.

7.6.2 The Contractor shall comply with the following requirements regarding Welded Construction:

a. All welding inspection shall be performed by an independent testing agency at the Contractor's expense in accordance with AREMA Chapter 15 unless otherwise specified in the Contract Documents.

b. All welds shall be visually inspected in their entirety by the fabricator.

c. The Contractor shall submit to the Engineer reports of all visual inspections and non-destructive testing performed. These reports shall indicate the type of inspection, the amount of inspection performed in linear feet, the location and length of defects, if any, and a certification that the tests were performed in accordance with the required specifications.

d. Welds requiring repair shall be retested after the approved repairs are made.

e. All welding, welding procedures and qualifications, welder qualifications, weld filler material and weld filler metal control shall be in accordance with AWS D1.1 and the additional requirements herein. Welding procedures and qualifications shall be maintained and readily accessible in the shop where welding is being performed.

f. Welders qualified to ASME IX are considered acceptable for AWS D1.1 work.
g. Only low-hydrogen type covered electrodes shall be used as weld filler metal if shielded metal arc welding (SMAW) is the welding process selected for production.

h. The weld inspection shall be performed by an AWS Certified Inspector, or Assistant Welding Inspector(s), under the supervision of the AWS Certified Inspector. Alternatively, a program for self-certification of welding inspectors may be implemented provided the program is written and supervised by an AWS Certified Inspector in compliance with the requirements of AWS D1.1. The Weld Inspection Program, including the Inspector's certification records, shall be maintained and readily accessible in the shop where welding is being performed.

i. All welds found deficient shall be repaired in accordance with AWS D1.1 and be re-inspected. All welds found deficient shall be tested using magnetic particle testing over their full length. Magnetic particle testing shall be performed for an additional length of welds equal to the length of deficient welds for each weld type.

j. A record shall be maintained for all the welds that required repairs after visual and Magnetic Particle Testing.

7.6.3 The Contractor shall comply with the following requirements regarding Protective Coating:

a. All carbon steel members, fabrications, bars, plates and rolled shapes shall be hot dipped galvanized (after fabrication) in accordance with ASTM A123 and A 385. Coating grade to be 100 (3.9 mils thickness, 2.3 oz./sf).

b. Repair galvanized coating per ASTM A 780 recommendations. Products meeting that requirement include ZIRP ® by Duncan Galvanizing, Galvilite ® by ZRC Worldwide and approved equal. Apply product in strict accordance with the manufacturer's recommendations.

7.7 Bonding and Grounding - Signal Equipment Sites

7.7.1 The Contractor shall electrically bond and ground the Steel Platforms, Access Stairs, and hand railings for Signal Equipment sites as required in these Technical Specifications and in accordance with the Contract Drawings.
7.7.2 Bonding shall be provided for electrical continuity between all connected top and bottom modular units, the connected stair stringers, and railings using 4 AWG stranded copper insulated jumpers.

7.7.3 The Contractor shall also install grounding for new houses cases and fencing. With the exception of fence ground clamps specifically used for attaching jumpers to fence fabric, all bonding of individual modular units and external grounding connections shall be welded exothermically to the structure elements. Splices are not permitted in bonding and grounding conductors.

7.7.4 Platforms and Stairs shall be grounded to a dedicated ground rod using a 4 AWG stranded copper insulated grounding conductor. The ground rod shall be located in close proximity to the structure. A minimum of 2 foot separation shall be provided between ground rods and footings or any other reinforced concrete structures.

7.7.5 Ground rods shall be manufactured with a medium carbon steel core, copper-clad by the molten weld casting process, with a nominal 5/8 inch diameter, not less than ten feet in length, threaded top and bottom with a coupling of corrosion resistant copper alloy for joining.

7.7.6 The ground rods shall provide a maximum resistance to ground of 3 ohms. Measurement shall be by the fall-of-potential method, made under the observation of the Engineer. To meet this resistance requirement, additional ground rods or electrolytic grounding electrodes shall be installed as necessary.

7.7.7 Ground rod or rods shall be installed vertically if possible. If this is impossible, ground rods may be installed at an angle or (as a last resort) buried horizontally 24 inches (minimum) below grade.

7.7.8 Connections to ground rod or rods shall be One-Shot Mechanical compression connector, Driveze Part No. DIC58-4 (or approved equal). Ground rods and connections shall comply with the standard of ANSI UL 467, "Grounding and Bonding Equipment". Ground rod enclosure box shall be Carson Model No. 910-10 with bolt down cover (or approved equal).

7.7.9 Steel platforms and stairways shall also be bonded to the base of the nearest Catenary Bridge. A single insulated 4/0 copper conductor shall be direct buried, running from the platform or stairway base to the base of the catenary structure. This conductor shall be welded exothermically to both the stair and catenary structures.

7.7.10 Bonding cable to the Catenary Bridges shall be direct buried 24
inches (minimum) below grade. The buried cable shall be placed as straight and level as conditions permit. The Contractor shall be responsible for avoiding other buried facilities.

7.7.11 When placing the bonding cable in the excavated open trench, a sand bed shall be compacted to a depth of not less than six inches on an acceptable subgrade prior to the installation of the bonding cable. Sand backfill shall then be placed and compacted with hand tools around and over the cable in a six-inch layer. Finally, the trench shall be backfilled with excavated soil and compacted in four-inch to six-inch uniform layers. All backfill shall be free of large or sharp stones that may damage the cable.

7.7.12 Should the excavation for bonding cable have to be left open, it shall be protected in an approved manner to prevent injury to individuals. Piles of excavated material must not be left in such a way as to present a tripping hazard.

7.7.13 The Contractor is solely responsible for determining lengths of bonding and grounding wires/cables necessary for this work, based on field conditions, as approved by the Engineer.

7.7.14 Wires for bonding and grounding shall be ICEA Class B stranded, meeting the requirements of ASTM B3, soft drawn. Insulation shall be 600V, moisture resistant and heat resistant thermoplastic (type THHN/THWN) or cross-linked synthetic polymer (type XHHW). Insulation shall be rated for 90 deg. C (minimum) in dry locations and 75 deg. C (minimum) in wet locations. It is not required that this insulation have low smoke low halogen properties.

7.7.15 Wires for bonding and grounding shall be supplied by a cable manufacturer who is regularly engaged in the production of similar wire and cable. The contractor shall provide products from the following manufacturers, or approved equal:

- a. The Okonite Company
- b. Boston Insulated Wire
- c. BICC
- d. Rockbestos Surprenant Cable Corporation
- e. Pirelli Cable
7.7.16 All equivalent submittals, such as those required in accordance with Sections 12.7 and 12.9 for copper signal and communications cable, shall also be made for the bonding and grounding wires/cable to be installed in conjunction with the Employee Access Stairs, and shall be made in conjunction with the signal and communications cable submittals. This includes but is not limited to manufacturer’s catalog cuts, shop drawings and material specifications for the bonding and grounding cable to be furnished, and manufacturer’s certification that furnished cables meet specified requirements.

7.7.17 Shop drawings and catalog cuts to be submitted for the proposed bonding and grounding hardware shall include but not be limited to details and descriptions of the proposed exothermic welding system (including detail for each specific connection required), fence ground clamps, and the ground rod assembly. The submittal shall address the compatibility of the proposed hardware with the specific bonding and grounding cables being proposed.

7.8 Soldier Pile and Lagging Wall

7.8.1 This work consists of the construction of permanent Soldier Pile and Precast Concrete Panel Walls as shown on the Contract Drawings and specified herein. Due to the potential presence of cobbles or boulders in the existing embankment, soldier piles will need to be placed in predrilled holes backfilled with concrete.

7.8.2 Project Site Conditions

a. The Contractor shall fully examine site conditions to ensure that his equipment can operate without removing or relocating existing utilities, structures or structural members. Proceed with caution in areas of utility facilities and structures. Expose existing utilities by hand-excavation or by other method acceptable to the utility owner.

b. The Contractor should be made aware that the project site could contains adverse subsurface conditions including but not limited to cobbles, boulders, and debris that will impact installation of foundation elements and other construction activities.

c. The Contractor is responsible for conducting a subsurface investigation consisting of at least one test boring at each wall location. The test boring shall be placed within the footprint of the wall and shall extend a minimum of 5 feet below the lowest soldier pile tip.
elevation for that wall. Provide the Engineer with a copy of each test boring logs within 7 days of completing the boring, and at least 30 days prior to starting any drilled shafts at the wall location associated with the test boring.

7.8.3 Installation of Soldier Piles and Lagging

a. Excavate the ground to the required grade as per the Contract Drawings. Ensure that the slopes are stable and safe.

b. Using the appropriate drilling equipment, predrill holes to the required depth below existing ground surface and specified diameter. Remove and dispose of excavated soil material.

c. To prevent collapse of overburden soils and/or seepage of water, predrilled holes will require temporary steel casing from existing ground elevation to the proposed tip elevation. Temporary steel casing shall remain during cleaning and inspection of holes and can be withdrawn either during or immediately after concrete placement. Uncased holes shall not be permitted.

d. Keep the drilled holes free from any loose materials, debris, and water, at all times. No more than 1 foot of standing water shall be left in the bottom of the hole prior to placing soldier beam.

e. Prior to concrete placement, the hole shall be inspected and approved by the Engineer.

f. After a pile has been plumbed and seated in the drilled shaft, encase it with concrete from the bearing tip to the top of drilled shaft elevation indicated on the Contract Drawings.

g. Top of cut-off elevation:

1. Piles shall be cut off at the designated elevation.

2. Cutoffs of soldier piles shall be made at right angles to the axis of the pile. Repair galvanized coating per ASTM A780 recommendations.

h. The air content in the freshly mixed concrete shall be limited to 7.5% max.

i. The slump for the concrete shall be 7 inches (+/- 2 inches).
j. Concrete shall be placed continuously by methods that ensure against segregation and shall completely fill the hole. Concrete shall be placed by gravity, tremie or pumped methods. The end of the discharge nozzle shall be kept a minimum of 5 feet below the fresh concrete surface at all times during placement.

k. Provide reinforced precast concrete lagging panels, placed within the soldier piles, contained in the recesses between the flanges. When placing subsequent concrete lagging panels, attach short strips of closed-cell neoprene sponge along the top of the previously installed panels to prevent high contact stresses. Carry the bottom of the panel system to the top of the predrilled hole. Provide temporary supports, as required, to support the precast concrete panels in place within the pile flanges until the backfill is placed. The finish on the exposed surfaces shall be a smooth form finish.

l. Install geocomposite strip drains on the rear face of the concrete panels as shown in the Contract Drawings.

m. Place pervious structure backfill per Contract Drawings.

n. Install steel handrails per Contract Drawings.

o. Install steel stair systems, where applicable, per Contract Drawings.
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8.0 MATERIALS

8.1 General

8.1.1 The quantities of material required for the Work of this Contract shall be determined by the Contractor from the Contract Drawings, from site inspection and from project requirements as determined by the Contractor. The Contractor shall furnish and install all material necessary to make a complete installation.

8.1.2 All products and installation work shall comply with governing codes and regulations. The Contractor shall provide products of acceptable manufacturers that have been in satisfactory use in similar service for three years at minimum. The Contractor shall use experienced installers in the execution of the Work.

8.1.3 The Contractor shall provide products that are free from defects impairing performance, durability, or appearance, and of the commercial quality best suited for the purpose shown on the Contract Drawings or specified herein.

8.1.4 The Contractor shall deliver, handle, and store materials in accordance with manufacturer's instructions. The Contractor shall submit for approval the methods by which the Contractor shall bundle and deliver the material before any delivery is made.

8.1.5 Conduit stored on unpaved surfaces outdoors shall be supported at least one foot above grade, or shall be provided with end closures to that height.

8.1.6 Conduits shall be sealed with end closures during the course of construction, to protect threads and to prevent the entry of foreign material.

8.1.7 The Contractor shall verify the quantities of material required to provide a complete project by examining the Contract Documents and by the performance of a thorough field investigation prior to commencing the Work. Quantities implied or otherwise shown in these Contract Documents shall not relieve the Contractor from responsibility to supply any and all quantities of material as may be required to provide a complete system installation.

8.1.8 The Contractor shall furnish installation material in conformance with these Contract Documents, or as approved by the
Engineer.

8.1.9 The Contractor shall comply with manufacturer’s instructions for storage, shelf-life limitations, and handling.

8.1.10 Submittals

   a. The Contractor shall submit product data prior to start of construction for all material installed as part of the Work of this Contract, indicating product standards, physical and chemical characteristics, technical specifications, limitations, and general recommendations regarding the material.

   b. The Contractor shall submit manufacturers’ certificates prior to the start of any construction that document that products meet or exceed specified requirements.

   c. The Contractor shall submit manufacturers’ installation instructions prior to the start of any construction.

   d. Submittal requirements are listed in Section 12, “Submittals,” of these Technical Specifications.

8.2 Attachment Hardware – General Requirements

8.2.1 The Contractor shall fabricate, furnish, and erect attachment hardware for attaching conduits or cables to catenary structures, bridges, walls and all other attachments as required and as shown on the plans and in accordance with the Contract Documents.

8.2.2 Miscellaneous steel shapes including but not limited to bent j-brackets, angles, channels and plates shall be ASTM A 36 steel, hot dipped galvanized to ASTM A 123, Coating Grade 100 (2.3 ounces per square foot) or Stainless Steel grade 316L.

8.2.3 Unless otherwise specified, all steel bolts, nuts, washers, lock washers and other attachment hardware shall be hot dip galvanized according to ASTM A153.

8.2.4 Where stainless steel hardware is required by the Contract Documents, all stainless steel bolts, nuts, washers, lock washers and other attachment hardware shall be ANSI 316L stainless steel.

8.2.5 The Contractor shall repair any damaged or disturbed galvanizing, including cases where factory-galvanized material is cut in the field by the Contractor as part of normal installation. Minor repairs
may be effected in the field; major repairs shall be effected by returning the piece and repeating the galvanizing process. The Engineer shall be sole judge of what constitutes minor or major repair.

8.2.6 Field galvanizing shall be repaired by the following method. Clean the damaged area by wire brushing, sand or grit blasting, or any other suitable method approved by the Engineer, to remove all loose and cracked coating. Paint the cleaned area with one brush coat or two spray coats of zinc repair material. The brand of material proposed shall be submitted to the Engineer for approval.

8.2.7 The Contractor shall mark the piece weight on each member and match-mark all shop pre-fitted members.

8.2.8 Small parts, such as bolts, nuts, washers, fillers and small connecting plates and anchors shall be shipped in boxes, crates, or barrels. Pack separately each length and diameter of bolt and each size of nut and washer. Plainly mark and list the contents on the outside of each container.

8.2.9 Structural steel material shall be loaded, transported, unloaded, and stored in such a manner that the metal is kept clean and free from injury. Material above ground on platforms, frames, or other supports shall be covered and protected from corrosion.

8.2.10 Bent or damaged pieces shall be replaced.

8.3 Attachment Hardware - Products

8.3.1 The Contractor shall provide hardware meeting the following requirements:


b. Stainless steel fasteners where specified on the Contract Drawings, shall meet the requirements of ASTM A-316.

8.3.2 The Contractor shall provide SPACERS meeting the following requirements:

a. The 5/8" ID 2 Inch Spacers shall be Wisconsin Stamping ID 3/4" OD 1" Wall 1/8" L 2", either galvanized or stainless as shown on the Contract Drawings, or approved equivalent.
8.3.13 The Contractor shall provide 3-BOLT CABLE SUSPENSION CLAMPS meeting the following requirements:

   a. The 3-bolt cable suspension clamps shall be Allied Bolt part number 5080, or approved equivalent.

   b. The 3-bolt cable suspension clamps shall be used for suspension of bare messenger strand. Jacketed messenger, such as that integral with the Figure 8 Aerial Duct defined herein, shall be suspended with Serpentine 3-Bolt Clamps as defined herein.

8.3.14 The Contractor shall provide SERPENTINE 3-BOLT CLAMPS meeting the following requirements:

   a. The Serpentine 3-Bolt Clamps shall be Allied Bolt part number 4080, or approved equivalent.

8.3.15 The Contractor shall provide BEAM CLAMPS meeting the following requirements:

   a. Beam Clamps shall be Unistrut part number PFL050T, or approved equivalent.

8.3.16 The Contractor shall provide STRANDVISSES meeting the following requirements:

   a. Strandvises used with 7/16-inch aerial messenger strand shall be Hubbell Power Systems part number GDE5203, or approved equivalent.

   b. Strandvises used with 3/8-inch aerial duct integral messenger shall be Hubbell Power Systems part number GDE5202, or approved equivalent.

   c. Where strandvises are to be used for mid-span drops (not dead ends) as specified on the Contract Drawings, the strandvise shall be Hubbell Power Systems part number GDE5203, or approved equivalent.

   d. Strandvises shall be designed for use on extra high strength galvanized aerial messenger strand.

   e. The Contractor may submit equivalent strandvises by other manufacturers including Preformed Line Products.

8.3.17 The Contractor shall provide DEAD END CLAMPS
meeting the following requirements:

a. Dead End Clamps shall be A B Chance part number 6502 or approved equivalent.

8.3.18 The Contractor shall provide 1 5/8 INCH CHANNEL meeting the following requirements:

a. 1 5/8 Inch Channel shall be Unistrut part number P1100HS, or approved equivalent.

b. 1 5/8 Inch Channel shall be cold formed to size from low-carbon strip steel.

c. 1 5/8 Inch Channel shall be pre-galvanized 12 gauge steel conforming to ASTM A653 GR 33.

d. 1 5/8 Inch Channel shall be designed to accommodate mounting of associated materials as shown on the Contract Drawings.

e. 1 5/8 Inch Channel that is cut to length in the field shall have its cut ends field galvanized by the Contractor as specified herein.

8.4 Messenger, Lashing and Related Products

8.4.1 The Contractor shall furnish and install messenger strand and all hardware necessary to lash cables to the strand, and shall lash cables to that strand as shown on the contract drawings. Requirements for individual products are as follows.

8.4.2 The Contractor shall provide AERIAL MESSENGER STRAND meeting the following requirements:

a. Aerial Messenger Strand shall be as manufactured by PPC Insulators or approved equivalent.

b. Aerial Messenger Strand shall be 7-strand, Extra High Strength Class A Grade galvanized steel strand of 7/16-inch nominal size.

c. Average weight shall be 0.399 lbs./ft. d. Minimum strength shall be 20,800 lbs.

8.4.3 The Contractor shall provide LASHING WIRE meeting the following requirements:

a. Lashing Wire shall be General Machine Products part number
71534, or approved equivalent.

b. Lashing Wire nominal diameter shall be .045 inch.

c. Lashing Wire shall be made of Type 316 stainless steel with modified 18-10 analysis containing approximately 2.5% molybdenum.

d. Lashing Wire shall be designed to be resistant to corrosive action of most chemicals, including chlorides and sulfides, and shall be particularly resistant to pitting and pin hole corrosion of the kind commonly caused by salt spray.

e. Lashing Wire shall be designed to resist failure under the most severe atmospheric conditions.

f. Lashing Wire shall be wound in a straight hub configuration to fit standard lashers.

8.4.4 The Contractor shall provide LASHING WIRE CLAMPS meeting the following requirements:

a. Lashing Wire Clamps shall be General Machine Products part number 81460, or approved equivalent.

8.4.5 The Contractor shall provide LASHED CABLE SUPPORTS/CLAMPS meeting the following requirements:

a. Lashed Cable Supports / Clamps shall be Diamond Sachs part number 34-08912/22/32, or approved equivalent.

8.4.6 The Contractor shall provide LASHED CABLE SPACERS meeting the following requirements:

a. Lashed Cable Spacer shall be Diamond Sachs part number 34-08850/75, or approved equivalent.

8.4.7 The Contractor shall provide GALVANIZED CABLE RINGS meeting the following requirements:

a. The Galvanized Cable Rings shall be 3-inch ring for 7/16-inch strand Clifford of Vermont part number 1077, or approved equivalent.

8.4.8 The Contractor shall provide Q SPAN CLAMPS meeting the following requirements:

a. The Q Span Clamps shall be Diamond / Sachs part number 27-
8.4.9 The Contractor shall provide BEAD CABLING STRAPS WITH BRONZE HOOKS meeting the following requirements:

a. The Bead Cabling Straps with Bronze Hooks shall be Safetran part number 028503-19X or approved equivalent.

8.4.10 The Contractor shall provide THIMBLE CLEVISES meeting the following requirements:

a. The Thimble Clevises shall be MacLean Power Systems part number FSA-88A-5 or approved equal.

8.5 Figure 8 Aerial Duct and Related Products

8.5.1 The Contractor shall furnish and install Figure 8 Aerial Duct, including all hardware necessary to complete that installation, and shall install fiber optic cables within the aerial duct as shown on the Contract Drawings. Requirements for individual products are as follows.

8.5.2 The Contractor shall provide FIGURE 8 AERIAL DUCT meeting the following requirements:

a. Figure 8 Aerial Duct shall be Duraline Part Number 2099-52 or Engineer approved equivalent.

b. Figure 8 Aerial Duct shall be 1-1/4 inch nominal diameter, standard figure 8 duct with 3/8 inch integral support strand.

c. Outside diameter shall be 1.556 inches +/- 0.015 inch.

d. Minimum wall thickness shall be 0.176 inch.

e. Maximum wall thickness shall be 0.200 inch.

f. Minimum strand breaking strength shall be 15,400 lbs.

g. Average weight shall be 0.635 lb/ft.

h. Bend radius shall be 24 inches.

i. Brittleness Temperature shall be -75 degrees C.

8.5.3 The Contractor shall provide COMPRESSION COUPLINGS
meeting the following requirements:

a. The Figure 8 Aerial Duct Coupling shall be Morris Coupling Company Side Band Compression coupling for 1 1/2 inch diameter OD tubing, or approved equivalent.

b. The Figure 8 Aerial Duct Coupling shall be designed to splice two sections of Aerial Duct, providing an airtight union for cable blowing installation at the range of installation pressures selected by the Contractor. Side band couplings may be required to resist higher installation pressures and shall be provided by the Contractor at no additional cost if required to support the Contractor's installation methods.

c. The Figure 8 Aerial Coupling shall be resistant to ultraviolet radiation and otherwise be suitable for aerial installation.

8.5.4 The Contractor shall provide SPLIT DUCT PLUGS meeting the following requirements:

a. Split Duct Plugs shall be Etco CL Series, or approved equivalent of the appropriate size for the innerduct and fiber cable utilized.

8.5.5 The Contractor shall provide LOOP NUT DUCT PLUGS meeting the following requirements:

a. Loop Nut Duct Plugs shall be Carlon part number MAEPG4, or approved equivalent.

8.6 Messenger Bonding

8.6.1 The Contactor shall bond all messengers, including those integral to the Figure 8 Aerial Duct, to the Metro-North catenary structures as shown on the Contract Drawings. Requirements for individual products are as follows.

8.6.2 The Contractor shall provide GROUND CLAMPS FOR FIGURE 8 AERIAL DUCT meeting the following requirements:

a. The type C ground connector for the figure 8 aerial duct insulated messenger strand shall be Allied Bolt part number 1025 or an approved equivalent.

8.6.3 The Contractor shall provide MESSENGER GROUNDING CLAMPS meeting the following requirements:
a. Messenger Grounding Clamps shall be Electric Motion Company, Inc. part number EM 4811, or approved equivalent.

8.6.4 The Contractor shall provide SERVICE POST CONNECTING GROUNDING STUDS meeting the following requirements:

a. The service post connecting grounding stud shall be Thomas & Betts part number SP2DL, or approved equivalent.

8.6.5 The Contractor shall provide GROUND WIRE meeting the following requirements:

a. Ground Wire shall be McMaster-Carr part number 7512K64, or approved equivalent.

b. Ground Wire shall be #6 AWG, stranded conductor, non-insulated, non-tinned copper wire.

c. Where insulated ground wire is specified on the Contract Drawings, the Ground Wire shall be Coleman Cable part number 42111, or approved equivalent.

8.7 Rigid Conduit and Related Products

8.7.1 The Contractor shall furnish and install rigid conduit, including all hardware and accessories necessary to complete the conduit locations and conduit runs called for on the contract drawings. The contract drawings depict locations where conduit shall be utilized and define the type of conduit material required. The Contractor shall determine the numbers and sizes of conduits required for each location or conduit run in accordance with National Electric Code Standards.

Requirements for individual products are as follows:

8.7.2 The Contractor shall provide RIGID GALVANIZED STEEL (RGS) CONDUIT meeting the following requirements:

a. RGS Conduit shall be Allied Tube and Conduit 4 Inch Galvanized Rigid, or approved equivalent.

b. All metal conduit used shall be 4 inch, schedule 40 Rigid Galvanized Steel (RGS) (also known as Galvanized Steel Pipe – GSP) and shall comply with ASTM A-53/A53M-01 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
c. Expansion joints for steel conduit, if required, shall be as manufactured by Appleton Electric Co., or Engineer approved equal, and shall include a grounding ring or a grounding conductor.

8.7.3 The Contractor shall provide CONDUIT CLAMPS meeting the following requirements:

a. Conduit Clamps shall be Unistrut part number P1121 hot dipped galvanized, or approved equivalent for 4 inch conduit. Other sizes shall be supplied as appropriate.

b. Conduit Clamps shall be designed for use with 1-5/8 Inch Channel as specified herein.

c. Conduit Clamps shall be manufactured from hot-rolled, pickled and oiled steel plates, strip or coil, and shall conform to ASTM specifications A575, A576, A635, or A36.

8.7.4 The Contractor shall provide CONDUIT HANGER CONNECTORS meeting the following requirements:

a. Conduit Hanger Connectors shall be Unistrut part number P2535, or approved equivalent.

b. Conduit Hanger Connectors shall be designed for use with 1-5/8 Inch Channel as specified herein.

c. Conduit Hanger Connectors shall be manufactured from hot-rolled, pickled and oiled steel plates, strip or coil, and shall conform to ASTM specifications A575, A576, A635, or A36.

8.7.5 The Contractor shall provide THREADED COUPLINGS meeting the following requirements:

a. Threaded Couplings shall be Appleton part number EC-400 or approved equal.

b. Threaded Coupling shall be a three piece threaded union designed for coupling 4” GRS Conduit.

8.7.6 The Contractor shall provide Conduit Sealing Bushings in all locations where open ends of conduits are exposed to the intrusion water, rodents, dirt, or other foreign material. Examples of these locations include exposed conduit ends on vertical conduits attached to catenary structures. Conduit sealing bushings shall meet the following requirements:
a. Conduit Sealing bushings shall be OZ Gedney Type CRC (or equal).

b. A top cover shall be installed where conduit sealing bushings are located at the top of vertical conduits.

c. Sealing compound shall be compatible with conduit sealing bushings and shall be manufactured by the same supplier.

8.7.7 The Contractor shall provide REINFORCED THERMOSETTING RESIN CONDUIT (RTRC) AND FITTINGS meeting the following requirements:

a. All RTRC and required fittings shall be from the ID Extra Heavy Wall (XHW) Conduit System supplied by FRE Composites of St-Andre-d'Argenteuil, Quebec, Canada, or approved equivalent.

b. All RTRC used shall be 4 inch, extra heavy wall conduit suitable for above-ground and below-ground telecommunications applications, including exposed installations subject to physical damage.

c. All RTRC and fittings shall comply with UL 1684, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings, as well as UL 1684A, Supplemental Requirements for Extra Heavy Wall Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

d. All RTRC and fittings, including but not limited to elbows, couplings, sleeves, expansion joints, threaded adapters and all other necessary special fittings shall be part of a complete system from a single manufacturer.

e. All RTRC and fittings, regardless of application, shall be UV stabilized for installation in outdoor applications with direct exposure to sunlight.

f. All RTRC and fittings shall be manufactured from E or E-CR glass and epoxy resin with no fillers, and shall have a resin content of 32%, plus or minus 3%.

g. All RTRC and fitting joints shall be adhesive bonded inside a straight bell end of even socket depth through out the raceway.

8.7.8 The Contractor shall provide PVC CONDUIT AND FITTINGS meeting the following requirements:

a. PVC Conduit for application in underground, encased or
exposed applications in accordance with the National Electrical Code (Article 347).

b. Conduit shall be rated for 90° C conductors, UL Listed or approved. Material shall comply to NEMA Specification TC-2 (Conduit) and TC-3 (Fittings) and UL Standards 651 (Conduit) and 514b (Fittings)

c. The conduit and fittings shall carry a UL label (Conduit - on each 10 foot length; Fittings - stamped or molded on each fitting).

d. Conduit and fittings shall be identified for type and manufacturer and shall be traceable to location of plant and date manufactured. The markings shall be legible and permanent.

e. The conduit shall be made from polyvinyl chloride compound (recognized by UL) which includes inert modifiers to improve weatherability and heat distortion.

f. The conduit and fittings shall be homogeneous plastic free from visible cracks, holes or foreign inclusions. The conduit bore shall be smooth and free of blisters, nicks or other imperfections which could mar conductors or cables.

g. Conduit, fittings and cement shall be produced by the same manufacturer to assure system integrity.

h. Testing and Acceptance Criteria: Conduit and fittings shall be tested in accordance with the testing requirements defined in NEMA TC-2, NEMA TC-3 and UL-651 and 514. The acceptance criteria shall be as given in the same standards.

i. All conduit and fittings shall be cut, cleaned, prepared, and solvent cemented in accordance with instructions from the manufacturer.

### 8.8 Miscellaneous Hardware

8.8.1 The Contractor shall furnish and install the following miscellaneous hardware items, including all hardware necessary to complete that installation, as shown on and described in the Contract
8.8.2 The Contractor shall provide INNERDUCT (non-figure 8) meeting the following requirements. Non-figure 8 innerduct shall be utilized for underground and other miscellaneous installations shown on the contract drawings.

a. Innerduct shall be Duraline SDR-13.5 1-1/4 Inch or Engineer approved equivalent.

b. Innerduct shall be of color as required in Contract Drawings, in particular Drawings. Where color is not designated by Contract Drawings innerduct shall be orange.

c. Innerduct shall conform to ASTM D-3035.

d. Nominal duct diameter size shall be 1-1/4 inches.

e. Average inside diameter shall be 1.394 inches.

f. Minimum wall thickness shall be 0.123 inch.

i. Minimum supported bend radius shall be 17 inches.

j. Safe working pull strength shall be 1425 lbs.

k. Average weight shall be 0.259 lbs. per foot.

l. Innerduct shall be constructed of high-density polyethylene (HDPE), coextruded with permanent dry silicon lining producing a ribbed inner surface.

m. Each innerduct shall have a non-deteriorating (e.g., Kevlar) “mule tape” with permanent footage markings installed. The mule tape shall have an average breaking strength of 1,250 pounds or greater.

n. Innerduct couplers shall be two-piece units consisting of a threaded aluminum coupling and an over fitter with a hot shrink tubing with hot melt adhesive to create a watertight and airtight seal using Raychem ATUM-3/1-0-STK or approved equal. Couplings shall be the innerduct manufacturers approved product for the innerduct supplied.

o. Innerduct shall be shipped with a pre-installed pull rope. The pull rope shall be 5/16” polypropylene with a polyester core or braided equivalent and have a minimum breaking strength of 2,000 pounds. All pull rope shall be UV stabilized for installation in direct sunlight.
p. Installed innerduct shall be sealed to protect against the entrance of any foreign matter (e.g., dust, silt, rodents). Seal innerduct ends and void spaces between innerduct and cable at innerduct ends with either duct plugs or split duct plugs as specified herein, or other Engineer-approved method.

q. Submit innerduct, accessories and manufacturers recommended installation practice to the Engineer for approval prior to the start of construction.

8.8.3 The Contractor shall provide SPLIT DUCT CHAFFING GUARDS meeting the following requirements:

a. Split Duct Chaffing Guards shall be Preformed Line Products part number PTG-0203, PTG-0205, PTG-0207 or PTG-0208 (or approved equivalent). The Contractor shall select the correct Chafing Guard size based on the diameter of cables being protected.

b. The Split Duct Chaffing Guard, also referred to herein as a Split Duct Abrasion Protector, shall be designed to protect all dielectric fiber optic cable jackets from abrasion from structures, trees or other cables.

c. The Split Duct Chaffing Guard shall be made from black, low density polyethylene. It shall be designed to be field cut to accommodate specific length needs.

8.8.4 The Contractor shall provide GUY MARKERS meeting the following requirements:

a. The 2/3 inch diameter Guy Markers shall be Arris item number 033839 or approved equivalent. The 2-inch diameter Guy Markers shall be MacLean J1493Y or approved equivalent. The type to be installed shall be as indicated on the Contract Drawings.

b. Guy Markers shall be designed to significantly improve visual detection of exposed down guy wires.

c. 2/3 inch diameter Guy Markers shall be 2/3 in. round, 7 ft. in length, weight 1.7 lbs. and of color yellow.

d. 2 inch diameter Guy Markers shall be 2 in. round, 8 ft. in length, weight 2.4 lbs and of color yellow. 2 inch Guy Markers shall be produced from high impact resistant polyethylene that is ultraviolet stabilized and equipped with mounting clamp assembly.
The Contractor shall provide EPOXY ADHESIVE ANCHORING SYSTEM meeting the following requirements:

a. Drill-in Anchor shall be Epoxy Adhesive Anchoring System, Hilti part number HIT-RE 500-SD or approved equivalent.

b. Drill-in Anchors shall be injectable two component epoxy adhesive and threaded rod system supplied by a single vendor. Component A shall contain bisphenol A and F epoxy resin, quartz sand, Alkyglycidyl ether, diglycidyl ether and synthetic amorphous silica. Component B shall contain m-xylene diamine, aliphatic polyamine, quartz sand, aluminum oxide, cement and amorphous silica. The threaded rod shall be of the diameter and length shown on Contract Drawings, and have one end 45 degree chisel cut and manufactured from 316 stainless steel.

The Contractor shall provide TY WRAPS meeting the following requirements:

a. Ty Wraps shall be Thomas and Betts part numbers as listed below.
   1. TY272MX – 8 Inch.
   2. TY27MX – 13 Inch.
   3. TY275MX – 18 Inch.
   4. TY277MX – 24 Inch.
   5. TY29MX – 30 Inch

b. Ty Wraps shall be constructed of 6.6 Nylon.

c. Ty Wraps tensile strength shall be 120 pounds (533 Newtons) at minimum.

d. Ty Wraps body width shall be .27 inches at minimum.

e. Ty Wraps shall be black, ultraviolet and weather resistant.

The Contractor shall furnish and install HEAT SHRINK CABLE END CAPS meeting the following requirements for protection of cut cable ends as defined herein and shown on the Contract Drawings:

a. Heat Shrink Cable End Caps shall be supplied by Super Seal Corporation of Stratford, CT or approved equivalent.

b. Heat Shrink Cable End Caps shall be sized appropriately according to size of cables to be protected.

c. Heat Shrink Cable End Caps shall be installed according to manufacturer’s instructions.
8.8.8 The Contractor shall provide INSULATING BUSHINGS meeting the following requirements:

a. The insulating bushings shall be Garvin Industries part number IB-400, or approved equivalent.

b. Insulating bushings shall be installed wherever cables transition into or out of rigid conduit ends to prevent abrasion and other damage.

c. Insulating bushings shall be manufactured of nylon or other Engineer-approved insulating material.

8.9 Fiber Optic Cable – General Requirements

8.9.1 The Contractor shall furnish and install all fiber optic cable, including all hardware necessary to complete that installation, as shown on the Contract Drawings.

8.9.2 All fiber optic cable shall be Corning LANscape® Pretium™ Solutions ALTOS® all-dielectric gel-free fiber optic cable (Corning part numbers as defined below) or Engineer-approved equivalent.

8.9.3 All fiber optic cable shall be suitable for installation in Figure 8 Aerial Duct, RGS Conduit, Innerduct and cable trough. All fiber optic cable shall be designed for outdoor use.

8.9.4 All fiber optic cable shall be fully water-blocked to prevent water penetration using absorbent polymers lining the interior wall of the buffer tubes.

8.9.5 All fiber optic cable shall be single-mode, loose tube, gel-free, all dielectric with medium polyethylene jacket.

8.9.6 Buffer tube size shall be standard 2.5 mm.

8.9.7 Temperature rating shall be as follows, at minimum:

a. Storage: -40° to +70°C (-40° to +158°F)

b. Installation: -30° to +70°C (-22° to +158°F)

c. Operation: -40° to +70°C (-40° to +158°F)

8.9.8 Maximum Attenuation Coefficient shall be 0.4/0.4/0.3 dB/km (1310/1383/1550 nm). Optical characteristics shall conform to ANSI/ICEA S-87-640.
8.9.9 The Contractor shall have the manufacturer of the fiber optic cable for this Contract approved by the Engineer. The Contractor shall provide all of the data required below for evaluation and shall make the arrangements for any required demonstrations and tests.

8.9.10 Manufacturer qualifications shall be based on the following criteria: The proposed cable manufacturer must have had experience in supplying fiber optic cables, and shall have a minimum of at least 2,000,000 fiber feet installed. A list of such installations which have been supplied by the manufacturer shall be provided for each cable manufacturer proposed.

8.9.11 The Contractor shall provide full technical data that demonstrates compliance with the requirements of this Specification for the manufacturer’s cable the Contractor proposes to supply.

8.9.12 The Contractor shall certify compliance with the following warranty prior to selection of the manufacturer:

a. The Contractor warrants that the design, material, and workmanship incorporated in each item of cable shall be of the highest grade and consistent with the established and generally accepted standards for fiber optic cable used for optical communications systems and that each such item and every part and component thereof shall comply with this Specification.

b. The Contractor agrees that this warranty shall commence with the acceptance of each item after initial satisfactory operation of the item, and shall extend for a period of two (2) years after acceptance of the item of the cable, whether the defect is patent or latent.

c. The warranty covering any length of cable that shall be replaced by the Contractor under the above conditions shall be reinstated for a period of two (2) years effective as of the day when said replacement is affected. If the failure is found to be of major importance and affects any other item of the cable, the reinstatement of the warranty shall then be extended to cover the item(s) so affected as well, and shall start as of the date of such replacement. The warranty reinstatement provided for in this subparagraph shall apply only to the first replacement or repair of any such item and, in the case of failure of major importance, to the first extension of said warranty to said affected items.
d. The Contractor warrants that 100% of the fibers provided in compliance with the Contract Documents shall meet or exceed the requirements set forth herein. The Contractor may elect to provide this warranty by providing a percentage of fibers in excess of those specifically required; however, these additional fibers shall be provided at no additional cost to Metro-North.

e. The foregoing warranties are exclusive and in lieu of all other warranties, written, oral implied, or statutory.

f. The vendor’s entire obligation under this warranty shall be, at own cost and expense, to promptly replace that item of cable which, under the contemplated specified use, proves defective or insufficient within the warranty period, or, during such period, proves to have failed to comply with the Specification, provided the Railroad gives the vendor prompt written notice of the failure.

g. The warranty covering any item of cable that shall be replaced by the vendor under the above conditions shall be reinstated for a period of eight years effective as of the day when said replacement is affected. If the failure is found to be of major importance and affects any other item of cable, the reinstatement of the warranty shall then be extended to cover the item so affected as well, and shall start as of the date of such replacement. The warranty reinstatement provided for in this subparagraph shall apply only to the first replacement or repair of any such item and, in the case of failure of major importance, to the first extension of the said warranty to said affected items.

8.10 Fiber Optic Cable and Related Products

8.10.1 The Contractor shall provide 144-STRAND FIBER OPTIC CABLE meeting the following requirements:

a. The 144-Strand Fiber Optic Cable (144-FOC) shall be Corning LANscape® Pretium™ Solutions ALTOS® all-dielectric gel-free fiber optic cable, Corning part number 144EW4-T4101D20, or Engineer-approved equivalent.

b. 144-FOC shall contain 12 active buffer tubes, each containing 12 strands of fiber.

c. 144-FOC shall have minimum bending radius of 10.3 inches loaded and 6.9 inches installed.
8.10.2 The Contractor shall provide 24-STRAND FIBER OPTIC CABLE meeting the following requirements:

a. The 24-Strand Fiber Optic Cable (24-FOC) shall be Corning LANscape® Pretium™ Solutions ALTOS® all-dielectric gel-free fiber optic cable, Corning part number 024EW4-T4101D20, or Engineer-approved equivalent.

b. The 24-FOC shall contain two active buffer tubes each containing twelve strands of fiber.

c. The 24-FOC shall have minimum bending radius of 6.7 inches loaded and 4.4 inches installed.

8.10.3 The Contractor shall provide FIBER OPTIC CABLE SLACK STORAGE LOOPS meeting the following requirements:

a. Aerial Fiber Optic Storage Loop shall be AFL Telecommunications model FSU-12 or approved equivalent.

b. Aerial Fiber Optic Storage Loop shall be designed to store slack fiber cable or extra fiber cable for future use on aerial strand.

c. Fiber storage loops shall be constructed of aluminum with baked black acrylic enamel finish and chromate pre-finish per MIL-C-5541-B to prevent fiber storage loop from rusting.

d. Strand mount support brackets shall meet Telecordia™ specification and shall be RUS accepted.

e. The Contractor shall provide two adjustable Tap Brackets with each Fiber Optic Cable Slack Storage Loop to be used to mount to Aerial Messenger Strand or Figure 8 Aerial Duct. Tap Brackets shall be Arris Model TWS209066 or Engineer approved equivalent. Tap Brackets shall be comprised of a set of aluminum jaws (top and bottom), an aluminum bracket and a steel carriage bolt and square nut. Tap Brackets shall be made with 5052 H 34 high-strength domestic aluminum. Tap Bracket carriage bolt and square nut shall be hot-dipped galvanized to ASTM A153 class D specifications.

f. Each Aerial Fiber Optic Storage Loop shall be include but not be limited to the following components: two strand mount support Tap Brackets with strand clamps, mounting hardware (bolts, nuts and washers), and cable tie slots for securing fiber cables to the fiber storage loop, preventing cables from sliding. Mounting hardware attaching strand mount support Tap Brackets to fiber storage loops
shall include the following at minimum: stainless steel lock nut, nylon washer, shoulder washer and stainless steel bolt.

8.11 Copper Communications Cable – General Requirements

8.11.1 The Contractor shall furnish and install all copper communications cable, including all hardware necessary to complete that installation, as shown on the Contract Drawings.

8.11.2 The Copper Communications Cables shall be Superior Essex Sealpic aerial 19AWG communications cables (Essex part numbers as defined below) or Engineer approved equivalent.

8.11.3 Copper Communications conductors shall be solid annealed copper, 19 AWG.

8.11.4 Copper Communications conductors shall be insulated with solid polyolefin, color coded in accordance with industry standard TIA-568.

8.11.5 Copper Communications individual insulated conductors shall be twisted into pairs with varying lay lengths to minimize crosstalk.

8.11.6 Copper Communications conductors shall be assembled into a cylindrical core.

8.11.7 A non-hygroscopic, dielectric tape shall be applied over the core assembly to provide protection for the core.

8.11.8 A corrugated, copolymer coated, 8-mil aluminum tape A black, linear low-density polyethylene jacket shall be applied overall, providing a tough protective covering designed to withstand exposure to direct sunlight, atmospheric temperature changes and stresses expected in standard installations.

8.11.9 The following information shall be indelibly placed (indented) on the exterior of the jacket at a minimum interval of 3 feet for the entire length of the cable: Name of the manufacture; year of manufacture; voltage rating; cable composition and type; the text "Property of Metro-North Railroad". The characters shall be a minimum of 1/8 inch high. The indented characters shall be of a bold printing and clearly visible. The use of a filled character labeling system is not permitted.

8.11.10 Average mutual capacitance at 1000 Hz shall be 83 ± 4 nF/mile (52 ± 2 nF/km).
8.11.11 Minimum insulation resistance at 68° F (20° C) shall be 1.0 gigohmmile (1.6 gigohmkm).

8.11.12 Maximum average attenuation 772 kHz @ 68°F (20° C) shall be 3.3 dB/kft (10.9 dB/km).

8.11.13 DC resistance unbalance maximum percentage shall be 1.5% average, 5.0% individual pair.

8.11.14 Dielectric strength DC potential shall be 5,000V conductor to conductor and 10,000V conductor to ground.

8.11.15 Nominal outside diameter shall be 0.76 inch (19mm).

8.11.16 Approximate weight shall be 310 lbs/kft (460 kg/km).

8.12 Copper Communications Cable Products

8.12.1 The Contractor shall provide 25-PAIR COPPER COMMUNICATIONS CABLE meeting the following requirements:

a. The 25-Pair Copper Communications Cable shall be Superior Essex Sealpic aerial 19AWG communications cable, Essex Part Number 01-031-40 or Engineer approved equivalent.

8.12.2 The Contractor shall provide 100-PAIR COPPER COMMUNICATIONS CABLE meeting the following requirements:

a. The 100-Pair Copper Communications Cable shall be Superior Essex Sealpic aerial 19AWG communications cable, Essex Part Number 01-038-40 or Engineer approved equivalent.

8.13 Copper Signal Cable

8.13.1 The Contractor shall furnish and install all aerial and non-aerial copper signal and signal power cable, including all hardware necessary to complete that installation, as shown on the Contract Drawings. The Contractor is solely responsible for determining cable lengths based on field conditions and as approved by the Engineer. Copper signal cables shall meet the requirements of Metro-North’s Standard Specification, "Technical Specification for Signal Cables, Revision 5.0, January 15, 2013." except as described in the following paragraphs.

8.13.2 The Contractor shall provide 6-PAIR #14 AWG COPPER
SIGNAL CABLE meeting the following requirements:

a. 6-Pair #14 AWG Copper Signal Cable shall meet all applicable requirements stated in Metro-North’s Standard Specification, “Technical Specification for Signal Cables, Revision 5.0, January 15, 2013.” except as described in the following.

b. The cable construction shall be suitable for aerial installation as shown on the Contract Drawings.

c. The width, height and weight of cable reels shall be submitted to the Engineer for approval prior to the start of construction.

d. The Contractor is solely responsible for determining cable lengths based on field conditions as approved by the Engineer.

e. The requirement for a low smoke zero halogen jacket in the referenced Technical Specification for Signal Cables, Section 7.0 is not applicable.

8.13.3 The Contractor shall provide SIGNAL POWER CABLE meeting the following requirements. Note that requirements stated in Metro-North’s Standard Specification, “Technical Specification for Signal Cables, Revision 5.0, January 15, 2013 do not apply.

a. 3-Conductor #1/0, 3-Conductor #2, and 2-Conductor #4 Signal Power Cable shall be suitable for aerial installation and non-aerial installations as shown on the Contract Drawings.

c. The width, height and weight of cable reels shall be submitted to the Engineer for approval.

d. The Contractor is solely responsible for determining cable lengths based on field conditions as approved by the Engineer.

8.14 Cable Trough

8.14.1 The Contractor shall furnish, and install continuous cable trough as specified herein and shown on the contract drawings. Signal, power, control, and communication cables shall be installed in the cable trough as shown in the design and as approved by the engineer. The Contractor shall determine cable trough size required for each location where cable trough is called for in the contract documents. The fill factor for cable trough shall not exceed 40%. Cable trough shall meet the following requirements:

a. Cable trough installed in non-traffic/non-roadway areas shall be
Plastibeton as manufactured by Oldcastle Moulded Products, or approved equal. The cable trough and cover shall be high density polymer concrete.

b. Roadway areas are noted on the contract drawings. Cable trough installed in roadway areas shall be Trenwa HS 20 Road Crossing Trench or approved equal. Covers shall be steel reinforced concrete. The cable trough base units shall be provided with 4 inch minimum diameter drain holes.

8.15 Soldier Pile and Lagging Wall

8.15.1 General

a. The Contractor shall not deliver materials to the site until the Engineer has approved the submittals specified herein.

b. The designated storage area shall be protected from vandalism, passage of vehicles, theft and other damage to materials delivered to the site by the Contractor.

8.15.2 Steel Soldier Piles: ASTM A709, Grade 50, of sizes indicated on the Contract Drawings. The steel soldier piles shall be hot-dip galvanized.

8.15.3 Concrete: Refer to Contract drawings for Cast-In-Place Concrete and Precast Concrete.

8.15.4 Grout: Non-shrink grout per ASTM C1107 with a 28-day compressive strength of 4,000 psi.

8.15.5 Reinforcing Steel: ASTM A 615, Grade 60, zinc coated (galvanized), deformed billet steel bars.

8.15.6 Structural Fill: Structural Fill shall meet the requirements of Pervious Structure Backfill per ConnDOT Form 816, M.02.05, and shall be placed and compacted in accordance with Section 2.16.

8.15.7 Geocomposite Strip Drain: Mirafi G100N or equivalent shall be placed behind the precast concrete lagging panels per the Contract Drawings.

8.15.8 Joint Material: Closed Cell Neoprene Sponge as per ASTM D1056.

8.15.9 Galvanize all steel reinforcing bars according to ASTM A767, Class I. Fabricate bends and details before galvanizing.
8.15.10 Temporary steel casing is required for the drilled shafts. Temporary casing shall be smooth, non-corrugated, and watertight steel, with sufficient strength to withstand handling stress, concrete fluid pressure, drilling fluid pressure and lateral earth pressure including surcharge load. The steel casing shall have an inside diameter of not less than that indicated for the predrilled holes on the Contract Drawings.

8.16 Snow Melter Panels

8.16.1 General

a. The Contractor shall supply new Snow Melter Panels (Distribution and Control Cases) as defined in these Technical Specifications and Contract Drawings. The Contract Drawings provide a sample Snow Melter Panel design for reference. The Contractor shall prepare detailed case design for each location identified in the Contract Drawings.

b. The Snow Melter Panels represent a discrete element in the overall wayside signal and network system to be provided by the Contractor. All requirements for pre-wired cases, wiring, components, terminal, submittals, testing and documentation shall be provided by the Contractor and be based on these Technical Specifications and Contract Drawings.

c. The Contractor shall provide submittals to the Metro North Engineer on all elements of the Snow Melter Panels to include, but not limited to, external enclosure, hardware, electrical and testing.

d. The Contractor shall provide a system that has a proven record in implementation and operation within a 13.8 kV AC electrified rail environment.

e. The Contractor shall provide a design that is compatible with Metro North’s current systems without requiring modifications to the current system.

f. Each standard #20 turnout requires a 60 Amp distribution breaker to provide proper operation of the heater elements attached to the switch points and a separate 20 Amp distribution breaker to provide proper operation of ballast heater elements beneath the switch rods.

g. Each #20 turnout with helper rod requires a 60 Amp distribution breaker to provide proper operation of the heater elements attached to
the switch points and a separate 25 Amp distribution breaker to provide proper operation of ballast heater elements beneath the switch rods.

h. Each #15 turnout requires a 60 Amp distribution breaker to provide proper operation of the heater elements attached to the switch points and beneath the switch rods.

i. Each #10 turnout requires a 50 Amp distribution breaker to provide proper operation of the heater elements attached to the switch points and beneath the switch rods.

j. Distribution breaker requirements and heater element information for all turnout configurations including those not described above can be found in the Contract Drawings.

k. The heater elements are powered by 480 volt AC single phase.

l. The Contractor is responsible for furnishing all apparatus required for the proper operation of the systems supplied except were explicitly indicated in these specifications.

8.16.2 System To Be Furnished

a. The Contractor shall provide pre-wired Snow Melter Panels as required to meet the requirements of these Technical Specification and Contract Drawings. The fabrication requirements for Snow Melter Panel external enclosures is provided in Appendix I.

b. Contract Drawings show typical case layouts and wiring required. The details shall be provided by the Contractor.

c. The Contractor shall provide the items listed below to include, but not be limited to:

- Cases in quantities defined elsewhere.
- Main Circuit Breakers.
- Distribution Circuit Breakers.
- Distribution Frames.
- Ground Fault Interrupters.
- Lighting.
- Terminal Connections.
- Fuses and terminals.
- Transformers.
- Current coils.
8.16.3 Cable Sizes
Metro North utilizes the following typical cable sizes (external to the pre-wired cases):

a. Power Distribution - 500 MCM
b. Heater Element - 2c #4
c. Monitor/Control - 19c #14 or 17c composite (5 #9 - 12 #14)
d. Ground Wire - #4 solid

The Contractor shall immediately notify the Engineer, if the cable plant appears to be inadequate for the circuits as designed.

8.16.4 System Requirements

a. The pre-wired Snow Melter Panels covered by this specification, shall be used to provide for the operation of resistive heater elements attached to the running rails and installed under the operating rods on turnouts located in the interlockings.

b. The Contractor shall furnish cases with apparatus wired in place, in accordance with typical plans prepared by the Engineer.

c. The snow melter power shall be 480 Volts AC 60 Hertz. All apparatus shall be rated at 600 volts.

d. Any apparatus supplied by Contractor shall be fully compatible with existing systems. The interface supplied by the Contractor shall not require and changes in existing signal or power systems.

e. The operation of each Snow Melter Panel shall be as follows:

   • Each distribution circuit breaker shall limit the operating current to the rated values for the breaker.

   • The Main circuit breaker shall be provided with a ground fault detector. The GFI shall operate the shunt trip to trip the breaker when a ground is detected. A remote indication circuit shall be activated on this event.

f. Each case shall have two (2) Power On Indication Lights, located at each side of cases.

g. Circuit Breakers
h. The Contractor shall supply Square D Thermal-Magnetic Molded Case Circuit Breakers for I-Line panel boards for the cases. The frames shall be rated at 100 Amps. Style FA standard interrupting shall be supplied. A separate breaker shall be supplied for each load leaving the case.

i. The breakers shall be rated for 600-volt operation.

j. All auxiliary and alarm contacts required shall be supplied.

8.16.5 Ground Fault Relay (GFI)

a. The GFI shall be a Square D GAT-12 self-contained, combination sensing and relaying service suitable for 480-volt single-phase service application. The GFI systems shall consist of an independent sensing coil and control unit. The GFI unit shall be NEMA rated for heavy-duty industrial service and meet UL Requirements. A GFI shall be supplied for only the main feed to the case.

b. The GFI shall have an adjustable trip set from 1 to 6 amps.

c. The GFI shall operate on 120 volt 60 cycle.

d. The GFI shall have one N.O. contact and one N.C. contact.

e. The GFI relay shall have a temperature range of 0 to 65 degrees C and -40 to +85 degree C for the sensor.

8.16.6 Main Breaker

a. The Main Breaker shall be Square D Thermal Magnetic Molded Case with a frame rating of 400 Amps. Model LAL 400 amp LHL26400 or approved equal shall be used.

b. A suitable NEMA enclosure complete with all terminals and wiring is required.

c. All labeling for the switch and terminals shall be supplied.

d. The operating lever shall be supplied with a locking mechanism to lock it in the off position.

e. All auxiliary and alarm contacts required shall be supplied.

f. A shunt trip operation shall be provided.
8.17 Ground Buss Cases

8.17.1 General

a. The Contractor shall supply new Ground Buss Cases as defined in these Technical Specifications and Contract Drawings. The Contract Drawings provide a sample Ground Buss Case design for reference. The Contractor shall prepare detailed case designs for each location identified in the Contract Drawings.

b. The Ground Buss Cases represent a discrete element in the overall wayside signal and network system to be provided by the Contractor. All requirements for pre-wired cases, wiring, components, terminal, submittals, testing and documentation shall be provided by the Contractor and be based on these Technical Specifications and Contract Drawings.

c. The Contractor shall provide submittals to the Metro North Engineer on all elements of the Ground Buss Cases to include, but not limited to, the external enclosure, hardware, electrical and testing.

d. The Contractor shall provide a design layout that has a proven record in implementation and operation within a 13.8 kV AC electrified rail environment.

e. The Contractor shall provide a design that is compatible with Metro North’s current systems without requiring modifications to the current system.

f. Each Ground Buss Case requires an internal ½” x 4” Copper Bar Pre-Drilled with connections for 500 MCM or 250 MCM cables to tracks, catenary structures, static wires, or side leads.

8.17.2 System To Be Furnished

a. The Contractor shall provide Ground Buss Cases as required to meet the requirements of these Technical Specification and Contract Drawings. The fabrication requirements for Ground Buss Case enclosures is provided in Appendix I.

b. Contract Drawings show typical case layouts and wiring required. The details shall be provided by the Contractor.
c. The Contractor shall provide the items listed below to include, but not be limited to:

- Cases in quantities defined elsewhere.
- Terminal Connections

8.17.3 Cable Sizes

Metro North utilizes the following typical cable sizes (external to the pre-wired cases):

a. Impedance Bonds - 500 MCM
b. To Catenary Structures – 500 MCM
c. Side Leads – 250 MCM
d. Ground Wire - #4 solid

The Contractor shall immediately notify the Engineer, if the cable plant appears to be inadequate for the circuits as designed.

8.17.4 System Requirements

a. The Ground Buss Cases covered by this specification shall be used to provide for connections at Cross Bonding A Points and Cross Bonding Drain Locations. See Contract Drawings for the placement of each A Point and Drain Location.

b. The Contractor shall furnish cases with apparatus in place, in accordance with typical plans prepared by the Engineer.

c. Any apparatus supplied by Contractor shall be fully compatible with existing systems. The interface supplied by the Contractor shall not require and changes in existing signal or power systems.
9.0 TESTING

9.1 General

9.1.1 The Contractor shall, at their own expense, arrange to have a third party testing agency test all copper and fiber optic cable provided in this Contract as specified herein, in accordance with the Engineer-approved Test Procedures. Within this Section, the term “Contractor” shall refer to both the Contractor and the selected third party testing agency wherever applicable. The Contractor shall provide all testing services required.

9.1.2 In lieu of a third party testing agency performing all copper and fiber cable testing, the Contractor may submit evidence to the Engineer prior to any testing that the Contractor has the experience, qualifications and skilled factory trained employees necessary to perform the testing described herein. Such evidence shall minimally include, but not be limited to, prior customer submitted and approved comprehensive test reports with narratives, findings, and test results, including OTDR print outs, customer references for the report submitted with complete contact information, a listing of the Contractor’s proposed testing personnel, and certificates of successful completion of factory or other external testing training completed by each of the proposed employees. Acceptance of such evidence supplied by the Contractor shall be at the sole discretion of the Engineer. If such approval is granted by the Engineer, no approved testing employee may be substituted without the written authorization of the Engineer. Approval of the Engineer does not relieve the Contractor of the responsibility for conducting any of the tests, or supplying the submittals that are required of the independent testing agency, as described in the Contract Documents.

9.1.3 The Contractor shall submit for review and confirmation certification of training and experience on the use of all test equipment to be used in the Project prior to any testing. This confirmation shall be submitted for all personnel conducting testing, whether they are Contractor employees or third party testing personnel.

9.1.4 The Contractor shall perform all testing following procedures recommended by the manufacturer of the applicable test equipment. Prior to any testing performed, the Contractor shall submit detailed test procedures for approval by the Engineer.

9.1.5 All test forms, results, reports and documentation shall be submitted for review within 14 days of completion of each test. All test forms, results, reports and documentation shall be submitted in hard
copy and in soft copy. No special hardware or software shall be required to review test documentation. A test report shall be submitted with each test form detailing date tested, test engineer, pass/fail results as well as corrective action taken or to be taken, signed by the test engineer and witnesses.

9.1.6 In general, testing of fiber and copper cables shall be conducted in accordance with the latest version of the New York City Transit Authority Fiber Optic Testing Specification and Procedures, attached as an appendix to these Technical Specifications, as well as 7CFR1755 including 1755.400 RUS standard for acceptance tests and measurements of telecommunications plant, and 1755.900 RUS Specification for fiber optic cables except as noted here.

9.1.7 The Contractor shall make all cable testing available for witnessing by Metro-North. The Contractor shall arrange for inspection visits to cable manufacturers’ factory or facility if requested by Metro-North. Metro-North retains the right to repeat any or all of the acceptance tests prior to accepting any or all of the cable.

9.1.8 The Contractor shall notify Metro-North of the scheduled date and time of each test at least one calendar week in advance of the test so that Metro-North may schedule personnel to witness the test.

9.2 Reference Codes and Standards

9.2.1 Supplied fiber optic and copper cables shall comply with the following codes, standards and requirements:

a. Rural Utilities Service (RUS) [formerly Rural Electrification Administration (REA)].


9.3 Testing Agencies

9.3.1 The Contractor shall submit to the Engineer for approval and selection, a list of proposed testing agencies to perform the field tests. This Section describes the requirements for services provided by an independent testing agency employed by the Contractor.

9.3.2 Selection and Payment
a. The Contractor shall employ and pay for services of, on behalf of Metro-North, an independent testing agency to perform specified inspection and testing.

b. Employment of an independent testing agency shall in no way relieve the Contractor of the obligation to perform the Work in accordance with the requirements of the Contract Document.

c. The Contractor shall submit, not less than 90 days prior to the start of testing work, the names of three independent testing laboratories of which the Engineer will select one.

9.3.3 Quality Assurance

a. The testing agency shall maintain a full-time Engineer registered in the State of New York and State of Connecticut on staff to review services.

b. The agency shall be certified as an engineering testing agency to operate in the State of New York and the State of Connecticut.

c. Testing equipment shall be calibrated annually with devices of accuracy traceable to either National Bureau of Standards (NBS) standards or accepted values of natural physical constraints. Up-to-date calibration stickers shall be applied to all test equipment used in the Project.

d. Agency Responsibilities:

1. Provide qualified personnel at site after due notice; cooperate with the Engineer and Contractor in the performance of services.
2. Perform specified inspection, sampling, and testing of products and materials in accordance with these Contract Documents.
3. Notify Engineer and Contractor of observed irregularities or non-conformance of Work or products within 10 days.
4. Perform additional inspections and tests required by the Engineer.

e. Agency Reports:

1. Submit two copies of test report to Engineer and to Contractor within 14 days after each inspection and test.
2. Include in report; date of issue, project title and number, name of inspector, date and time of testing, of inspection, identification of product and Contract Document reference, location in the Project, type inspection or test, date of test, results of test, and
conformance with the Contract Documents.
3. When requested by Engineer, provide interpretation of test results.

9.4 Fiber Optic Cable Testing - General

9.4.1 Each reel of fiber cable used in the Project shall be tested a minimum of three times as follows:

a. Factory pre-shipment: Each fiber shall be tested as specified herein to assure it is suitable for shipping. Submit factory test results for each piece or reel of fiber optic cable before it is shipped to the job site.

b. Pre-installation: After shipment to job site and before installation test, test each fiber optic cable as specified herein to assure it is suitable for installation. Submit pre-installation test results for each piece of fiber optic cable before it is installed.

c. Post-installation: After installation, test each fiber as specified herein to assure it is suitable for acceptance. Submit results for approval within 10 days of test.

9.4.2 Contractor shall have all fiber optic test equipment calibrated in accordance with the test equipment manufacturer's recommendations. The Contractor shall determine that all fiber optic test equipment is in good working condition.

9.4.3 The Contractor shall use the following fiber optic cable test equipment for this Project:

a. Optical Time Domain Reflectometer (OTDR), used to measure fiber length, locate problems, measure the reflection characteristics of the fiber link and estimate end-to-end link attenuation. The OTDR shall be a Corning OptiVisor 400 Mini-OTDR or Engineer approved equivalent.

b. Optical Loss Test Equipment (OLTE) comprised of either an optical loss test set (OLTS) or a stabilized light source (SLS) used with an optical power meter (OPM). OLTE are used to measure end-to-end link attenuation. The OLTE shall be a Corning OMS-400 or Engineer approved equivalent.

c. Dispersion Test Equipment (DTE), used to measure the chromatic and/or polarization mode dispersion caused in a fiber link. The DTE shall be Agilent N3909A or Engineer approved equivalent.

9.4.4 The Contractor shall use the same make and model of testing
devices throughout the Project so that format of test results remains the same.

9.4.5 The Contractor shall match fiber jumpers used to connect test equipment to the fiber being measured to the type of fiber under test, i.e. single mode jumpers for single mode fiber. Adapters used to attach bare, non-terminated fibers to test equipment shall match the type of fiber, i.e. single mode, and introduce no more than 0.6 dB of insertion loss and no more than -50 dB of reflectance. The Contractor shall only use mechanical splices or adapters recommended by the fiber optic cable manufacturer for testing purposes. No fusion splices or other types of permanent splices shall be made by the Contractor for any reason, including testing.

9.4.6 Before any measurements are made, the Contractor shall perform all cleaning as recommended by the test equipment manufacturer. This shall include but not be limited to cleaning bare fiber ends, fiber connector ends and optical jumpers thoroughly with alcohol using lint-free wipers and blown dry with compressed, clean air.

9.5 Fiber Optic Cable Testing – Factory Pre-Shipment

9.5.1 The Contractor shall verify that the manufacturer of the fiber optic cable performs the following types of testing on the provided fiber optic cable:

a. Wind, vibration, and ice loading in aerial deployments.

b. High tension dynamic bending.

c. Closure mock up / buffer tube routing and thermal cycling.

d. Aging testing to simulate 20+ year life.

9.5.2 The Contractor shall submit copies of the fiber optic cable manufacturer’s test reports indicating the results of testing performed by the manufacturer before shipment for all fiber optic cable to be installed as part of the Work of this Project.

9.5.3 The fiber optic cable manufacturer’s test report shall include but not be limited to the following information:

a. Name of tester.

b. Date of test.
c. Product identification.

d. Reel identification.

e. Actual cable length.

f. Tested wavelength.

g. Attenuation for each fiber

9.6 Fiber Optic Cable Testing – Receipt from Manufacturer

9.6.1 The Contractor shall conduct Receipt from Manufacturer Testing on all Fiber Optic Cable upon taking receipt of the fiber optic cable from the manufacturer.

9.6.2 The Contractor shall make a careful visual inspection of the cable and its packaging as it is received. The Contractor shall document all aspects of the visual inspection. The Contractor shall inspect the cable reel and its protective covering (lagging and/or environmental/heat shield). If damage is noted, the Contractor shall determine the extent of the damage, including but not limited to whether or not the damage extends to the cable sheath or the fibers. If damage includes fiber and/or cable sheath, the Contractor shall contact the cable’s supplier to determine the disposition of the cable and follow their instructions. The Contractor shall document the extent of the damage by measuring each of the fibers in the damaged cable with an OTDR as specified herein.

9.6.3 The Contractor shall consider fiber optic cable reels that are lying on their side, have damaged wooden lagging, or a damaged temperature shield as candidates for potential fiber damage. The Contractor shall document any of these conditions observed, along with all other relevant observations made.

9.6.4 The Contractor shall test every fiber with an OTDR to verify that the received cable meets or exceeds the specifications of the fiber optic cable as stated in these Technical Specifications, including, but not limited to, fiber attenuation coefficients (loss per unit length) as specified in Section 8.9, “Fiber Optic Cable – General Requirements.” The Contractor shall make measurements at both 1310 nm and 1550 nm. The Contractor shall make measurements in both directions.

9.6.5 Contractor shall verify that the cable length measured with the OTDR is equal to or exceeds the purchased length.
9.6.6 The Contractor shall save the OTDR fiber trace for each fiber on CD, DVD or other standard electronic media in accordance with the test equipment manufacturer’s recommendations. The Contractor shall clearly mark each fiber trace record to note the cable identification, the fiber measured, the date of the measurement and the individual who made the measurement. The fiber traces shall become part of the test report.

9.6.7 After testing, the Contractor shall restore the cable reel protection to its as-shipped condition to preserve the protection during cable storage.

9.6.8 The Contractor shall record all Receipt from Manufacturer data and measurements using the following form, or Engineer approved equivalent form:
9.7 Fiber Optic Cable Testing – Pre-Installation

9.7.1 The Contractor shall conduct Pre-installation Testing on all Fiber Optic Cable upon delivery to Metro-North property.
9.7.2 The Contractor shall make a careful visual inspection of the cable and its packaging as it is received. The Contractor shall document all aspects of the visual inspection. The Contractor shall inspect the cable reel and its protective covering (lagging and/or environmental/heat shield). If damage is noted, the Contractor shall determine the extent of the damage, including but not limited to whether or not the damage extends to the cable sheath or the fibers. If damage includes fiber and/or cable sheath, the Contractor shall contact the cable’s supplier to determine the disposition of the cable and follow their instructions. The Contractor shall document the extent of the damage by measuring each of the fibers in the damaged cable with an OTDR as specified herein.

9.7.3 The Contractor shall consider fiber optic cables reels that are lying on their side, have damaged wooden lagging, or a damaged temperature shield as candidates for potential fiber damage. The Contractor shall document any of these conditions observed, along with all other relative observations made.

9.7.4 The Contractor shall test every fiber with an OTDR to verify that the received cable meets or exceeds the specifications of the fiber optic cable as stated in these Contract Documents including but not limited to fiber attenuation coefficients (loss per unit length) as specified in Section 8.9, “Fiber Optic Cable – General Requirements.” The Contractor shall make measurements at both 1310 nm and 1550 nm. The Contractor shall make measurements in both directions.

9.7.5 The Contractor shall verify that the cable length measured with the OTDR is equal to or exceeds the purchased length.

9.7.6 The Contractor shall save the OTDR fiber trace for each fiber on CD, DVD or other standard electronic media accordance with the test equipment manufacturer’s recommendations. The Contractor shall clearly mark each fiber trace record to note the cable identification, the fiber measured, the date of the measurement and the individual who made the measurement. The fiber traces shall become part of the test report.

9.7.7 The Contractor shall record the results of the Pre-Installation Testing on the Engineer-approved form(s).

9.7.8 After testing, the Contractor shall restore the cable reel protection to its as-shipped condition to preserve the protection during cable storage.

9.7.9 The Contractor shall record all Pre-Installation data and measurements using the following form, or Engineer approved equivalent
form:
## Fiber Optic Cable Pre-Installation Test Form

<table>
<thead>
<tr>
<th>Date and Time of Test:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tester's Name (Contractor):</td>
<td></td>
</tr>
<tr>
<td>Witness' Name (Engineer/Railroad):</td>
<td></td>
</tr>
<tr>
<td>Temperature and Weather:</td>
<td></td>
</tr>
<tr>
<td>Test Equipment Used (Make, Model and Serial Numbers):</td>
<td></td>
</tr>
</tbody>
</table>

### Cable Reel Identification:
- **Cable Type:**
- **Cable Length (m):**

### Results of Visual Inspection:
- Reel Condition:
- Reel Covering Condition:
- Other:

### Test Wavelength (nm): | Direction:
<table>
<thead>
<tr>
<th>Fiber No.</th>
<th>Measured Span Length (m)</th>
<th>Total Measured Span Loss (dB)</th>
<th>Average Measured Span Loss (dB/km)</th>
<th>Measured Reflectance (dB)</th>
<th>Measured Optical Return Loss (dB)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

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Figure 9.7.1 - Pre-Installation Test Form
9.8 Fiber Optic Cable Testing – Post-Installation

9.8.1 The Contractor shall conduct Post-installation Testing on all installed fiber optic cable prior to acceptance.

9.8.2 The Contractor shall make a visual inspection of all installed fiber cable, documenting observations on test report.

9.8.3 The Contractor shall measure the following fiber parameters:

a. Link loss or end-to-end loss, the total attenuation that occurs from one end of the fiber link to the other, measured in decibels (dB).

b. Link Optical Return loss (ORL), a measure of the optical power reflected back to the transmitter end of the fiber as compared to the total optical power launched into the fiber, measured in decibels (dB).

c. Polarization Mode Dispersion (PMD), the difference in arrival time at the receiver of the portions of the signal that are in the two principal states of polarization, measured in picoseconds (ps).

d. Fiber Length, measured in feet.

9.8.4 The Contractor shall measure each fiber installed to determine if the fiber’s end to end loss, optical return loss (ORL), and polarization mode dispersion meet the requirements of Section 8.9, “Fiber Optic Cable – General Requirements” and Section 8.10, “Fiber Optic Cable and Related Products.” If any fiber is found deficient in meeting the requirements of these Contract Documents, the Contractor shall, at no additional cost to Metro-North, rectify all such deficiencies. If necessary, this shall include, but not be limited to, repair or replacement in its entirety of any affected cable segment.

9.8.5 The Contractor shall measure the end-to-end loss of each installed fiber using OLTE meeting Contract requirements. The Contractor shall measure end-to-end loss of each installed fiber at both 1210 nm and 1550 nm and in both directions.

9.8.6 The Contractor shall measure ORL of each installed fiber using an OTDR meeting Contract requirements. The Contractor shall measure ORL of each installed fiber at both 1310 nm and 1550 nm and in both directions.
9.8.7 The Contractor shall measure PMD delay of each installed fiber using DTE. The Contractor shall measure PMD of each installed fiber at both 1310 nm and 1550 nm.

9.8.8 The Contractor shall measure fiber length of each installed fiber using the OTDR. The Contractor shall verify that the measured cable length is equal to or exceeds the required actual length.

9.8.9 The Contractor shall save the OTDR fiber trace for each fiber either as a paper record or as a soft copy on a computer floppy disk or other standard media in accordance with the test equipment manufacturer’s recommendations. The Contractor shall clearly mark each fiber trace record to note the cable identification, the fiber measured, the date of the measurement and the individual who made the measurement. The fiber traces shall become part of the test report.

9.8.10 The Contractor shall record all Post-Installation data and measurements using the following form, or Engineer approved equivalent form:
## Fiber Optic Cable - Post Installation Test Form

| Date and Time of Test: | 
|------------------------|----------|
| Tester's Name (Contractor): | 
| Witness' Name (Engineer/Railroad): | 
| Temperature and Weather: | 
| Test Equipment Used (Make, Model and Serial Numbers): | 

| Cable End A Location: | 
|----------------------|----------|
| Cable End B Location: | 
| Cable Type: | 
| Cable Length (m): | 

**Results of Visual Inspection:**

<table>
<thead>
<tr>
<th>Test Wavelength (nm):</th>
<th>Direction:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber No.</td>
<td>Measured Span Length (m)</td>
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</tr>
</tbody>
</table>

**Figure 9.8.1 - Post Installation Test Form**
9.9 Copper Cable Testing - General

9.9.1 The Contractor shall test each conductor and pair of each installed copper cable as specified herein to assure the installed cables meet the requirements of these Contract Documents and is suitable for acceptance. If any conductor or pair is found deficient in meeting the requirements of these Contract Documents, the Contractor shall, at no additional cost to Metro-North, rectify all such deficiencies. If necessary, this shall include but not be limited to repair or replacement in its entirety of any affected cable segment.

9.9.2 The Contractor shall have all copper cable test equipment calibrated in accordance with the test equipment manufacturer’s recommendations. Calibration reports shall be submitted to the engineer prior to any testing. The Contractor shall determine that all copper cable test equipment is in good working condition.

9.9.3 The Contractor shall use the following copper cable test equipment for this Project:

a. Volt-ohm Meter (VOM), Fluke Model 289 or Engineer Approved Equivalent.

b. Insulation resistance test set or direct current (DC) bridge type megohmmeter. The insulation test set shall have an output voltage not to exceed 1000 volts DC and shall be hand cranked or battery operated. The DC bridge type megohmmeter, which may be alternating current (AC) powered, shall have scales and multiplier which make it possible to accurately read from 1 megohm to 1 gigohm. Insulation Test Set shall be Fluke Model 1507, Simpson Model 501, or Engineer approved equivalent.

c. Audio Transmission Test Set, Fluke Networks Model CableIQ Qualification Tester or Engineer approved equivalent.

d. Noise Meter, Fluke Model 289 or Engineer Approved Equivalent.

9.9.4 The Contractor shall make a visual inspection of all installed copper cable, observing for any visible kinks, bends, abrasions or cuts to the cable and shall document all observations on a test report.

9.10 Copper Cable Testing Types

9.10.1 The Contractor shall perform the following copper cable
tests:

a. Conductor continuity, shorts and grounds.

b. Cable shield resistance.

c. Insulation resistance.

d. Insertion loss.

e. Noise.

9.10.2 The Contractor shall use the following steps to measure cable continuity, shorts and grounds:

a. Select a conductor in the cable as the conductor under test.

b. Using a VOM measure and record the resistance between the conductor under test and all other conductors in the cable. Measurement shall be an open to pass test.

c. At the far end short the conductor under test to another conductor. Using a VOM at the near end measure and record the resistance across the pair. Measurement shall be less than 0.5 Ohm to pass test.

d. Using a VOM measure and record the resistance of the conductor to ground. Measurement shall be an open to pass test.

9.10.3 The Contractor shall use the following steps to measure the cable shield or shield/armor resistance of each installed copper cable:

a. Select a pair in the cable under test as the test pair. Short the test pair at the far end of the cable.

b. Using a VOM measure and record as R1 the resistance across the pair at the near end.

c. At the near end short the test pair.

d. At the far end connect the shorted test pair to the shield or armor/shield.

e. Using a VOM measure and record as R2 the resistance across the shorted test pair and the shield or armor/shield at the near end.

f. Calculate and record R3, where \( R3 = \frac{R2 - R1}{4} \). Calculate and
record the temperature corrected value \( RS = \frac{R3}{1 + 0.0021(T - 68)} \), where \( T \) is the temperature in degrees F at the time of testing. To determine Shield Resistance per 1000ft multiply \( RS \) times 1000 divided by the length of the cable under test.

9.10.4 The Contractor shall consider values of Shield Resistance of 0.5 Ohms/1000ft or less as indicating a continuous shield. The Contractor shall investigate instances of Shield Resistance greater than 0.5 Ohms/1000ft to determine cause and find remediation.

9.10.5 Measurements of shield continuity of sections of installed cable shall be made prior to bonds have been made to the supporting strand, multi-grounded neutral, etc. All bonding wires shall be removed from the bonding lugs at the far end of the cable section to be measured.

9.10.6 The Contractor shall use the following steps to measure the insulation resistance of each conductor of each installed cable:

a. Select a single conductor for testing. All other conductors in the cable and the cable sheath shield and/or shield/armor shall be electrically connected and grounded at the near end. All conductors shall be open and disconnected at the far end.

b. Measure and record the resistance to ground of the conductor under test using an insulation resistance tester. Calculate and record the megohm-mile insulation resistance of the conductor by multiplying the resistance measure by the length of the conductor under test.

c. Repeat for each conductor in the cable under test.

9.10.7 The Contractor shall consider values of Insulation Resistance of 500 Megohm-mile or greater as indicating acceptable insulation resistance. The Contractor shall investigate instances of Insulation Resistance less than 500 Megohm-miles, or values that vary significantly from that of other conductors in the same cable, to determine cause and find remediation.

9.10.8 The Contractor shall use the following steps to measure the insertion loss of each pair of each installed cable:

a. Select a pair for testing. At the far end of the cable connect a calibrated tone generator set for 0 dBm output at 1000 Hz to the pair under test. There shall be no other connections to the pair under test.

b. At the near end of the cable connect a terminating (600 Ohms) audio test set to the pair under test. There shall be no other connections to the pair under test.
c. Measure and record the level of the received 1000 Hz tone in dBm. This value also represents the pair’s insertion loss in dB. Calculate and record the insertion loss per mile by dividing the pair’s measured insertion loss by the length of the pair under test.

d. Repeat for each pair in the cable under test.

9.10.9 The Contractor shall consider values of Insertion Loss of 1.25 dB/mile or less as indicating acceptable insertion loss. The Contractor shall investigate instances of Insertion Loss greater than 1.25 dB/mile, or values that vary significantly from that of other pairs in the same cable, to determine cause and find remediation.

9.10.10 The Contractor shall use the following steps to measure the noise of each pair of each installed cable:

a. Select a pair for testing. At the far end of the cable connect a 600 Ohm quiet termination to the pair under test. There shall be no other connections to the pair under test.

b. At the near end of the cable connect a noise meter to the pair under test. There shall be no other connections to the pair under test.

c. Measure and record the noise level in dBrnc.

d. Repeat for each pair in the cable under test.

9.10.11 The Contractor shall consider values of noise of 20 dBrnc or less as indicating acceptable noise. The Contractor shall investigate instances of noise greater than 20 dBrnc, or values that vary significantly from that of other pairs in the same cable, to determine cause and find remediation.

9.11 Copper Cable Testing for Communications Cables

9.11.1 For 25-Pair Copper Communications Cables the Contractor shall conduct the following tests as specified herein before installation:

   a. Conductor continuity, shorts and grounds.

9.11.2 For 25-Pair Copper Communications Cables the Contractor shall conduct the following tests as specified herein after installation:
a. Conductor continuity, shorts and grounds. b. Cable shield resistance.

c. Insertion loss. d.

Noise

9.12 Copper Cable Testing for Signal Cables

9.12.1 For 6-Pair #14 AWG Signal Copper Cables the Contractor shall conduct the following tests as specified herein before installation:

   a. Conductor continuity, shorts and grounds.

9.12.2 For 6-Pair #14 AWG Signal Copper Cables the Contractor shall conduct the following tests as specified herein after installation:

   a. Conductor continuity, shorts and grounds.

   b. Cable shield resistance.

   c. Insulation resistance.

   d. Insertion loss.

   e. Noise

9.13 Copper Cable Testing for Signal Power Cables

9.13.1 For 3-Conductor #1/0 AWG and 2-Conductor #4AWG Signal Copper Power Cables the Contractor shall conduct the following tests as specified herein before installation:

   a. Conductor continuity, shorts and grounds.

9.13.2 For 3-Conductor #1/0 AWG and 2-Conductor #4AWG Signal Copper Power Cables the Contractor shall conduct the following tests as specified herein after installation:

   a. Conductor continuity, shorts and grounds.

   b. Insulation resistance.
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10.0 CONTRACTOR’S QUALITY PROGRAM

10.1 General

10.1.1 The Contractor shall meet all requirements of the document “Section 014300 Quality Assurance Program” found in the appendices of these Technical Specifications.

10.1.2 The document “Section 014300 Quality Assurance Program” refers to a second document entitled “Section 014300 Attachment – Quality Manual Template.” This document may also be found in the appendices of these Technical Specifications.
11.0 DRAWINGS AND AS-BUILT PLANS

11.1 General

11.1.1 The Contractor shall create, develop and submit the following drawings as defined in this Section:

a. Working Drawings

b. Rigging Plans

c. Installation Drawings

d. Shop Drawings

e. Record Copy Drawings

f. As-Built Drawings

11.1.2 When the content of drawings affects the safety of the traveling public, Metro-North employees or others, the drawings shall be sealed by a Professional Engineer (PE) licensed in the State of Connecticut. Test plans, descriptive literature, catalog cuts and manuals are not required to be sealed by a Professional Engineer (PE) unless the content of the document affects safety as described above. When the Contractor has been provided with sealed Contract Drawings and the Contractor has fabricated and installed the material in the exact fashion shown and the Contractor has certified that he has done so, the Contractor's drawings will not have to be sealed.

11.1.3 The Contractor's drafting work shall conform to acceptable standards for clarity and consistency, and shall be of the utmost quality and accuracy. Drawings shall be done to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the Work.

11.1.4 Drawings for work on utility facilities, streets and other facilities which are constructed for owners other than Metro-North will be coordinated so that the information required by these owners is included on the Working Drawings for their facilities.

11.1.5 A final acceptance of the Work and full payment will be contingent upon the Engineer's acceptance of the "As-Built" drawings and software. The Engineer and Metro-North have the right to reject unacceptable work
and the Contractor shall remedy the same at no additional cost to Metro-North.

11.1.6 All drawings created by the Contractor shall contain a title block. The title block shall display the following:

   a. Contract Number and Name

   b. Number and Title of the Drawing

   c. Date of Drawing or Revision

   d. Name of Contractor and Subcontractor submitting drawing

   e. Clear identification of contents and location of work

   f. Contract Documents Reference Number

   g. Where applicable, name, New York and Connecticut State Registration Numbers, and seals of Professional Engineer (PE) certifying the drawing.

11.2 Working Drawings

11.2.1 Working Drawings consist of detailed drawings and plans for temporary work and for other such work as may be required for construction, but which does not become an integral part of the completed project. Working drawings shall comply with Metro-North I&C Specification Section A (attached Appendix C). The Contractor shall develop and submit Working Drawings for all such work in the Project. Working Drawings shall be accompanied by calculations or other sufficient information to completely explain the structure or system described and its intended manner of use.

11.2.2 The Contractor shall prepare and submit site specific Working Drawings for work to be performed in and around the railroad and in the vicinity of passenger stations. The Contractor’s plan for demolition, erection, and any operation adjacent to or within the Railroad Right of Way shall be submitted.

11.2.3 The Contractor shall submit Working Drawings within 30 days of Notice-to-Proceed and no less than 30 days before beginning any field work, unless otherwise directed by the Engineer.
11.3 Rigging Plans

11.3.1 Rigging Plans consist of detailed drawings and calculations for the placement and use of construction equipment utilized to lift or move loads near the Railroad. Rigging Plans shall comply with Metro-North I&C Specification Section B (attached Appendix C). Rigging Plans shall be scale drawings showing the placement of cranes and other similar forms of construction equipment utilized in the work. Rigging plans shall clearly show the placement of equipment in relation to the Railroad for each condition required during the operation being described. Rigging Plans shall provide detailed description of weights and loads, lifting radius information, equipment charts, and details of rigging hardware such as slings and shackles. Rigging Plans shall be accompanied by calculations or other sufficient information to completely explain the operation and factors of safety.

11.4 Installation Drawings

11.4.1 The Contractor shall develop and submit for approval of the Engineer detailed Installation Drawings depicting all information required for the Work of this Project. Installation Drawings shall become part of the As-Built Drawing Set. Refer to Section 2.10, “Installation Planning.”

11.5 Shop Drawings

11.5.1 For this Project, Shop Drawings are considered a subset of Installation Drawings and shall meet all requirements for Installation Drawings.

11.5.2 Shop drawings include design drawings, fabrication drawings, erection drawings, schedule drawings, manufacturer's scale drawings, and/or other types of drawings required to depict details of fabrication or assembly required in the Work. These drawings shall provide all information necessary to adequately perform the work, and to document the installation for Metro-North’s future maintenance and operations. The level of detail shall be greater than that shown on the Contract Drawings. These Shop Drawings shall become part of the As-Built Drawing set.

11.5.3 The Contractor shall prepare and submit Shop Drawings detailing the final catenary support structure and bridge attachment assemblies in accordance with the Contract Drawings.

11.5.4 Shop Drawings shall accurately and distinctly indicate the
following:

a. All working and erection dimensions. b.

Arrangements and sectional views.

c. Necessary details, including complete information for making connections between work under this Contract.

d. Kinds of materials and finishes.

e. Parts lists and descriptions thereof.

11.6 Record Copy Drawings

11.6.1 Record Copy Drawings are the master set of Contract Drawings, approved Working Drawings and approved Installation Drawings kept at the jobsite and identified as “Record Copy Drawings.” The Record Copy Drawings shall be retained at each site for Metro-North maintenance forces until the permanent "As-Built" documentation is delivered to the Engineer.

11.6.2 During the progress of the Work, a careful and neat record of all approved deviations from the Installation Drawings and Working Drawings in the Work as actually constructed, shall be kept on the Record Copy drawings.

11.6.3 All changes and corrections shall be entered on the Record Copy drawings in a clear and neat manner and include notification of same in a Change Log to be kept with the Record Copy Drawings and immediately available to the Engineer for his inspection at any time.

11.6.4 Changes shall be entered on the Record Copy Drawings regularly as they occur, and these drawings shall be presented to the Engineer for review upon request on a regular basis.

11.6.5 Record Copy Drawings shall not be used for construction purposes. The Contractor shall provide protection from deterioration and loss in a secure, fire-resistive location, and shall provide access to record documents for inspection during normal working hours.

11.6.6 The Contractor shall have a draftsperson and other support personnel assigned uniquely to this Project as necessary to comply with the provisions of this Section.
11.6.7 The Contractor shall submit the Record Copy Drawings to the Engineer at or prior to substantial completion.

11.7 **As-Built Drawings**

11.7.1 As-Built or final drawings and documents shall be submitted to the Engineer for approval prior to substantial completion. These drawings and documents shall also include the latest revision of all previously submitted drawings and documents and shall show the final system configuration.

11.7.2 The Contractor shall prepare all As-Built Drawings in AutoCAD 2004 format. All standard drawings shall be submitted at 22 inches by 34 inches with a one-half inch border; the field print paper shall be 24 inches by 36 inches. Each drawing shall be provided with a blank area five inches by five inches, located adjacent to the title block.

11.7.3 As-Built Drawings shall indicate the actual location of concrete cable trough, conduit crossings, pull boxes, junction boxes, splice boxes, fiberglass cable tray, cable vaults and similar appurtenances by dimensioning from the near rail and by Contract stationing and by GPS stationing in latitude and longitude. Submit a log in tabular form for all items located, the type of item, its off-set from near rail, the reference rail, the Contract stationing, the latitude, and the longitude. Submit the geo-positional reference system to the Engineer for approval prior to accumulating the location data and clearly indicate the reference system on the location table. The tabular information shall be presented on a Contract As-Built Drawing and the information contained therein shall be submitted to the Engineer in Microsoft Excel format on the As-Built CD’s in addition to any other requirements.

11.7.4 The Contractor shall deliver 5 copies of full size As-Built Drawings and 5 CD’s each containing a full set of the As-Built Drawings in AutoCAD 2004 format to the Engineer prior to Final Acceptance.
12.0 SUBMITTALS

12.1 General

12.1.1 The Contractor shall submit to the Engineer all documents required in these Contract Documents, including but not limited to Working Drawings, Installation Drawings, Shop Drawings, As-Built Drawings, product submittals, certificates of compliance, test reports, etc.

12.1.2 Submittal procedures have been established to ensure that the specified products are furnished and installed in accordance with design intent. A comprehensive listing of all required submittals is provided in Section 13, “Contract Data Requirements List,” of these Technical Specifications.

12.1.3 The Contractor shall submit documentation and drawings for approval by the Engineer prior to product fabrication, procurement, and installation. All submittals shall reference applicable Contract Document Reference Numbers, in particular Technical Specification Section, article or paragraph numbers. Each submittal with multiple subsystems shall include a complete working system and include all subsystem documentation and drawings necessary for a complete system evaluation. No partial submittals of a system shall be accepted unless all subsystem documentation and drawings are included.

a. The Contractor shall make all submittals required by the Contract Documents, or as requested by the Engineer, and revise and resubmit as required to establish compliance with the specified requirements.

b. The Contractor shall comply with the requirements of the Contract Terms and Conditions, except as modified herein, and with other provisions pertaining to submittals described elsewhere in these Contract Documents.

12.2 Submittal Schedule

12.2.1 The Contractor shall compile and submit a complete and comprehensive schedule of all submittals to be made during progress of the Work. The initial version of the Submittal Schedule shall be made within 15 days after Notice of Award. The Submittal Schedule shall be updated and submitted by the 10th of each month. Include a list of each
type of item for which Contractor’s drawings, Shop Drawings, Certificates of Compliance, material samples, guarantees, or other types of submittals are required. Upon approval by the Engineer, the Contractor will be required to adhere to the schedule except when specifically otherwise permitted.

12.2.2 The Contractor shall coordinate the submittal schedule with the Monthly Project Schedule to be submitted. The schedule shall be coordinated with all necessary subcontractors and materials suppliers to ensure their understanding of the importance of adhering to the approved schedule and their ability to so adhere.

12.2.3 The Project Schedule shall be revised and updated on a monthly basis or more frequently as necessary to reflect conditions and sequences. Refer to Section 2.5, “Management and Administration.”

12.3 Engineer’s Review

12.3.1 The Engineer’s review of drawings and schedules will be for conformance with the design concept only and shall not be construed:

a. As permitting any departure from the Contract requirements.

b. As offering relief from the responsibility for any errors, including details, dimensions, and materials.

c. As approving departures from details furnished by the Engineer except as otherwise provided herein.

12.3.2 The Contractor shall describe in the letter of transmittal any variations from the Contract requirements. Failure to describe such variations shall not offer relief from the responsibility for executing the Work in accordance with the Contract, even though such drawings have been reviewed.

12.3.3 Submittals reviewed by the Engineer and returned to the Contractor will be marked with one of the following designations:
a. No Exceptions Taken.

b. Proceed as Noted.

c. Revise as Noted and Resubmit.

d. Rejected – Resubmit.

e. Review not Required.

12.3.4 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 "Proceed as Noted," unless specifically authorized to do so by the Engineer.

12.3.5 Submittals to be Resubmitted

a. If corrections to the submittals are required returned copies will be marked “Proceed as Noted” or "Revise as Noted and Resubmit", and in either case the required corrections will be shown. One reproducible copy will be returned to the Contractor for corrections.

b. The Contractor shall resubmit the corrected material in the same quantity within fifteen (15) days after receipt by the Contractor of the returned submittal.

c. Resubmissions will be handled in the same manner as first submissions. Direct specific attention, in writing or on re-submittals, to revisions other than the corrections requested by the Engineer on previous submittals.

d. The Contractor shall notify the Engineer within 10 days if any correction indicated on submittals constitutes a change of the Contract requirements.

e. Work indicated on submittals marked "Proceed as Noted" may be carried out prior to resubmission and final review.

12.3.6 Submittals designated as “No Exceptions Taken”
a. When the Engineer has found a submittal acceptable he will mark each copy with the notation “No Exceptions Noted” and the date. One reproducible copy will be returned to the Contractor. Construction may then proceed.

b. No further changes may be made except upon written instructions from the Engineer.

12.3.7 Reimbursement of Engineers Costs

a. In the event any Contractor's submittal is rejected twice for the same reason and must be submitted a third time, the Engineer will record all time used by his staff, Engineering consultants, and sub-consultants in evaluation of third or subsequent submittal.

b. Metro-North will deduct such costs from the Contract Price through change order procedures and other means as established in the Contract.

12.4 Mobilization Submittals

12.4.1 The Contractor shall submit the following items to the Engineer for review and approval within 30 days after Notice to Proceed:

a. The address and description of the proposed Contractor’s field office.

b. Construction Schedule detailing the sequence of construction.

c. Schedule of field operations and methods.

d. Schedule of Values for all materials and items of work.

e. Staging site and storage yard requirements, including fences, roads, buildings, and trailers.

f. The layout and location of, and equipment contained in, the Engineer’s Field Offices.

g. All required and/or specified insurance, bonds, and permits, schedule of field operations and methods.
12.4.2 The Contractor shall submit Working Drawings showing the proposed locations and sizes of all offices, shops, storage areas, security fencing, stationary equipment, and similar facilities.

12.4.3 The Contractor shall enumerate in the CPM what is covered (for cost loading) in this Section.

12.5 Safety, Health and Environmental Control Submittals

12.5.1 The Contractor shall issue and implement a Safety, Health and Environmental Control Plan for this Contract in accordance with the Contract Terms and Conditions. The Contractor shall submit the following items to the Engineer for review and approval 30 days before beginning any fieldwork:

a. Lab credentials and certifications for laboratories providing analysis of medical surveillance testing, and analysis of personal air monitoring cassettes. Both laboratories must be accredited by OSHA as well as the New York State and State of Connecticut Department of Labor (DOL) and the Department of Health (DOH), and hold any other appropriate licenses and certifications.

b. The Safety, Health and Environmental Control Plan shall include but not be limited to the following:
   1. A Site-Specific Compliance Program in accordance with 29CFR 1926.62, “Lead,” paragraph (e)(2).
   2. Safety and Health Training
   3. Description of emergency procedures
   4. Contractor’s written Safety Policy
   5. Safety Organization chart
   6. Reporting and Record Requirements
   7. Electrical Safe Practices
   8. Industrial Hygiene including Right to Know:
      Material and Safety Data sheets (MSDS)
   9. Weather Safe Practices
   10. Hazardous Communications Policy
   11. Railroad Safety Program

12.6 Installation Submittals

12.6.1 The Contractor shall submit the following items to the Engineer for review and approval 30 days before
beginning any item of related work:

a. A report showing all aerial and underground utilities, cables, etc., in the vicinity of all excavations, detailing each potential conflict and how the Contractor will resolve the conflict.

b. Requests for protective personnel and track outages shall be made in writing. Cancellation of requests for protective personnel shall be in writing.

c. Detailed plans and drawings for the execution, installation and routing of all aerial duct and fiber optic cable pulling requirements. These submittals shall include:
   1. Installation Drawings showing designs and details of all aerial cable construction details.
   2. Detailed Installation Drawings for all transition points between the Contractor installed aerial ducts, cables and devices and existing Metro-North hand holes, cable trough and duct bank.
   3. Installation and placement plans for all required conduit, aerial duct, copper and fiber optic cables, and other hardware as proposed.
   4. Catenary and bridge attachment Shop Drawings and Installation Plans.
   5. Documents, drawings, calculations and other items required by other Agencies having jurisdiction over any related facet of the Work.

12.6.2 A cable installation plan that shall detail each cable pull including:

a. Reel location.

b. Pull assist points.

c. Figure eight points.

d. Sequence of operations.

e. Pulling plans, including pulling tension calculations and the Contractor’s proposal for monitoring pulling tension during cable installation.
f. Cable bending radius plans demonstrating minimum bending radius compliance both during and after installation.

g. Methods by which the Contractor shall secure the cable and prevent its theft.

12.6.3 Catalog cuts of swivel pulling eyes with information showing how the Engineer can confirm the 600-pound breakaway rating by visual inspection.

12.6.4 Refer to Section 2.10, “Installation Planning.”

12.7 Fiber Optic and Copper Cable Submittals

12.7.1 The Contractor shall submit the following items to the Engineer for review and approval 30 days before procuring any cable.

a. Testing agency names, addresses, and telephone numbers and names of full-time registered Engineers and responsible officers.

b. A list of the proposed cable manufacturer's fiber optic and copper cable installations.

c. The cable manufacturer’s Quality Assurance Program, including test procedures.

d. Full technical data and product cut-sheets and sample specimens in four-foot lengths for each proposed manufacturer's cable. The sample shall remain the property of Metro-North.

e. Proof that the submitted cable meets Title 7 of the Code of Federal Regulations Part 1755.900 requirements for type acceptance (see Part 1755.900 section 19)

12.8 Miscellaneous Material

12.8.1 The Contractor shall provide submittals for all procured items. Submittals shall, at a minimum, identify the manufacturer, model name and model number, and provide a sufficient product description, including technical specifications. Submittals for procured items shall include but not be limited to the relevant Contract Document reference number, in particular
Technical Specification Section, article and paragraph numbers. The Contractor shall submit procured items to the Engineer for review and approval 30 days before procuring any item of material. This shall include but not be limited to:

a. Aerial duct
b. Pole line hardware.
c. Fiber optic cable.
d. Copper cable.
e. Conduit and accessories.
f. Catenary structure and bridge attachment materials.

12.9 **Certificates of Compliance**

12.9.1 The Contractor shall submit to the Engineer all Certificates of Compliance for material approval prior to installation of materials, as follows:

a. Certify that all materials used in the Work comply with all specified provisions thereof. Certification shall not be construed as relieving the Contractor from furnishing satisfactory materials if, after tests are performed on selected samples, by the Contractor or by the Engineer, the material is found to not meet specified requirements.

b. Show on each certification the name and location of the Work, name and address of Contractor, quantity and date or dates of shipment or delivery to which the certificate applies, and name of the manufacturing or fabricating company. Certification shall be in the form of letter or company-standard forms containing all required data. Certificates shall be signed by an officer of the manufacturing or fabricating company and shall bear the Contractor's approval stamp.

12.10 **Testing Submittals**

12.10.1 The Contractor shall submit the following items to the Engineer for review and approval:
a. A completed, signed, and notarized test report sheet prior to shipment of each batch cable. Information to be supplied in the certified cable test reports shall include the following:
1. Report number.
2. Date and location of test.
3. Description of test and test conditions.
5. Lot, batch, and/or reel identification number.
6. Quantitative test reports.
7. Summary of the test results.
8. Information on the components of the cable tested shall include batch numbers, physical, optical, and electrical properties.
9. Test representatives printed name and signature.

b. Cable field test procedure - 30 days before performing scheduled field test.

c. Test results - within 10 days of completion of each test.

d. This shall include the results of any additional tests contained in Title 7 of the Code of Federal Regulations Part 1755 (7CFR1755) as deemed necessary by the Engineer.

e. Test documents shall be submitted in an electronic format suitable for archiving, i.e. DVD or CD, the format to be approved by the Engineer. The DVD or CD shall also contain copies of the software required to read the files.

f. Distances to copper and fiber optic cable ends and localized attenuations shall also be recorded and submitted to the Engineer for approval in a written report and on electronic media (CD or DVD), as produced by the OTDR.

12.11 Quality Assurance Submittals

12.11.1 The Contractor shall submit the Contractor’s QC Plan as required by the Contract Terms and Conditions.

12.11.2 The Contractor shall submit procedures covering the following to the Engineer within 30 days after
award (this is not intended to be a complete list of procedures the Contractor may need):

a. Control of Design Changes.


d. Inspection and Testing (all aspects). e. Control of Nonconformance.

f. QC System Supervision and Improvement.

g. QA audits deficiencies shall be responded to in writing within 15 days.

12.11.3 Engineer approval of changes shall be in writing prior to construction.
13.0 CONTRACT DATA REQUIREMENTS LIST

13.1 General

13.1.1 The following table is an example format for preparation of the Contractor’s list of the required Contract Data deliverables. The Contractor shall develop a complete list of Contract Data Deliverables no later than 60 days after NTP. The Contractor’s list of Contract Data deliverables shall include the delivery schedule relative to Contract award, with cross references to the Technical Specifications that describe the required submittal. The following table is an example; lack of inclusion in this sample listing does not relieve the Contractor of the obligation to provide any submittal or deliverable required elsewhere in these Contract Documents. Submittals of this Contract Data shall reference the CDRL item numbers as tabulated below, and shall be assigned a date and numbered revision level, including a brief revision history, in order to provide for the subsequent tracking of revised submittal documents.

<table>
<thead>
<tr>
<th>SUBMITTAL</th>
<th>SPEC REF.</th>
<th>SCHEDULE FOR SUBMITTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Monthly Work Plan Update</td>
<td>2.5.5</td>
<td>Initial version prior to first Project Progress Meeting, subsequent versions by the 10th of each month.</td>
</tr>
<tr>
<td>2. Schedule / One-month Look Ahead Schedule</td>
<td>2.5.6</td>
<td>Initial version prior to first Project Progress Meeting, subsequent versions by the 10th of each month.</td>
</tr>
<tr>
<td>3. Progress Report</td>
<td>2.5.7</td>
<td>Initial version prior to first Project Progress Meeting, subsequent versions by the 10th of each month.</td>
</tr>
<tr>
<td>4. Listing and organization chart for all personnel necessary for completion of this Contract</td>
<td>2.6.9</td>
<td>Prior to any installation work.</td>
</tr>
<tr>
<td></td>
<td>Working Plans, Installation Plans / Shop Drawings and Material List</td>
<td>2.10, 11.2, 11.3, 11.4</td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td>5.</td>
<td>On-track equipment dimensions</td>
<td>2.14.3</td>
</tr>
<tr>
<td>SUBMITTAL</td>
<td>SPEC REF.</td>
<td>SCHEDULE FOR SUBMITTAL</td>
</tr>
<tr>
<td>6.</td>
<td>Permits</td>
<td>2.15.3</td>
</tr>
<tr>
<td>7.</td>
<td>Written notification of each and every coordination or application to any utility, and written notification of the completed coordination and/or approved application.</td>
<td>2.16.1</td>
</tr>
<tr>
<td>8.</td>
<td>Plans and Details for Maintenance and Protection of Traffic</td>
<td>2.20</td>
</tr>
<tr>
<td>9.</td>
<td>Methods of performing work that may affect the safety or movement of trains</td>
<td>2.22.6</td>
</tr>
<tr>
<td>10.</td>
<td>Field office related submittals</td>
<td>2.27, 2.28</td>
</tr>
<tr>
<td>11.</td>
<td>Track Outage Plan</td>
<td>3.3.16</td>
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PART 1 - GENERAL

A. Safety and security of customers, passengers, Railroad employees, employees of the Contractor and its subcontractors, and other persons, as well as protection of property and the environment, shall be a primary responsibility and concern of the Contractor. Precautions shall be exercised at all times for the protection of person and property. The Contractor shall assume the full responsibility and obligation to provide a safe working environment at all times and shall maintain a safe, clean, and healthy worksite. The Contractor shall supply, install, and maintain all safety apparatus and equipment necessary to protect the welfare of his employees, the public, customers, and Railroad employees.

B. The Contractor shall comply with this specification section, Metro-North Railroad Operating Procedures and General Safety Instructions, and all applicable federal, State, and local laws, rules, regulations, codes, statutes, ordinances, and provisions including but not limited to, the Occupational Safety and Health Administration, the Federal Railroad Administration, the Environmental Protection Agency (Federal), New York State Department of Environmental Conservation (State), Department of Environmental Protection (City), the National Fire Protection Association (NFPA), the National Electrical Code, the New York State Industrial Code, the New York State Uniform Fire Prevention and Building Code, and requirements of the local municipality in which the Work is performed.

C. Notwithstanding any remedies for maintaining a safe, clean, secure and healthy work site, in the event that the Contractor’s work environment chronically provides a site such that, there are significant safety or security concerns, this may constitute an Event of Default in accordance with Article 7.01 of the Contract Terms and Conditions.

D. PROJECT INCIDENCE RATES

1) Metro-North maintains a database of injuries occurring to Contractor employees, customers, and Railroad employees. Metro-North calculates Recordable and Lost Time injury incidence rates for comparison to the industry average rates maintained by the Bureau of Labor Statistics. These rates are updated monthly. Metro-North utilizes the industry classification of Specialty Trade Contractors (NAICS 238) for comparative analysis. The safety record of a project is based upon comparison of the calculated project incidence rate to the latest national average incident rate for Specialty trade Contractors.

2) Incidence rates are calculated utilizing the following formula. The Contractor shall review the project incidence rates with the work force during Worker Safety Meetings.

\[
\text{Incidence Rate} = \frac{\text{Number of Recordable or Lost Time Injuries}}{\text{Actual Hours Worked}} \times \frac{200,000}{(100 \text{ workers} \times 40 \text{ hours} \times 50 \text{ weeks})}
\]

(NOTE: Work hours are tallied from the WF-257 Work Force Utilization Reports submitted by the Contractor)
PART 2 - SAFETY & HEALTH REQUIREMENTS

2.01 EMPLOYEE CONDUCT & RESPONSIBILITY

A. The Contractor shall be responsible for the implementation and enforcement of safety and security rules and requirements.

B. To promote safety, the Contractor shall hold regular safety meetings, ensure its and all Subcontractor employees are properly trained, and monitor job site safety via inspection at the start and completion of each shift as well as monitoring the job site for this purpose throughout the day. The Contractor shall correct and report any safety violations and convene investigative meetings, as directed by the Engineer.

C. Any Contractor personnel who in the Engineer's opinion violates or is not in conformance with the safety requirements may be prohibited from working on Railroad property. Metro-North will maintain records of such prohibitions and the individual will also be prohibited from working on all other Metro-North projects for the duration of this contract.

D. The Engineer reserves the right to refuse access to the Site or require immediate removal from the Site any individual violating, or alleged to have violated, site safety or security regulations and Contractor agrees to obtain consent of its subcontractors to a similar provision, and Contractor agrees to hold the Railroad harmless for taking such actions.

2.02 BAN AGAINST INTOXICANTS / FITNESS FOR DUTY - SAFE AND PROPER CONDUCT OF CONTRACTOR PERSONNEL

A. While on Metro-North property or otherwise performing work for the Contract, employees and Consultants of the Contractor and its Subcontractors shall conduct themselves in a safe and businesslike manner, conducive to the safe and efficient operation of the Railroad. In connection therewith, the Contractor shall prohibit the possession and use of alcoholic beverages and intoxicants by all Contractor and Subcontractor personnel. Any Contractor or Subcontractor personnel determined by Metro-North, in its sole discretion, to be in violation of the provision, including but not limited to those determined by Metro-North to have violated the ban against intoxicants, will be prohibited from working on the Contract for its duration.

B. The Contractor shall not permit a worker whose ability or alertness is impaired because of drugs, fatigue, illness, intoxication, or other conditions to work at the Site. The Contractor shall ensure that its supervisory staff and the supervisory staff of each subcontractor perform a fitness for duty inspection on each worker reporting for work and throughout the day. The Contractor shall have a substance abuse program, pre-employment drug testing, and testing for cause.

2.03 METRO-NORTH CONTRACTOR SAFETY ORIENTATION

A. All contract personnel must complete a training class entitled Roadway Worker Procedures for Contract Employees Working on Metro-North Property. The training will be provided by Metro-North at no cost to the Contractor. It is the Contractor's responsibility to schedule such training with Metro-North Railroad prior to the start of
work. Contractor personnel will not be permitted to enter Railroad property to commence work until they present documentation demonstrating that each workman has completed the aforementioned class.

B. Documentation evidencing completion of the OSHA 10 hour or 30 hour Construction Safety course within five (5) years of the contract award date shall be provided as a prerequisite for attending Metro-North’s Roadway Worker Procedures for Contract Employees Working on Metro-North Property.

C. The requirements covered by this training are a condition of working on Metro-North Railroad property.

D. The training is valid for a period of one (1) year from the date of training. The training must be refreshed annually on or before the initial date of training. It is the Contractor’s responsibility to ensure the training of its workforce is current.

E. The Contractor shall provide a television and DVD player and/or laptop computer with DVD player to be used for each orientation class. The screen size and audio system shall be commensurate with the size of the group to be trained. The use of a laptop computer is only suitable for groups of ten (10) persons or less and shall have a minimum screen size of seventeen inches (17”). The television and DVD player and/or laptop computer remain the property of the Contractor.

2.04 METRO-NORTH SPECIFIC SAFETY REQUIREMENTS

A. The Contractor is hereby notified that the Railroad contains hazards not typical of other construction sites, including but not limited to, moving rail equipment and hazardous energy (i.e Third Rail 750 volts DC, Overhead Catenary 12.5 kV to 25 kV AC). Employee awareness and management’s vigilance are crucial to maintaining safety in this environment. The presence of a Metro-North Conductor-Flagman (if any) shall not relieve the Contractor of responsibility for taking all proper precautions, especially in the vicinity of tracks and high voltage electrical circuits.

B. Communication is paramount to safety, especially in the railroad environment. Where any language barrier exists with respect to other Contractor or Subcontractor employees, the Contractor will provide a qualified interpreter(s) who will be present whenever needed, in the opinion of the Engineer, to enforce safe conduct of the Work including but not limited to, at each work site and during meetings and safety classes. The Contractor shall provide at least one (1) individual that is fluent in the English language and able to communicate effectively with the Engineer and/or Conductor Flagman and translate between non-English speaking or comprehending individuals and the Engineer and/or Conductor Flagman. This individual must be able to effect communication between the work force and the Engineer and/or Conductor Flagman. Should the Engineer and/or Conductor Flagman deem the communication ineffective, or has a potential to jeopardize the safety of the work force, the Engineer and/or Conductor Flagman has the right to stop the work until the Contractor can provide effective communication, the cost of any resulting delays to be borne by the Contractor.

C. Mobile telephones and other electronic devices shall not be used while on or about the tracks, and/or while operating machinery or equipment. Mobile telephones and other
electronic devices may not be used while in areas of risk, such as on ladders, or while actively engaged in the work. Refer to General Safety Instruction 300.3 and Operating Rule D6 for specific requirements.

D. Audio devices such as radios, stereos, personal music players, or other audible devices are prohibited from use on Metro-North property. This includes audio devices within construction equipment.

E. All ladders shall meet or exceed OSHA requirements. Commercially available ladders used during the work shall be limited to those of fiberglass construction. Job site constructed ladders may be of wood construction.

F. All stairways and passageways shall be maintained free of obstructions unless specifically necessitated by the work and approved by the Engineer.

G. Eyewash stations shall be provided, maintained, and readily accessible at all construction sites regardless of the presence or use of corrosive materials. Large sites, or projects having remote work locations, shall have additional eyewash stations as necessary.

H. Should known or suspect hazardous materials be unearthed, uncovered, or otherwise discovered during the course of the work, the work in that area shall cease and the Engineer shall be immediately notified. Work impacting the known or suspect hazardous material shall not resume without the direction of the Engineer.

I. All materials, whether to be used for temporary or permanent construction, shall be fire resistant or fire retardant treated. Materials shall have the manufacturers labeling evidencing such. Materials shall come from the manufacturer pretreated. Application of fire retardants on the project site is prohibited.

### 2.05 SPECIFIC REQUIREMENTS FOR WORK IN GRAND CENTRAL TERMINAL

A. The following requirements are specific to work being performed within Grand Central Terminal (GCT) from 42nd Street to 57th Street and Madison Avenue to Lexington Avenue.

B. The Contractor shall notify the Metro-North Project Manager and Construction Manager of their intent to work in GCT. At no time shall the Contractor enter GCT without the knowledge of the Metro-North Project Manager, Construction Manager, and Station Master’s Office. The Contractor shall provide a schedule identifying the days, dates, shift times, locations of the work, and companies/subcontractors that will be on site.

C. The Contractor shall assign one individual the responsibility of Designated Emergency Contact. The Designated Emergency Contact (DEC) shall be an individual that is on site and at the location of the work activity. An alternate DEC shall be assigned whenever the primary DEC is not on site. The DEC shall be responsible for implementation of the Emergency Action/Evacuation Plan if necessary. The DEC shall be familiar with the Emergency Action/Evacuation Plan, which includes the primary and alternate evacuation routes and GCT emergency numbers (i.e. Station Master’s Office, Fire Command Center, Operations Command Center, MTA Police).
D. The Contractor shall include the following numbers in the Emergency Contact List for projects within GCT.

MTA Police (212) 878-1001
(888) 682-9117
(888) MTA911PD
Fire Command Center (FCC) 212 340-3191 /3192
Station Master’s Office (SMO) 212 340-2583
Transportation Office (Track 25) 212 340-2325/2329
Operations Control Center (OCC) 212 340-2050
(800) 724-3004

E. The Contractor shall provide the following information to the Station Master’s Office at the start of each work shift: the name and phone number(s) of the DEC, a list of names of all contractor personnel working within GCT, a description of the location of the work, the shift start and end times.

F. Equipment and materials shall only be stored in areas designated by GCT building management. Storage areas shall be kept neat and orderly, and free from accumulations of debris.

G. Passenger elevators shall not be used for the transportation of construction materials without the prior approval of GCT building management. Transport of construction equipment, tools, and materials via escalators is strictly prohibited.

H. Care shall be taken for the transportation or movement of construction equipment, tools, and materials via rolling dollies, pump jacks, or other wheeled equipment throughout GCT. Such are prohibited on ramps or other inclined surfaces unless adequate controls are implemented to prevent run-away of the wheeled equipment. Unless otherwise approved by GCT building management, transportation or movement of construction equipment, tools, and materials is limited to off hours.

I. All materials, whether to be used for temporary or permanent construction, shall be fire resistant, and when possible, non-combustible materials shall be chosen over combustible materials (i.e. steel framing instead of wood framing, gypsum board instead of plywood). Each temporary structure shall be constructed of fire resistant or fire retardant treated material. All materials (i.e. lumber, plywood) shall be fire retardant treated and contain the manufacturer’s stamps evidencing such. If the stamps are illegible or otherwise not provided, the material shall be immediately removed from the premises and replaced at no additional expense to Metro-North. On site application of fire retardants by the Contractor is prohibited, except when the material is not commercially available pretreated from the manufacturer.

J. Temporary barriers used to segregate work areas from non-work areas shall be constructed as to provide a two (2) hour fire rating.

K. The storage of flammable materials within GCT shall be pre-approved by the Metro-North Office of Fire Prevention in Grand Central Terminal. Flammable materials shall be stored in approved containers in accordance with NFPA and FDNY guidelines and requirements.
2.06 SAFETY SUBMITTALS

A. The Contractor shall provide the following submittals:
   1) Safety, Health, and Environmental Control Plan (SHECP)
   2) Emergency Contact List
   3) Subcontractor’s Notice of Intent to Comply with Project SHECP
   4) Record of Metro-North Roadway Worker Safety Training
   5) Record of Employee Safety Orientation
   6) Safe Work Plans
   7) Daily Safety Reports
   8) Monthly Site Safety Audit Reports
   9) Resumes & Qualifications of Safety Engineer and Safety Supervisor
   10) Forms and reports for the documentation and investigation of Incidents, Accidents, and Injuries
   11) Record of Employee Safety Meeting (i.e. Tool Box Meetings)
   12) Evidence of Employee Training (i.e. OSHA 10 hr Construction Safety, Fall Protection, Confined Space Entry & Attendant, Scaffold Erection & User)
   13) Fall Protection Plan
   14) Material Safety Data Sheets
   15) Employee Roster / Daily Employee Sign In/Sign Out Log
   16) Crane, Rigging, Hoisting Plan
   17) Copies of Citations, Suits, or Complaints

2.07 SAFETY KICKOFF MEETING

A. The Contractor’s Project Manager, Safety Engineer, and Safety Supervisor(s) shall attend a Safety Kickoff Meeting which will be convened by the Engineer within 45 calendar days of Award.

2.08 SAFETY, HEALTH, AND ENVIRONMENTAL CONTROL PLAN (SHECP)

A. The Contractor shall develop and maintain a written, Contract specific, Safety, Health, and Environmental Control Plan (SHECP) to:
   • Protect the lives and health of all persons,
   • Provide employees with information to enable them to work safely
   • Prevent damage to property and environment
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- Identify hazardous conditions and unsafe work practices
- Provide a system for auditing work site safety and compliance with the established safety program
- Avoid work interruptions or any delay to train services due to accidents

B. Within fifteen (15) days of the date of Award, the Contractor shall submit the SHECP to the Railroad. Work on the Site shall not be permitted to start until the full written plan, covering all required items, has been submitted and accepted, and Safe Work Plans (SWPs) for the upcoming construction activities meeting the requirements of Section 2.16 are submitted, reviewed, and revised accordingly.

C. The Safety Engineer shall be involved in the preparation and review of the SHECP as evidenced by their signature on the cover page of the document.

D. Failure of the SHECP to address the safety concerns specific to the contract and its scope of work, and contain the information required by this section, shall be grounds for immediate rejection of the submittal.

E. The Contractor shall utilize the provided SHECP Checklist to prepare the SHECP. The Contractor shall complete the SHECP Checklist and attach it to the SHECP upon submittal. Failure of the SHECP submittal to contain a completed SHECP checklist shall be grounds for rejection of the submittal.

F. The SHECP shall be a written plan laying out the management organization and strategy to assure high levels of job site safety for all performed tasks. It shall define the personnel responsible for developing and assuring safe work practices for each major item of work or subcontract.

G. The Contractor shall revise and resubmit the SHECP based upon comments returned from the Engineer. As to facilitate the SHECP review process, should comments be returned to the Contractor, the Contractor shall address each comment individually and separately from revisions to the SHECP itself. A cover letter identifying each of the reviewer’s comments and the Contractor’s responses shall accompany the revised and resubmitted SHECP.

H. The Contractor shall take immediate action to prevent the recurrence of each incident, accident, or injury. In addition, the Contractor shall review the SHECP based on such an occurrence and revise as necessary. Upon any changes in work conditions, the Contractor shall also revise the SHECP. The Contractor shall submit each revision of the SHECP to the Engineer for review.

I. The Contractor shall maintain a copy of the SHECP within the project field office. The Contractor’s SHECP including each Subcontractor’s Notice of Intent to Comply with the Contractor’s SHECP shall be readily available for review by the Railroad.

J. The Contractor shall ensure that all Subcontractors and Suppliers comply with the Contractor’s SHECP, or submit their own programs that the Contractor shall be required to approve. Each subcontractor shall comply with the Contractor’s SHECP, and shall provide written notification of its intent to adopt and comply with the Contractor’s SHECP. If the Subcontractor elects to submit its own SHECP, it shall demonstrate that their program meets the requirements of this Section, be approved by the Safety Engineer,
and be incorporated into the Contractor’s SHECP. The Subcontractor’s SHECP shall be submitted and approved prior to the start of the Subcontractor’s work on the Site. The Contractor shall review the Subcontractor’s and Supplier’s agreements to ensure the flow down of all applicable safety requirements.

K. The following are the minimally required elements of the SHECP. The SHECP shall contain the following. Failure of the SHECP to contain the following information shall be grounds for rejection of the submittal. The Contractor may include information beyond what is required herein, but shall limit it to information applicable to the contract scope of work.

1) Cover page with Name of Contractor, Title of Contract, and Contract Number. Include plan revision number, date of revision, name and signature of Safety Engineer responsible for the maintenance and enforcement of the SHECP.

2) Table of Contents that provides section numbers, title or description of the section contents, the page number of the section, and identification of the revision number and revision date of each section.

3) Safety Policy Statement signed by an Officer of the Contractor.

4) Organizational chart of Contractor and Subcontractor personnel responsible for implementing the SHECP and their duties and responsibilities. The chart shall show the reporting relationship and integration of the Safety Engineer with all personnel, including top-level managers, responsible for implementing the SHECP.

5) Description of the relationship between the Prime and Subcontractor(s) and the responsibility for management of site safety.

6) Identification of the Safety Engineer including their duties and responsibilities.

7) Identification of the Safety Supervisor including their duties and responsibilities.

8) Identification of the Competent Person(s) for each of the respective construction disciplines or specialties.

9) A statement regarding the responsibility of all employees to work safely, to not engage in unsafe behavior, and abide by safety rules.

10) A comprehensive description of the project and scope of work under the contract. This section shall be of sufficient detail so that those not directly involved in the project, including reviewers of the SHECP, may attain sufficient knowledge to judge the applicability and adequacy of the SHECP contents.

11) A listing of the known and anticipated hazards to be encountered during the work.

12) A detailed Employee Safety Orientation Plan for all Contractor and Subcontractor personnel (see Section 2.12). The Contractor shall include a Record of Employee Safety Orientation form for employee acknowledgement / sign-off of having received such safety orientation.

13) Requirement for Worker Safety Meetings (i.e. Tool Box Meetings). Include Record of Worker Safety Meeting form to be used to document meetings. At a minimum, the Record of Worker Safety Meeting shall identify the date, topic(s) of discussion, and
attendees.


15) A description of the how the contractor intends to monitor the work site and ensure that employees are following established policies, procedures, and work practices. Requirement for Daily Site Safety Inspections. Daily inspections for each work shift and inspections being recorded in a Daily Safety Report. Include a copy of the proposed Daily Safety Report as an attachment.

16) Requirement for Monthly Site Safety Audits. Include a copy of the example Monthly Site Safety Audit Report to be utilized.

17) Procedures for the Identification and Handling of Unsafe Conditions

18) A section dedicated to Slip, Trip, Fall hazards and abatement

19) Employee Fitness for Duty including monitoring of employee fitness, and handling of employees deemed unfit for duty.

20) Incident/Accident Response - Procedures for Handling and Reporting Injuries, Incidents, Accidents, and Near Misses. Include an Accident Investigation Procedure including a decision chart for identifying root causes. Include Accident Investigation Report form(s). Include a generic action plan for review, analysis and immediate action necessary to prevent recurrences of all accidents or incidents (near misses). The Contractor shall review and if necessary, revise the SHECP based on the occurrence of serious accidents, incidents, injuries, or near misses, and upon any changes in job conditions, or as required by the Engineer.

21) An Emergency Preparedness and Response Plan to include the following:
   a. An Emergency Contact List which shall identify the proper numbers to call for all emergencies including fire, police, medical (hospital, clinic, ambulance), disruptions of train service, and the release of contaminants into the environment, in addition to the phone numbers of all involved parties including the Metro-North contacts and Contractor / Subcontractor Contacts. Identify the location of phones to be used for emergency notification.
   b. A plan for the safe and effective response to medical emergencies for Contractor and Subcontractor personnel. Emergency medical services shall include first-aid treatment (including all necessary first aid supplies), and ambulance service (or other standing arrangement) for the immediate transport of injured workers to medical treatment.
   c. Include emergency phone numbers for fire and life-safety emergency contacts.
   d. Include the name, address, phone number, and driving directions and map(s) of local routes to the hospitals and/or other medical treatment facilities nearest to the project site.
   e. An Evacuation Plan that identifies the emergency escape routes or available means of egress during an evacuation, designates the primary and secondary assembly (i.e. muster) areas for personnel, and a system by which each individual can be accounted for in the event of an evacuation, fire, or other
such emergency. Include copy of the Employee Roster form or Daily Sign-in/Sign out Log.

f. Include requirement for an annual emergency preparedness drill(s).

g. The identification of potential environmental accidents and emergencies associated with site-specific construction activities. And the response procedures to construction site environmental accidents and emergencies and for the prevention and mitigation of the environmental impacts that may be associated with them.

h. Site security and control: The Contractor shall outline its plan for site security including prevention of unauthorized entry onto the project site and prevention of vandalism. The plan shall include all contractually required security items. This plan shall include where necessary: use of fencing, temporary enclosures, concrete barricades, surveillance cameras, guard service and worker identification.

i. Notification to Engineer and all appropriate agencies.

j. Annual reviews and revisions of the Emergency Preparedness and Response Plan, in particular after the occurrence of environmental accidents and emergency situations.

22) Outline of general safety rules and procedures for the performance of the Work. The Contractor shall ensure that all applicable safety regulations are addressed and included in this section. Examples for inclusion in this section are as follows:

a. Hazardous Communication (HAZCOM) Program,
b. Protection of Existing Public and Private Utilities (Utility Identification, Call Before You Dig)
c. Fall Protection Program,
d. Lock Out / Tag Out,
e. Arc – Flash Protection,
f. Hearing Conservation Program,
g. Respiratory Protection Program,
h. Confined Space Program,
i. Burning & Welding / Use and storage of compressed gases,
j. Powder Actuated Tools
k. Hand & Power Tools
l. Ladders & Scaffolds

m. Handling, Containerization, & Storage of Flammable Materials/Liquids

23) Outline of site-specific safety rules and procedures for the performance of the Work. Examples for inclusion in this section are as follows:
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SAFETY, HEALTH, & ENVIRONMENTAL CONTROL

a. Plans for safe ingress and egress,
b. Fall Protection Plan
c. Maintenance & Protection of Traffic / Traffic Control Plans
d. Protection of the Public, and Metro-North Customers and Employees,
e. Plans for fire protection and emergency response, and
f. Plans for Lead and Asbestos Abatement.

24) Employee Conduct, Handling of Employees / Subcontractors Failing to Abide By Safety Requirements, and Disciplinary Procedures for Violations of Safety Rules.

25) Procedure for identification and labeling of products, control of products and materials containing hazardous components, including provisions for maintenance of Material Safety Data Sheets (MSDS).

26) Environmental protection to be implemented by the Contractor during the performance of the Work, including but not limited to, noise control, prevention and/or control of air and water pollution, erosion and siltation control, removal of waste materials, storage of construction materials, protection against fire, minimum disturbance to pedestrian and vehicular traffic, maintaining use of public facilities, protection against fugitive emissions / dust control, on site storage of fuels/petroleum products, spill prevention, leak containment, and clean-up.

27) Procedures for the periodic review and revision of the SHECP.

28) Procedures for the organization and maintenance of safety related documentation

29) Any other related safety information.

2.09 SAFETY ENGINEER (FULL TIME)

A. The Contractor shall provide and assign a full time Safety Engineer to this project within fifteen (15) days of Notice of Award until physical completion of the work. Within ten (10) days of Notice of Award, the Contractor shall submit a resume documenting the qualifications of the proposed candidate to the Engineer for approval. The individual serving in this capacity is often referred to as the Site Safety Engineer, Safety Manager, Site Safety Manager, Site Safety Officer, Health & Safety Officer, On Site Safety Manager but shall be clearly identified as the “Safety Engineer” throughout all documentation.

B. The authority and responsibility of Safety Engineer shall be assigned to a single individual who is full time, on the project site while work is actively underway, qualified as described herein, and a management representative of the Contractor. The Safety Engineer’s responsibility shall be limited to managing and monitoring site safety, site security, and environmental protection. The Contractor may subcontract this position to a qualified safety consultant.

C. Upon demonstration by the Safety Engineer, the ability to satisfactorily manage site safety, other supervisory and technical tasks may be assigned to this individual, but his/her first duty is to provide for project safety as described in these specifications. Prior to
assigning the Safety Engineer additional responsibilities, the Contractor shall submit in writing to the Engineer, a request to allow the Safety Engineer to assume additional responsibilities. If such approval is granted, Metro-North reserves the right to revoke the same in the event site safety is not being maintained.

D. Metro-North reserves the right to require the Contractor to replace the individual serving in the capacity of the Safety Engineer, at any time, for failure to perform the duties outlined in this section. The lack of accidents or employee injuries on a project shall not be utilized as the sole means of evaluating satisfactory performance of the Safety Engineer.

E. The Safety Engineer shall be present at the locations where the work is actively being performed. The Safety Engineer’s regular work shift shall be the work shift with the greatest work activity or the shift with the most hazardous work activity. This may require the Safety Engineer to be present for day, evening, night or weekend shifts. The Safety Engineer may be required to be present for multiple shifts if high hazard or high-risk work is occurring during multiple shifts. Failure to have a Safety Engineer or Safety Supervisor at a work area may result in a stoppage of work at that work area.

F. The Safety Engineer shall be given the authority to alter and implement changes to the contractor’s means and methods as necessary to benefit the safety of operations. In the event of an Unsafe Condition, the Safety Engineer shall have the authority to order the work to be stopped in the affected area until the Unsafe Condition is corrected.

G. The Contractor shall not change the approved Safety Engineer without prior written consent of the Railroad.

H. The responsibilities and duties of the Safety Engineer shall include the following:

1) Development of the Safety, Health and Environmental Control Plan (SHECP) and revise as required,

2) Implementation of the SHECP,

3) Monitoring of the Contractor’s and each subcontractor’s implementation of and adherence to the SHECP,

4) Development and review of Safe Work Plans, and monitor the implementation of the same in the field

5) Ensure that all employees on site have completed the requisite Metro-North training and any other training as may be required by regulation

6) Conduct Employee Site Safety Orientations

7) Conduct Worker Safety Meetings and manage Subcontractor’s Worker Safety Meetings

8) Conduct regular inspections of the work site(s) throughout the work shift to identify unsafe work practices and conditions, and monitor implementation of controls and use of proper protective equipment. One (1) of these inspections shall be conducted at the beginning of the shift; within one (1) hour of shift commencement. Such inspections shall be structured to identify unsafe employee work practices and conditions, and
implement corrective actions. The findings and corrective actions shall be documented on the Daily Safety Report.

9) Prepare Daily Safety Reports (see Section 2.19)

10) Coordinate and participate in Monthly Site Safety Audits and Monthly Safety Meetings

11) Attendance at all safety related project meetings

12) Conduct incident/accident investigations, prepare and distribute associated reports and documentation, and review to ensure completeness

13) Maintain all safety related documentation

I. Qualifications

1) Required qualifications include the following:

a. The Safety Engineer shall have not less than five (5) years of construction safety or construction safety related experience. The Safety Engineer must be familiar with the work being performed. The resume must include for a five (5) year period, a description of the duties, responsibilities, accomplishments, and safety record of preceding assignments from which the candidate has gained construction safety experience. Experience in construction and/or construction management does not satisfy the requirement for experience in construction safety.

b. A sound working knowledge of Railroad, State, and Federal occupational safety and health regulations.

c. Training in and working knowledge of the use of all necessary health and safety monitoring equipment.

d. American Red Cross or equivalent standard first aid and adult cardiopulmonary resuscitation (CPR).

e. OSHA 40-hour Hazardous Waste Operations & Emergency Response (HAZWOPER) training in hazardous materials safety and health as stipulated in 29 CFR 1910.120 e(3), 8 hours of supervisory training as described in 29 CFR 1910.120 e(4), and 8 hours of refresher training as described in 29 CFR 1910.120 e(8).

f. Successful completion of one (1) or more of the following:

   i. An ABIH Certified Industrial Hygienist (CIH) or ASSE Certified Safety Professional (CSP), or

   ii. A BCSP Construction Health and Safety Technician (CHST) or Occupational Health and Safety Technologist (OHST), or

   iii. Certification as a Site Safety Manager by the New York City Department of Buildings, or

   iv. OSHA #500 Trainer Course in Occupational Safety and Health Standards for the Construction Industry, or
2.10 SAFETY SUPERVISOR

A. Whenever the Safety Engineer is not present, the duties and responsibilities of the Safety Engineer shall be assigned to a Safety Supervisor. The Safety Supervisor’s primary responsibility shall be the management of all safety matters under his/her jurisdiction. Failure to have a Safety Engineer or Safety Supervisor at a work area may result in a stoppage of work at that work area.

B. The Contractor shall submit to the Railroad the names and duty tours of the proposed Safety Supervisors.

C. Within fifteen (15) days of Notice of Award, the Contractor shall submit a resume documenting the qualifications of the proposed candidate(s) to the Engineer for approval.

D. Qualifications

1) Required qualifications include the following:

   a. The Safety Supervisor shall be familiar with the work being performed, shall be competent to instruct others, and shall be familiar with the SHECP.

   b. The Safety Supervisor shall have not less than five (5) years of construction safety or construction safety related experience. The Safety Supervisor must be familiar with the work being performed. The resume must include for a five (5) year period, a description of the duties, responsibilities, accomplishments, and safety record of preceding assignments from which the candidate has gained construction safety experience. Experience in construction and/or construction management does not satisfy the requirement for experience in construction safety.

   c. Successful completion of one (1) or more of the following:

      i. An ABIH Certified Industrial Hygienist (CIH) or ASSE Certified Safety Professional (CSP), or
      ii. A BCSP Construction Health and Safety Technician (CHST) or Occupational Health and Safety Technologist (OHST), or
      iii. Certification as a Site Safety Manager by the New York City Department of Buildings, or
      iv. OSHA #500 Trainer Course in Occupational Safety and Health Standards for the Construction Industry, or
      v. OSHA #510 Occupational Safety and Health Standards for the Construction Industry, or
      vi. OSHA 30 hour Construction Safety and Health Training completed within
2.11 EMPLOYEE TRAINING

A. The Contractor shall ensure the proper training of its employees and subcontractor’s employees. Employee training required specifically by OSHA, NYSDOL, NYCDEP, NYCDOB, or other agency regulations shall be provided. Upon request of the Engineer, the Contractor shall submit evidence of such training.

B. All workers shall have completed the OSHA ten (10) hour Construction Safety Course within five (5) years of the contract award date. All management personnel, including Project Managers, Superintendents, Foremen, and Competent Persons shall have completed the OSHA thirty (30) hour Construction Safety Course within five (5) years of the contract award date. Only courses completed through OSHA recognized outreach training providers shall be acceptable. Evidence of such training shall be submitted to the Engineer and shall be a prerequisite for attending the Metro-North Contractor Safety Training required by Section 2.03.

2.12 EMPLOYEE SITE SAFETY ORIENTATION

A. Prior to working on the Site, the Contractor shall provide each employee with an effective Site Safety Orientation. The orientation shall be provided by the Safety Engineer, Safety Supervisor, Safety Manager, or other qualified management representative of the Contractor. The contents of the training shall include, but not be limited to, the following:

1) Introduction to the project site, scope of work, and key personnel;
2) Review of the company’s Safety Policy;
3) Review of the SHECP and where it is maintained on site;
4) Review of plans supplemental to the SHECP (i.e. HAZCOM, Respiratory Protection Program, Fall Protection Program, Confined Space Entry Program)
5) Review of the safety rules and requirements with a copy distributed to each employee;
6) Employee fitness for duty and substance abuse policy;
7) Worker responsibilities and disciplinary procedures for violation of safety rules,
8) Review of the Metro-North specific safety requirements, and Grand Central Terminal specific safety requirements (as applicable), with a copy distributed to each employee;
9) Review of the Project Incidence Rates for Recordable and Lost Time Injuries inclusive of prior incidents, accidents, injuries, and near misses
10) Requirement for the immediate reporting of incidents, accidents, injuries, and near misses;
11) Site security procedures (i.e. photo ID, company logo/insignia on PPE, sign-in/sign-out log, “if you see something, say something”, be aware of suspicious behavior, specific procedures for secured facilities);
12) Emergency Preparedness and Response Plan including identification of medically trained personnel, and location of First Aid and medical facilities, emergency phone numbers;

13) Evacuation Plan

14) Identification of the Safety Engineer and Safety Supervisor(s) and their duties and responsibilities;

15) Procedures in place for the identification and control of job site hazards (i.e. individual’s responsibility to report unsafe conditions and work practices, daily safety inspections, safety audits)

16) Review of site-specific hazards, respective controls, and safe work practices;

17) Review of the public, customer, and Metro-North employee safety concerns, the separation and protection of work areas (i.e. signage, barricades, fencing, barriers)

18) Review of the availability and content of Safe Work Plans;

19) Attendance requirements for Daily Safety Briefings, and Weekly Worker Safety Meetings;

20) Personal Protective Equipment requirements;

21) Housekeeping requirements;

22) Fire prevention requirements;

23) Construction equipment and vehicle safety (i.e. seat belts, speed limit, equipment escort/flagging for movements)

24) Warning devices and safety postings.

B. The Contractor shall maintain written records of the Site Safety Orientation program and each individual’s acknowledgement of having completed the orientation. As documentation of orientation, the Contractor shall provide a written Record of Employee Safety Orientation whereby each employee acknowledges having received such orientation. Upon completion of the employee’s orientation, the employee shall complete the Record of Employee Safety Orientation form. An example of this form shall be included in the SHECP. Copies of the completed Record of Employee Safety Orientation shall be submitted to the Engineer within five (5) working days after the orientation. At a minimum, the record shall include the following:

1) An outline of the topics covered

2) The date the training was completed

3) A statement whereby the employee acknowledges having completed such orientation and agrees to abide by the safety requirements

4) The printed names and signatures of the following:
   a. Employee having received the orientation
   b. Safety Engineer or Safety Supervisor
   c. Individual providing the orientation (if other than the Safety Engineer or Safety
2.13 **DAILY SAFETY BRIEFING**

A. An effective Safety Briefing shall be conducted at the start of each workday, or at any time during the work day when conditions change or new tasks are initiated. All individuals involved in the task shall attend the Safety Briefing. An employee failing to attend a Safety Briefing shall not be permitted to perform any work until the employee has received the same instruction.

B. The briefing is a two way communication tool to ensure that workers know what they will be doing, how it will be accomplished, have the ability to discuss better ways to do the job, and are alert and focused on the job.

C. Employees involved in the work shall be authorized and empowered to recommend changes to the means and methods to increase the safety of the operation. Employees should be encouraged to ask questions pertaining to things they are not confident about. The Contractor shall specifically inform employees of this authority.

D. The Safety Briefing should include:
   1) A description of the job and basic steps involved
   2) Assignment of tasks and responsibilities
   3) A check that all involved are familiar with applicable Safe Work Plans
   4) Existing and potential hazards applicable to that shift’s work
   5) Review of MSDS
   6) Required tools, equipment, and materials
   7) Necessary safeguards and procedures, including specific personal protective equipment required
   8) Special conditions to watch for
   9) When to stop and re-brief
   10) Feedback and questions

2.14 **WEEKLY WORKER SAFETY MEETINGS**

A. Worker Safety Meetings shall be held no less than one (1) time each week. Each employee of the Contractor and each Subcontractor working at the Site shall attend Worker Safety Meetings.

B. The Worker Safety Meeting shall be conducted by the Safety Engineer or a Subcontractor’s Competent Person. The Safety Engineer shall approve the content of each subcontractor’s Worker Safety Meeting.

C. The Worker Safety Meeting shall review safe working methods and applicable rules required for the safe performance of the work scheduled during the two (2) week period
following the Worker Safety Meeting. Each Worker Safety Meeting shall include,

1) Instruction and discussion of Safe Work Plans applicable to the upcoming work,
2) Review of recent injuries, incidents, accidents, near misses
3) The Engineer reserves the right to direct the Contractor to cover additional information.

D. The Contractor shall notify the Engineer at least one (1) week in advance of each scheduled Worker Safety Meeting.

E. The Contractor shall prepare a written Record of Work Safety Meetings. An example of this form shall be included in the SHECP. Copies of the completed Record of Work Safety Meeting shall be submitted to the Engineer within five (5) working days after the Worker Safety Meeting. The record shall include the following:

1) The date and time the meeting was held
2) An outline of the topics discussed
3) The specific Safe Work Plans that were reviewed
4) The printed names and signatures of
   a. All attendees
   b. The individual chairing the meeting
   c. Safety Engineer or Safety Supervisor

2.15 MONTHLY SAFETY MEETING

A. On a monthly basis while on site work is underway, the Contractor shall chair a Monthly Safety Meeting. The Contractor shall inform Metro-North of the meeting schedule (2) weeks in advance. An agenda and minutes of the meeting shall be prepared by the Contractor and submitted to the Engineer within five (5) working days after the meeting.

B. All Contractor personnel responsible for project safety including, management officers that are responsible for developing and maintaining company safety standards and policies (i.e. Corporate Safety Director), the Safety Engineer, the Safety Supervisor, the Superintendent, Foremen, and Subcontractor’s Competent Persons shall attend.

C. The agenda for the Monthly Safety Meeting shall minimally include the following:

1) Review of Incidents, Injuries, Accidents & Near Misses and Lessons Learned
2) Review of site safety audits and inspections completed since the last meeting
3) Review of the preceding month’s Monthly Site Safety Audit
4) Review of work plans for upcoming operations (i.e. new processes or procedures, sharing of new means and methods, new equipment or products, those requiring special precautions and/or PPE)
5) Development and review of Safe Work Plans
6) Safety program implementation (i.e. review of safety related project documentation
for completeness, Incident/Accident/Injury Reports, New Employee Orientation, OSHA 10 hr Construction Safety, OSHA required training such as Fall Protection, Scaffolds, Confined Space).

7) Dissemination of safety related information from Management to Work Force and vice versa (i.e. Safe Work Plans, Incident/Injury Reporting).

2.16 SAFE WORK PLANS

A. The Contractor shall prepare and submit a Safe Work Plan (SWP) for each of the primary construction tasks identified on the four (4) week Rolling Schedule. The SWP shall be structured to correlate with, and be integrated into, the four-week Rolling Schedule. By maintaining parallelism in document formats, a consistent, cohesive effort will effectively merge safety into the construction management process. (See example on following pages.)

B. The SWPs shall be transmitted to the Engineer one (1) week prior to the start of the work covered by the SWP. Failure to transmit SWPs may be grounds for not allowing the work to proceed and for withholding progress payments.

C. A SWP is a written work plan which identifies the tasks and corresponding sub-tasks to be completed, the method of work for performing each task, the hazards associated with the work, and the corresponding equipment and methods that will be used to control the hazards and prevent accidents. The SWP shall define a plan of action for each identified hazard including comprehensive prevention methods for exposures to workers, the public, property, and the environment. Access/egress and setup/breakdown under all expected environmental conditions shall be included.

D. SWP’s shall address all foreseeable exposures to the work force, the public, and property. Absence of an applicable standard or regulation does not preclude the Contractor from providing appropriate controls within an SWP. Specific references in the SWP to codes standards and regulations are not necessary.

E. When controls are compliance based, such as for confined space entry, all applicable compliance information shall be included or appropriately referenced. Of particular concern are training items that will be required to educate the employees about exposures such as Worker Safety / Tool Box Meetings held to discuss the hazard and accident prevention methods. More formal off site training (fall protection, confined space, trenching, competent person, etc) should be listed and documentation referenced or provided.

F. Work shall not begin until the SWP has been presented to and accepted by the Engineer. If the SWP does not adequately address all expected, foreseeable hazards posed by the work, the Engineer will require clarification or additional planning to ensure that work proceeds safely. The Contractor’s Competent Person involved, shall demonstrate knowledge of the Competent Person responsibilities as defined by OSHA and how the plan will be effectively implemented, to the satisfaction of the Engineer.

G. The SWP shall include the following information and be prepared in accordance with the example shown on the following pages.
SECTION 01 33 60
SAFETY, HEALTH, & ENVIRONMENTAL CONTROL

1) General Project Information (Contract, General Contractor, Contractor Performing Task)
2) SWP Number (i.e 1, 2, 3), Date, Revision (i.e 01, 02, 03)
3) Primary Task - Describe the scope of work
4) Method of Construction
5) List of equipment and products to be utilized, with product data sheets, material specifications, and Material Safety Data Sheets attached
6) Development Team (Preparers and Reviewers)
7) Competent Person(s) assigned to the task
8) Work Element(s)/Sub Tasks - Describe sub-tasks and activities of the Primary Task, as appropriate. Identify the equipment and methods of construction for the Work Element.
9) Hazard Description - Describe each foreseeable hazard for the Work Element
10) Hazard Control/Accident Prevention - Describe controls and procedures that will be implemented to reduce or eliminate each foreseeable hazard described above; reference attachments as necessary.
11) Training Required – Metro-North Roadway Worker Safety, Fall Protection, Scaffold Erector/Scaffold User, Confined Space, Equipment Operation (i.e. fork lift)
12) Specific PPE Required for Each Task – List the specific PPE required, beyond the standard minimally required PPE for all tasks (i.e. hard hat, safety vest, protective eyewear, work shoes)
13) Implementation / Review with Work Force

H. Priority should be given as follows in controlling hazards:
   1) Substitution or change of method to eliminate hazard
   2) Engineering controls
   3) Provision of Personal Protective Equipment (PPE)
   4) Management controls / training, such as a safety monitor for fall exposures.

I. Accident prevention procedures shall be based on industry standards including but not limited to:
   1) OSHA Standards
   2) Mine Safety and Health (MSHA) Regulations
   3) National Institute for Occupational Safety & Health (NIOSH)
   4) American National Standards Institute (ANSI)
   5) National Fire Protection Association (NFPA)
   6) American Conference of Governmental Industrial Hygienists (ACGIH).
# SECTION 1 – General Information

<table>
<thead>
<tr>
<th>Contract / Project Description:</th>
<th>Croton Harmon Yard Improvements – Phase IV</th>
<th>SWP No.:</th>
<th>1</th>
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<tbody>
<tr>
<td>General Contractor:</td>
<td>ABC Constructors</td>
<td>Date:</td>
<td>01/21/10</td>
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<tr>
<td>Contractor Performing Work:</td>
<td>DEF Excavating</td>
<td>Revision No.:</td>
<td>01</td>
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<tr>
<td>Primary Task:</td>
<td>Installation of Oil Water Separator. Excavate a pit approximately (10) feet long by (10) feet wide and (8) feet deep in the northwest corner of the yard near Track 4 and install oil water separator.</td>
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<tr>
<td>Method of Construction:</td>
<td>Standard cut and cover excavation</td>
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## Equipment / Materials (Product Data Sheets & MSDS Attached):

<table>
<thead>
<tr>
<th>Cat 245 backhoe equipped with 1.5 yard toothed bucket and lifting hook will be used to excavate, place materials, and backfill</th>
<th>20 yard dump truck will be used to remove excavated material from the Work Area</th>
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<tbody>
<tr>
<td>An engineered shoring system will be used to protect against cave-in and to support the soil near the track bed on Track 4</td>
<td>Wire rope slings and shackles will be used to lower oil water separator and top section into pit</td>
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<td>Gasoline powered tamper will be used to compact soil during backfilling</td>
<td>Shovels, rakes, and hand tools will be used for various tasks</td>
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# SECTION 2 – Development Team

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<tr>
<th>Prepared By:</th>
<th>Position/Title</th>
<th>Date</th>
<th>Reviewed By:</th>
<th>Position/Title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Doe</td>
<td>Laborer</td>
<td>01/12/10</td>
<td>Jane Mayfield</td>
<td>Safety Engineer</td>
<td>01/19/10</td>
</tr>
<tr>
<td>Bob Catt</td>
<td>Equipment Operator</td>
<td>01/12/10</td>
<td></td>
<td></td>
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<tr>
<td>Phil Spoil</td>
<td>Excavation Foreman</td>
<td>01/13/10</td>
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</tbody>
</table>

# SECTION 3 – Competent Person(s) Assigned

<table>
<thead>
<tr>
<th>Competent Person</th>
<th>Discipline</th>
<th>Competent Person</th>
<th>Discipline</th>
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</thead>
<tbody>
<tr>
<td>Phil Spoil</td>
<td>Excavation</td>
<td>Bob Fume</td>
<td>Confined Space Entry</td>
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<tr>
<td>Clevis Shackle</td>
<td>Rigging</td>
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</tbody>
</table>
## SAFE WORK PLAN

### SECTION 4 – Safety Analysis

<table>
<thead>
<tr>
<th>Work Element(s)/Sub Tasks:</th>
<th>Hazard Description</th>
<th>Hazard Control/Accident Prevention</th>
<th>Specific Training &amp; PPE Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavate - Dig pit for oil water separator</td>
<td>Potential collapse of excavation and related excavation hazards</td>
<td>Excavation will be shored utilizing a pre-engineered shoring system. Ladders will be provided for safe entry and egress. Ladder to extend 36” above excavation. A guardrail will be installed on top of the shoring system to protect against falls into the open excavation.</td>
<td>Fall Protection</td>
</tr>
<tr>
<td>Place Gravel - Place and level pea gravel in excavation</td>
<td>Hazards of moving vehicles.</td>
<td>The backhoe and dump truck are equipped with back up alarms. The swing area of the backhoe will be cordoned off with caution tape. A spotter will be provided while the truck is backing.</td>
<td></td>
</tr>
<tr>
<td>Set Oil Water Separator - Lower precast unit in place and level</td>
<td>Crushing hazard while placing sections of oil water separator.</td>
<td>Tag lines will be used while lowering sections. Workers will not be permitted in pit until load had been safely landed. All wire rope slings and rigging has been specified for the lift and will be inspected daily.</td>
<td></td>
</tr>
<tr>
<td>Install Top Section - Set precast top section (manhole)</td>
<td>Confined space exposures when entering oil water separator to make pipe connections and during final inspection.</td>
<td>Confined space procedures as outline in the Safety Health and Environmental Control Plan will be followed. Air monitoring will be performed prior to entry and throughout the course of work in the confined space. Rescue equipment will be maintained on site.</td>
<td>Confined Space Monitoring Confined Space Rescue Equipment</td>
</tr>
<tr>
<td>Connect Pipes - Connect concrete drain pipes to unit</td>
<td>Confined space exposures while working with gasket materials and waterproofing.</td>
<td>MSDS sheets will be obtained on the materials and workers will be provided with the proper PPE as required in the MSDS.</td>
<td>Face Shield Rubber Gloves Protective Clothing Respiratory Protection</td>
</tr>
<tr>
<td>Inspection - Conduct final inspection and tests</td>
<td>Exposures to burns from hot asphalt waterproofing.</td>
<td>Each worker performing waterproofing operations will be required to wear cotton work clothes including long sleeve shirts. Each worker handling buckets of material</td>
<td></td>
</tr>
</tbody>
</table>
**Backfill & Tamp - Restore site to finish grade**

| Hazards of moving vehicles. | The backhoe and dump truck are equipped with back up alarms. The swing area of the backhoe will be cordoned off with caution tape. A spotter will be provided while the truck is backing. |

**All Tasks**

| Heat Exhaustion / Heat Stroke | Wear loose fitting, breathable clothing. Break periods and worker rotation may be necessary. Potable water will be provided and consumption encouraged via toolbox talk about heat stroke exposures. |

| Miscellaneous exposures | Hard Hats, safety glasses and safety vests are minimally required PPE |

| As summer progresses, proper clothing requirements will be enforced. (No shorts, proper shoes, short sleeve shirts, no tank tops) |

**SECTION 5 – Implementation / Review with Work Force**

<table>
<thead>
<tr>
<th>Print Name</th>
<th>Signature</th>
<th>Date</th>
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2.17 **DAILY EMPLOYEE SIGN IN / SIGN OUT LOG**

A. In support of the Contractor’s Emergency Action Plan and Evacuation Plan, the Contractor shall maintain a sign-in / sign-out log of all employees working on Metro-North property. The log shall be completed daily. The log shall be submitted to the Engineer daily; on the next shift following the previous shift. (See example on following pages.)

B. The heading of the log shall include the following information: Contract number, Project description, Location of the work, Work shift hours, Name and Emergency Contact Information for Designated Emergency Contact (DEC), Superintendent, or Team Leader.

C. The body of the log shall include the following information: Employee Printed Name, Name of Employer, Date & Time Entering Work Site with Signature, Date & Time Leaving Work Site with Signature.

D. The logs must be available to the MTA Police and the Engineer within two (2) hours of the shift start time.

E. During an emergency situation or evacuation, the logs must be available to emergency services forthwith.

2.18 **DAILY FINAL INSPECTION OF WORK SITE**

A. At the completion of each work shift and prior to vacating the site, the Contractor shall conduct a final inspection of the project site. The purpose of the inspection shall be to ensure the site is adequately secured prior to being vacated. The Contractor shall notify the Engineer of having completed such inspection.

B. At a minimum, the inspection shall include the following:

1) The soundness, stability and security of equipment and material installed during the shift,

2) Housekeeping / cleanliness of site,

3) Removal of equipment, tools and materials from areas open to the public, customers, and employees,

4) Temporary protections to safeguard the public (i.e. fencing, barricades, signage),

5) Temporary and security lighting,

6) Potential fire hazards (i.e. equipment left running, electrical),

7) Securing of materials (i.e. materials that may be displaced by wind and/or water),

8) Securing of the site, including temporary facilities and equipment (i.e. storage areas, equipment, field offices, security gates)
# CONTRACTOR EMPLOYEE SIGN IN / SIGN OUT LOG

## Emergency Numbers

<table>
<thead>
<tr>
<th>MTA Police</th>
<th>Operations Command Center / Rail Traffic Controller</th>
<th>GCT Station Master’s Office / Fire Command Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>(888) 682 - 9117 or (212) 878 - 1000</td>
<td>(212) 340 - 2050</td>
<td>(212) 340 - 3191 / 3192</td>
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</tbody>
</table>

## Contract Number / Project Description

<table>
<thead>
<tr>
<th>Contract Number / Project Description</th>
<th>Contractor (Prime)</th>
<th>Field Office Location / Phone</th>
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</table>

## Work Location

(Give this description to emergency services)

<table>
<thead>
<tr>
<th>Start Day (circle)</th>
<th>Date</th>
<th>Time</th>
<th>Finish Day (circle)</th>
<th>Date</th>
<th>Time</th>
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<tbody>
<tr>
<td>M T W H F SA SU</td>
<td>05/24/10</td>
<td>2100</td>
<td>M T W H F SA SU</td>
<td>05/25/10</td>
<td>0500</td>
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## Contacts

<table>
<thead>
<tr>
<th>Contacts</th>
<th>Contractor’s Site Representative</th>
<th>Contractor’s 24 hr Emergency</th>
<th>Metro-North Project Manager</th>
<th>Metro-North Representative</th>
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<tbody>
<tr>
<td>Name</td>
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<td>Cell Number</td>
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<tr>
<td>Office Number</td>
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## Metro-North Authorization

<table>
<thead>
<tr>
<th>Name (Print)</th>
<th>Safety Training Sticker #</th>
<th>Company</th>
<th>Date</th>
<th>Time On Site</th>
<th>Signature</th>
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<th>Time Off Site</th>
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Print Name: __________________________ Signature: __________________________

Print Name: __________________________ Signature: __________________________
# CONTRACT EMPLOYEE SIGN IN / SIGN OUT LOG

<table>
<thead>
<tr>
<th>Name (Print)</th>
<th>Safety Training Sticker #</th>
<th>Company</th>
<th>Date</th>
<th>Time On Site</th>
<th>Signature</th>
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2.19 **DAILY SAFETY REPORT**

A. A Daily Safety Report shall be completed for each work shift and work area by the Safety Engineer/Safety Supervisor and shall be transmitted daily to the Engineer. An example of the proposed format of the Daily Safety Report shall be provided in the SHECP.

B. The Daily Safety Report shall include, at a minimum, the following information:

1) A header providing the general project information;
   a. Contract Number
   b. Project Description,
   c. Date,
   d. Work shift times,
   e. Inspection times,
   f. Work area(s) inspected, and
   g. Weather conditions

2) Commendable actions or observations pertaining to worker safety

3) An entry for each safety deficiency that includes;
   a. Location and nature of deficiency,
   b. Time noted,
   c. Names of persons and firms that were notified* of the deficiency including time notified; and
   (*NOTE: Notification shall include at a minimum the parties exposed to the safety hazard, the parties responsible for creating the deficiency, and the parties responsible for correcting the deficiency.)
   d. Time and nature of corrective action(s)

4) An entry for each deficiency that was not corrected on the prior shift’s Daily Safety Report until the deficiency is corrected;

5) A notation of each accident, incident, or injury reported including name of injured party or affected property owner; time of accident, incident, or injury, and description of accident, incident, or injury;

6) Notation of Safety Meetings conducted and attended including type of meeting and the name of each person in attendance;

7) A notation of visits by safety representatives of the Railroad, City, State or Federal Authorities, including name and phone number of representative, time of visit, and department or authority represented; and

8) Printed name and signature of person completing the report
2.20 MONTHLY SITE SAFETY AUDIT

A. For the duration of the project, the Contractor shall perform at least one (1) comprehensive site safety audit every month during which there is on site activity. The Monthly Site Safety Audit shall be performed by a team of individuals of the Contractor, and Subcontractor(s) that are responsible for project safety, including but not limited to, management officers that are responsible for developing and maintaining company safety standards and policies (i.e. Corporate Safety Director), the Safety Engineer, the Safety Supervisor, the Superintendent, Foremen, and Competent Persons. The Contractor shall inform Metro-North Railroad and Third Party Construction Management of the meeting schedule (2) weeks in advance so they may attend. The Safety Engineer shall prepare a report of the findings of the audit (i.e. Monthly Site Safety Audit Report). A copy of the completed Monthly Site Safety Audit Report shall be submitted to the Engineer. The findings of the Monthly Site Safety Audit shall be reviewed during the Monthly Safety Meeting.

2.21 INCIDENT, INJURY, ACCIDENT, & NEAR MISS NOTIFICATION & REPORTING

A. In the event of any incident, accident, employee injury, or near miss, the Contractor shall adhere to the following notification and reporting requirements.

B. The Contractor shall instruct all of its employees and Subcontractor’s employees that they are required to immediately notify their Supervisor of ALL incidents, injuries, accidents, illnesses, and near misses related to the work, no matter how insignificant they seem at the time.

C. INITIAL NOTIFICATION REQUIREMENTS

1) The Contractor shall immediately notify the Engineer of all incidents, injuries, accidents, and near misses involving personal injury, causing damage to property or the environment, affecting the safe movement of trains, or illnesses related to the work. The injured person’s immediate supervisor, a representative of the third party construction management firm, or other person who directly observes the incident, shall provide immediate telephone notification to Metro-North Construction Management. Telephone notification shall be provided to the following:

   a. The Metro North Construction Manager and/or Project Manager, or Third Party Construction Management Firm, and

   b. The Manager of the Owner Controlled Insurance Program (OCIP), as applicable

2) Resident Engineers on projects managed by third party construction management firms may be designated as the first point of contact for the notification of incidents. A protocol must be established for the immediate notification of Metro-North Construction Management and/or Project Management by the Resident Engineer / third party construction management firm.
3) Near misses shall be reported to the Engineer and a Lessons Learned session shall be convened. Any Near Miss incident involving rail equipment requires a full investigative report.

4) If this contract is covered under the Owner Controlled Insurance Program (OCIP), refer to OCIP specifications for additional information.

D. REPORTING REQUIREMENTS

1) Contractor Employee Injury
   a. In the event an employee of the Contractor or an employee of a subcontractor is injured on the Site, follow the reporting procedures below. The following applies to ALL injuries, whether deemed OSHA Recordable, or not:
      b. The injured employee must immediately report the injury to the Contractor.
      c. The Contractor must immediately report the injury to the Engineer and the OCIP Administrator (as applicable).
      d. The Contractor must provide the information listed below to the Engineer within two (2) hours of the incident, or by the end of the work shift during which the incident occurred, whichever is earlier. Metro-North Construction Management requires this information in order to complete the Metro North IR-1 Initial Report of Incident.
         i. Date and Time of Incident
         ii. Reason for Incident Not Being Reported Immediately (if applicable)
         iii. Location of Incident
         iv. Brief Description of Incident
         v. Name, Home Address, Daytime Phone, Evening Phone, and Date of Birth of Injured Person (Social Security Number not required)
         vi. Employer of the Injured Person
         vii. Description of Injury and Disposition
   e. The Contractor shall transmit the following to the Engineer (and OCIP Administrator if the project is covered under the OCIP) within twenty-four (24) hours of the incident:
      i. C-2 Employer’s Report of Work Related Injury/Illness

      NOTE: The employer of the injured employee must complete the applicable workers’ compensation claim form (C-2 in New York, C-10 in Connecticut). If the project is covered under the OCIP, the appropriate form shall be submitted to the On-Site Insurance Administrator within 24 hours. The On-Site Administrator will notify the appropriate Insurer, who will notify the Workers Compensation Board. Penalties are sanctioned to insurance carriers when reports to the Workers Compensation Board exceed 10 days.
      ii. Contractor’s Accident/Injury Investigation Report, or OCIP Form 5 – Supervisor’s Accident Investigation Report
f. All reports must be submitted within twenty-four (24) hours of each accident.
g. The Contractor shall make every effort to prevent further injury to others and to secure accident evidence and witness information. The Contractor shall provide the following supporting documentation, if available.
   i. Addendum to OCIP Form 5 - Witness List and Statement Form
   ii. Photographs of the accident site, machinery, and/or equipment involved in the accident
   iii. Description of the machinery or equipment involved in the accident
   iv. Police reports
   v. Evidence of a suspicious claim
   vi. Other relevant information

2) Employee Requiring Medical Attention
   a. The Contractor has the primary responsibility to accompany the injured employee to the nearest Hospital Emergency Room or Urgent Care Facility.
   b. The attending physician should be instructed to give the injured employee a note indicating one of the following:
      i. The employee is cleared to return to work
      ii. The employee requires additional medical treatment and will be disabled for a specified number of days.
   c. The Contractor shall provide the following additional information pertaining to injuries as it becomes available.
      i. Description of the Medical Treatment Provided (if divulged by employee)
      ii. Diagnosis by Physician / Medical Practitioner (if divulged by employee)
      iii. Medication Prescribed & Dosage (including over the counter medications)
      iv. If the injury will result in lost work days (i.e. Lost Time Injury)
      v. If the individual will be placed on Restricted Duty.

3) Serious Injuries or Fatalities to Employees
   a. "Serious Injuries" or fatalities to employees must be reported immediately by the Contractor via telephone to the Engineer and the OCIP Administrator (as applicable)
   b. Serious Injuries include, but are not limited to:
      i. Fatalities, or injuries that can cause death
      ii. Spinal Cord injuries
      iii. Burns to 10% of more of the body
      iv. Amputations or crushing injuries
v. Eye injuries causing partial or full loss of sight
vi. Severe head injuries
vii. Exposure to toxic substances
viii. Any occupational disease
ix. Any single occurrence involving hospitalization

4) **Reporting Procedures for Incidents Involving Third Party Injury, Property Damage, Environmental Pollution or Builders’ Risk**

a. "Serious Injuries" or fatalities to third parties must be reported immediately via telephone to the Engineer and the OCIP Administrator (as applicable).
b. The Contractor shall report all incidents, regardless of injuries sustained or property damage claimed, within twenty-four (24) hours to the Engineer and OCIP Administrator (if applicable).
c. The Contractor shall provide a completed Accident Investigation Report to the Engineer and OCIP Administrator (if applicable) (Form 5 - Supervisor’s Accident Investigation Report for OCIP projects).
d. If the project is covered under the OCIP, the OCIP Administrator will report the claim to the appropriate Insurer.
e. The following documents must accompany the Accident Investigation Report or Form 5 - Supervisor’s Accident Investigation Report (OCIP projects):
   i. Photos of accident site
   ii. Witness Statements (Addendum to Form 5)
   iii. Police report, if applicable

5) **Distribution of Correspondence**

a. Correspondence pertaining to an injury, accident, incident, or near miss shall be distributed to the following:
   i. Resident Engineer
   ii. Metro-North Capital Programs Senior Director
   iii. Metro-North Project Manager
   iv. Metro-North Project Manager’s Departmental Director
   v. Metro-North Construction Manager
   vi. Metro-North Construction Manager’s Departmental Director
   vii. Metro-North Construction Manager’s Departmental Deputy Director
   viii. Metro-North Manager, Construction Safety
   ix. Metro-North Safety Department
b. If the project is covered under the Owner Controlled Insurance Program (OCIP), correspondence distribution shall be extended to the individuals shown in the OCIP Administration Directory.

**COPIES OF ALL REPORTS ARE TO BE RETAINED IN THE CONTRACTOR’S RECORDS.**

2.22 **POST INCIDENT REVIEW**

A. The Contractor shall conduct a Post Incident Review for all incidents that resulted in Recordable Injuries, $5,000 or more in property damage, and Near Misses that could have resulted in injury or property damage. The primary purpose of the Post Incident Review is to learn from the accident, determine the cause of the accident, and actions to be taken to prevent a recurrence of such an accident. The Contractor shall notify the Engineer of the meeting schedule to permit the Railroad to attend.

2.23 **UNSAFE CONDITIONS**

A. An Unsafe Condition is a condition that gives rise to the imminent possibility of injury to workers or the public, of serious damage to property or the environment, or of effecting the safe movement of trains.

B. The Contractor shall instruct its employees and Subcontractor’s employees to immediately inform their Supervisor of any and all Unsafe Conditions.

C. When an Unsafe Condition exists at the Site, the work shall be stopped in the affected area until the Unsafe Condition is corrected. If the Contractor does not take corrective action immediately or within the time period specified by the Engineer, the Engineer reserves the right to take whatever action is required to correct the hazard or unsafe condition and back charge the Contractor for the costs associated with the remedial work.

2.24 **MAINTENANCE OF SAFETY RECORDS**

A. The Contractor shall maintain the following Safety Records for a period of not less than six (6) years after Construction Completion:

1) Safety, Health, and Environmental Control Plan;
2) Safe Work Plans;
3) Daily Safety Reports;
4) Monthly Safety Audit Reports;
5) Records of Worker Safety Meetings;
6) Records of Employee Training (i.e. Roadway Worker Safety, OSHA 10 Hour Construction Safety, Employee Site Safety Orientation, OSHA required training)
7) Competent Person Designations;
8) Material Safety Data Sheets;
9) OSHA Forms 300, 300A, and 301
10) Contractor’s Accident/Injury Investigation Report, C-2 Employer’s Report of Work Related Injury/Illness, Form 5 Supervisor’s Accident Report, Witness Statements/Addendum to Form 5;
11) Any permits required;
12) Written notice of Citations, Suits, or Complaints; and
13) Other compliance records as required by City, State, and Federal Agencies.

2.25 PROTECTION OF THE PUBLIC

A. The Contractor shall provide, erect, and maintain substantial, durable, and effective protective devices including but not limited to, guardrails, barricades, protective enclosures, fences, bridging, sidewalk sheds, platforms, ramps, floor coverings, road plates, sidewalks, guide rails, lights, traffic control devices, warning signs and signals, pedestrian detour signs, pedestrian information signs, cones, traffic barrels, and other protective devices as required by the Work or elsewhere in the Contract to adequately protect the Work and all individuals against injury to their person or damage to their property.

B. Protective devices shall be designed to protect the public and others on or adjacent to the Site from potential exposures created by the work. Such protective devices shall include but not be limited to; the use of welding screens to protect against welding flash, the use of solid barricades or tarps to protect against flying objects or debris created by cutting, chipping or grinding, or the use of fully sealed enclosures to protect against exposures to hazardous vapors, fumes, or dusts.

C. The Contractor shall promptly replace any of the foregoing that must be removed temporarily during the progress of the Work. If replacement is not properly made, the Engineer shall have the right to effect such replacements at the expense of the Contractor.

D. Protective devices shall be designed to withstand the reasonably anticipated forces in or around the work area including but not limited to wind, vibration, runoff, and other natural or man-made conditions.

E. Protective devices shall be maintained in a clean and smooth condition so as not to cause cuts, nicks, splinters, or snag clothing. The use of double headed nails is prohibited.

F. Each protective device shall be dismantled and removed from the site by the Contractor when the device is no longer required and prior to demobilization.

G. Each protective device shall be constructed of properly identified fire rated materials. Combustible materials shall be fire retardant treated and contain markings evidencing such.

H. The Contractor shall provide boundary fencing around the perimeter of the construction site and staging areas. The boundary fencing shall be constructed as to segregate work areas from non-work areas. Boundary fencing shall be of chain link type and a minimum of eight feet (8’) in height. The Contractor shall install access gates or removable fence sections as necessary to maintain access to, and emergency egress from, the work area.
The number and location of access points shall be determined by the Contractor and submitted to Metro-North Railroad for review. Additional access/egress points shall be added as necessary to maintain site safety and accessibility.

I. Locations of intermittent or short duration work may be protected by barricades and/or fences a minimum of four feet (4’) in height. Barricades or fences eight feet (8’) or higher shall be provided along work areas with moderate to heavy pedestrian traffic or along work areas where site security is required. Barricades and fences shall be rigid and capable of preventing unauthorized entry into the work area. Barricades and fences shall be maintained in a continuous unbroken line along the work area. Fencing shall be supported at regular intervals as to maintain its integrity. Caution tape or unsupported fencing shall not be considered a rigid barricade.

J. Covers, plates, and bridging used to protect holes shall be constructed so as to reduce potential slip and trip hazards. All covers, plates, and bridging shall be secured against movement. Covers, plates, and bridging shall be installed in accordance with ADA Accessibility Guidelines for Buildings and Facilities (Appendix A to 36 CFR Part 1911). All such covers, plates and bridging shall be solid and coated with slip resistant materials so that the surface is at least as slip resistant as the surrounding walking surfaces. The perimeter of floor covers and plates shall be painted yellow or another contrasting color approved by the Railroad.

2.26 SIGNAGE

A. All signs installed under this project or required by the work, including but not limited to those used for traffic control, traffic detour, pedestrian detour signs, pedestrian information signs, and general warning signs, shall meet DOT requirements for size, reflective sheeting, lettering, etc. in accordance with the Manual of Uniform Traffic Control Devices (MUTCD).

B. The Contractor shall install and maintain safety signage for the duration of the on site work. Signage shall meet the requirements of 29 CFR 1910.145. Signage shall be installed along construction fencing, the outer boundaries of the project site, or at entrances to work areas. Signs shall be installed at intervals not to exceed one hundred lineal feet (100’). Signs shall be secured via mechanical fasteners in clearly visible locations.

C. A minimum of two (2) signs shall be required. One sign shall read “DANGER – CONSTRUCTION SITE – AUTHORIZED PERSONNEL ONLY”, or approved similar language. One sign shall read “CAUTION – PERSONNEL PROTECTIVE EQUIPMENT REQUIRED BEYOND THIS POINT”, or approved similar language. Signs shall be weatherproof and a minimum size of fourteen inches in length by ten inches in width (14” L x 10” W).

2.27 STORAGE AND OFFICE TRAILERS

A. Trailers shall be fully chocked and tied down to prevent overturning in high wind conditions. Storage and office trailers shall be equipped with auxiliary supports at each corner.
B. Office and storage trailers shall be electrically grounded.

C. Identification and emergency signage shall be installed on the exterior of office and storage trailers. Signs shall be constructed of weatherproof material, have a white background with black lettering, and shall be a minimum of five feet in length by three feet in width (5’ L x 3’ W). Signs shall identify the entity occupying the facility, the site address, and a telephone number to contact in the event of an emergency.

D. Office and storage trailers shall be equipped with the following Fire-Life Safety devices and equipment:

1) Office Trailers
   a. Fire Alarm Panel (FAP) equipped with a dialer programmed to call MTA Police, RTC’s at GCT, and the local fire department
   b. Smoke detectors (tied into the FAP)
   c. Pull stations (tied into the FAP) at all exit doors
   d. Horn strobe
   e. Fire extinguisher – 20 lb ABC type
   f. Battery back-up emergency exit lights
   g. Evacuation plan
   h. Fire suppression system (i.e. sprinkler), within GCT only
   i. Emergency contact list posted

2) Flammable & Combustible Storage
   a. Smoke detectors (tied into the FAP)
   b. Fire extinguisher – 20 lb ABC type
   c. Battery back-up emergency exit lights
   d. Fire suppression system (i.e. sprinkler), within GCT only
   e. Exterior strobe light

3) Dry Storage (Tools, Nonflammable, & Noncombustible Materials)
   a. Smoke detectors (tied into the FAP)
   b. Fire extinguisher – 20 lb ABC type
   c. Battery back-up emergency exit lights
   d. Fire suppression system (i.e. sprinkler), within GCT only
   e. Exterior strobe light

2.28 TEMPORARY CONSTRUCTION

A. All materials, whether to be used for temporary or permanent construction, shall be fire resistant, and when possible, incombustible materials shall be chosen over combustible
materials. Each temporary structure shall be constructed of fire resistant or fire retardant treated material. All materials (i.e. lumber, plywood) shall be fire retardant treated and contain the manufacturer’s stamps evidencing such. If the stamps are illegible or otherwise not provided, the material shall be immediately removed from the premises and replaced at no additional expense to Metro-North. On site application of fire retardants by the Contractor is prohibited, except when the material is not commercially available pretreated from the manufacturer.

B. Temporary construction barriers within occupied facilities used to segregate work areas from non-work areas shall be constructed as to provide a minimum of a two (2) hour fire rating. Should local codes be more stringent, the more stringent code shall apply.

C. Temporary construction shall be properly, sturdily and securely constructed as necessary to serve its intended purpose. Unless otherwise directed, temporary construction shall be designed and constructed to withstand a one hundred mile per hour (100 mph) wind load. Temporary construction shall be maintained throughout the work as not to pose a hazard to workers and the public. Temporary construction shall be properly braced, secured, and tied down as necessary to prevent displacement.

D. Temporary construction shall be dismantled and removed from the site by the Contractor when the device is no longer required and prior to demobilization.

E. The use of screw fasteners / bolts shall be the preferred method of joining in locations subject to wind stress (i.e. platforms).

F. Protection consisting of physical guards, covers, foam padding, etc. shall be provided on or around protruding objects (i.e. bolts). The use of double headed nails, or other fastening devices that create an unnecessary snag or impalement hazard, are prohibited from use unless properly guarded to eliminate the hazard.

2.29 PRODUCTS / MATERIALS CONTAINING HAZARDOUS AGENTS

A. When choosing between equally performing materials and/or products, the Contractor shall make every effort to use products that are less deleterious to worker health and those that are environmentally friendly. When equally performing products are available, waterborne products shall be chosen over solvent borne materials.

B. Care shall be taken when using products containing volatile organic compounds (VOC’s) such as aromatic solvents. In addition to implementing proper worker protection, the Contractor shall provide adequate ventilation and separation of areas where VOC containing products are being used.

C. All products and/or materials containing hazardous agents shall be submitted to the Engineer for review. Products and/or materials containing hazardous agents shall not be used or incorporated into the work until reviewed and accepted by the Engineer.

D. The Contractor shall submit product data sheets, material specifications, and Material Safety Data Sheets for review. Physical samples shall be submitted upon request. The submittals shall be received well in advance of the scheduled usage or incorporation of the product as to allow sufficient time for review.
2.30 **MATERIALS SUSPECT OF CONTAINING ASBESTOS, LEAD, PCB, MERCURY, OR OTHER TOXICS**

A. The Contractor shall not disturb any materials suspect of containing asbestos, lead, PCB, mercury, or other toxic materials without the prior approval of the Engineer. If during the work, the Contractor identifies or otherwise uncovers such materials, the Contractor shall immediately notify the Engineer. The Contractor shall clear personnel from the area and cease work in the location of the suspect material until an assessment by qualified persons can be performed.

2.31 **MATERIAL SAFETY DATA SHEETS**

A. The Contractor shall submit to the Engineer current Material Safety Data Sheets (MSDS) for all materials to be stored, incorporated into, or used in the Work. Hard copies of MSDS shall be on file and at the ready at all times at the jobsite. MSDS shall be organized and/or catalogued as to facilitate reference during an emergency condition. The MSDS shall be readily available whenever required, in a convenient location, in close proximity to where the materials are used on the project. The Contractor’s safety personnel and competent persons shall have ready access to the MSDS.

2.32 **MATERIAL HANDLING, LABELING, STORAGE, USE & DISPOSAL**

A. All materials brought onto the jobsite shall be labeled. Labeling shall include but is not limited to, identification of the material and manufacturer, caution labels, hazard labels, warning/danger labels, use and instruction labels, servicing instructions, medical attention labels.

B. When bulk material is transferred from large storage containers to smaller point of use containers, at a minimum, the point of use containers shall be identified as to contents.

C. Products shall not be transferred into containers that are not designed to carry the product, or that are unsuitable for, or incompatible with, the product. At no time shall food containers (i.e. water bottles) be used for product containers.

D. The Contractor shall ensure that each hazardous material is clearly marked or labeled in accordance with either the NFPA 704 Hazard Warning System (NFR Diamond) or the new color bar format (HMIG labels) as specified in the OSHA Federal Hazard Communication Standard (29 CFR 1900.1200). Each Hazardous material shall be stored in accordance with manufacturer’s recommendations, NFPA Standards, OSHA Standards, and all other storage provisions of this Contract.

E. Flammable materials shall be stored in approved containers, within flammable storage cabinets, and in accordance with NFPA guidelines.

F. The Contractor shall provide details on the handling, use, and storage of flammable solvents and solvent containing products, corrosive or acidic products, toxic chemicals, and other hazardous products.

2.33 **FIRST AID, MEDICAL TREATMENT & MEDICALLY TRAINED PERSONNEL**
A. The Contractor shall provide first aid equipment, supplies and competent administering of first aid as may be reasonably prescribed by good practice or as may be required by any law for the care of injured personnel.

B. The Contractor shall provide an individual(s) that is certified in administering First Aid, Cardio Pulmonary Resuscitation (CPR), and use of an Automatic External Defibrillator (AED).

C. The Contractor will not be allowed to commence Work until there is a sufficient supply of first aid equipment, medically trained personnel (i.e. first aid, CPR, and AED), and an operable Automatic External Defibrillator (AED) as determined by the Engineer, at all work locations for its employees and all Subcontractors. Any resultant delay will be charged to the Contractor.

D. First Aid stations of adequate size and contents shall be provided by the Contractor. Such shall be located within reasonable proximity to the work site. Large work sites may require multiple First Aid stations be established throughout the project. The Contractor shall conduct a hazard assessment to determine the appropriate contents and locations of the First Aid stations.

E. The Contractor shall provide, and make arrangements with local hospitals, medical clinics, or other medical facilities, for the medical treatment of persons that are injured or become ill during the work. Such facilities shall be clearly identified in the Contractor’s Emergency Action and Evacuation Plan and include the addresses, phone numbers, and maps with driving directions to said facilities.

2.34 PERSONAL PROTECTIVE EQUIPMENT (PPE)

A. The Contractor shall provide, make readily available, and ensure the use of all Personal Protective Equipment (PPE) required or recommended for the work. Personal protective equipment as required shall include, but not be only limited to, the appropriate/approved hard hats, safety shoes, gloves, goggles, eye/face shield protection, safety belts, harnesses, respirators, hearing protection, traffic safety vests, etc.

B. The Contractor shall have the responsibility for monitoring and enforcing compliance by all employees, including subcontractors, with these provisions regarding the wearing and proper use of personal protective equipment. No person will be allowed on Railroad property, or the job site if off Railroad property, without the necessary PPE, including proper work clothing and work shoes/boots. Any Contractor employee not in compliance with having the appropriate personal protective equipment (PPE) will be forbidden to be on all Metro-North premises. Any resultant delay will be charged to the Contractor.

C. The Contractor shall enforce Metro-North’s requirement for the use of the following Personal Protective Equipment. Unless otherwise directed, the following is the standard PPE that shall be worn at all times while within the construction work area, on or about the tracks, on or along the right-of-way, in train yards, or in maintenance facilities and shops.

1) Work Clothing – Work clothing shall be suitable for heavy construction work and at a minimum, consist of long pants and a short sleeve shirt (no tank tops or short trousers of any type). Long sleeve shirts shall be worn as necessary.
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2) Foot Protection – Work boots with safety toe and ankle coverage. Work boots shall be at least six inches (6”) high, and be completely laced or buckled. The shoe shall have definite heels that are no more than one inch (1”) in height.

3) Hard Hats - Hard hats shall be SEI Certified as meeting the ANSI Z89.1-2009 requirements for Type I Class E protection.

4) Eye Protection – meeting ANSI Z87.1

5) Safety Vests - Safety Vests shall be flame retardant, 360-degree reflective, high visibility orange, and 100% tear away. The contractor’s company name, logo, insignia or the word “Contractor” shall be permanently printed on or sewn into the vest.

6) Hand Protection (Gloves) – Unless the finger dexterity required by the task precludes the use of gloves, hand protection (i.e. work glove) shall be required. Gloves shall be appropriate for the type of work.

D. Hard hats and safety glasses are mandatory at all times within construction work sites, on or about tracks, on or along the Right-of-Way, in maintenance facilities, shops, or yards, or on or about roadways.

E. Safety vests are mandatory at all times when on or about tracks, on or along the Right-of-Way, in maintenance facilities, shops, or yards, or on or about roadways.

F. In addition to the previously listed PPE, the Contractor shall provide, and require use of, other PPE (i.e. hearing protection, face protection, respiratory protection) as required by safety and health standards, recommended by product Material Safety Data Sheets, or recognized as standard protection for the task being completed.

G. The Contractor will not be allowed to commence work until there is a sufficient supply, as determined by the Engineer, of PPE for its employees and its Subcontractors on the job site. Additionally, the Contractor shall maintain, at the job site, a sufficient supply of extra PPE that can be issued as a replacement should a worker’s PPE become damaged or otherwise unusable.

2.35 SANITATION

A. The Contractor shall provide sanitary facilities for all employees on this project. The number of facilities provided shall be commensurate with the size of the work force. Facilities shall be located within a reasonable proximity to the work site. Facilities may have to be mobile or sited at multiple locations for projects involving transient operations or work spread over multiple sites. Locations of facilities shall be reviewed with the Engineer prior to placement. Facilities shall be kept in a clean and sanitary condition, and properly screened from public observation to the satisfaction of the Engineer. Same shall be removed when so directed.

2.36 HOUSEKEEPING

A. The Contractor shall provide for the regular housekeeping of all areas within the project limits. The Contractor is responsible for the regular cleaning of the site to maintain its appearance and safety of the workers and the public throughout the construction. This
includes removal of all wastes resulting from the construction, rubbish, and debris whether it was generated by the contractor or not.

B. The removal of general refuse such as food wrappers, drinking containers, newspapers, etc. shall be included in the housekeeping of the site.

C. The Contractor shall provide proper receptacles for waste disposal, whether they be roll-off containers for bulk disposal of construction wastes or smaller waste cans/barrels for common refuse.

D. Combustible debris shall be removed regularly and as necessary to prevent accumulations that may pose a fire hazard.

E. Specific care shall be taken to prevent impalement/puncture hazards created by lumber with protruding nails/screws. Such shall be removed or hammered flat.

F. Work areas shall be precleaned of existing debris that may pose hazards prior to the start of construction work (i.e. organic debris such as leaves and newspapers that may cover broken bottles, sharps, etc. under platforms).

G. Equipment and materials shall be stored in a neat and orderly fashion and properly secured when not in use.

H. Walkways and walking surfaces shall be continuously monitored for objects and materials that may pose tripping and slipping hazards and shall be maintained free and clear of the same.

I. Employees performing housekeeping shall be provided proper personal protective equipment.

2.37 PROTECTION OF UNDERGROUND FACILITIES & UTILITY IDENTIFICATION

A. Excavation shall be conducted in accordance with 16 NYCRR Part 753. In conformance with 16 NYCRR Part 753, the Contractor must notify the local One Call Center to allow member agencies to mark locations of underground utilities prior to commencing excavation. The Contractor shall take all necessary precautions to identify, locate and avoid contact with existing public utilities.

B. The Railroad maintains its own network of power, phone, signal, and gas utilities. In addition to public utilities, the Contractor shall provide for the location of Metro-North’s utilities in accordance with Metro-North’s Utility Location Protocol. The Contractor shall notify the Engineer a minimum of one (1) week in advance prior to excavating to allow for the identification of the Railroad’s utilities.

C. Should the Contractor uncover, unearth, or otherwise identify a utility that was not previously identified, work impacting the utility shall cease until the utility is identified.

D. Existing utilities shall be taken out of service (i.e. deenergized, depressurized) and tested to verify the same, prior to being spliced into, demolished, removed, or otherwise disturbed.

E. The Contractor shall implement a means of positively identifying existing utilities to be disturbed during the work. A means of identifying the utility as “in service” or “out of
service” shall be implemented and made known to project personnel.

F. All new buried utilities shall be properly identified with warning tapes specifically designed and manufactured for subgrade utility identification. Warning tapes shall run the entire length of the utility, and shall be located above the buried utility.

1) The Contractor shall install a warning tape located a minimum of twelve inches (12”) inches (300 millimeters) above all conduits, wires, cables, utility pipes, drainage pipes, underdrains, or other facility, unless the excavation’s depth, other underground facilities, or other engineering considerations make this minimum separation unfeasible. The warning tape shall be of durable impervious material, designed to withstand extended underground exposure without material deterioration or fading of color. The tape shall be of the color assigned to the type of facility for surface markings and shall be durably imprinted with an appropriate warning message. The tape shall also comply with the specific requirements of the utility that owns the facility.

2) All tapes, unless otherwise directed by the specific utility, shall be detectable to a depth of at least three feet (3’) with a commercial radio-type metal locator.

3) Assigned colors are:
   a. Green—Storm and sanitary sewers and drainage systems, including force mains and other non-hazardous materials
   b. Blue—Water
   c. Orange—Communication lines or cables, including, but not limited to, those used in, or in connection with, telephone, telegraph, fire signals, cable television, civil defense, data systems, electronic controls and other instrumentation
   d. Red—Electrical power lines, electrical power conduits and other electrical power facilities, traffic signals and appurtenances and illumination facilities
   e. Yellow—Gas, oil petroleum products, steam, compressed air, compressed gases and all other hazardous material except water
   f. Brown—Other
   g. Purple—Radioactive materials

2.38 EXCAVATION & TRENCHING

A. Excavation shall be conducted in accordance with New York State Code Rule 753 and Section 2.37.

B. Excavations shall be benched and/or sloped as necessary to protect against cave-in or collapse. When the site is not conducive to sloping or benching, appropriate shoring methods shall be implemented.

C. The Contractor shall provide an engineered shoring design to the Engineer. Shoring for excavations within proximity to the tracks shall be designed to meet Cooper E80 loading.

D. Excavations, including trenches, remaining open or inactive for more than one work shift
shall be protected. The perimeters of excavations, including trenches, shall be surrounded by high visibility temporary construction fencing. The fencing shall be maintained as necessary throughout the work. Excavations, trenches, and holes within pedestrian or vehicular travel ways that must remain accessible during the work shall be protected by bridges or cover plates. Cover plates shall be secured against displacement. (See Section 2.25 Protection of the Public for requirements).

E. Excavations six feet (6’) or greater in depth with slopes steeper than 45 degrees shall also be provided with fall protection.

2.39 BLASTING

A. Prior to blasting all necessary precautions shall be exercised by the Contractor as required by the applicable ordinances, rules and regulations of the authority having jurisdiction. The Contractor shall obtain all necessary permits from the Fire Department of the City of New York for blasting within New York City.

2.40 ELECTRICAL

A. In accordance with 29 CFR 1926.417, the Contractor shall implement Lockout / Tagout procedures.

B. Temporary electrical power and lighting shall be installed in accordance with latest National Electric Code and 29 CFR 1926 Subpart K. Temporary electrical apparatus shall be installed as to not create a hazard to the work force or general public.

C. All temporary electrical power and lighting shall be equipped with Ground Fault Circuit Interrupter (GFCI) protection. All other power sources, including portable generators (regardless of wattage), as well as extension cords plugged into permanent power sources, shall be protected by GFCI at the source.

D. All splices shall be contained within NEMA approved junction boxes.

E. Extension cords shall be inspected regularly for damage (i.e. compromised insulation, missing ground prongs). Damaged cords shall be immediately removed from service and tagged as such or otherwise rendered unusable.

F. Assured grounding shall not be allowed as a means of electrical protection.

G. Energized electrical apparatus shall be adequately segregated, isolated, shielded, or otherwise protected.

2.41 POWDER ACTUATED TOOLS

A. All operators of powder-actuated tools (i.e. Hilti, Ramset) shall be trained in their use by the tool manufacturer. Certificates or other evidence of such training shall be maintained in the field office.

B. The main store of power loads shall be kept in a locked metal ammunition box.

C. The box must bear a permanent sign having the words “DANGER AMMUNITION” in two inch (2”) wide letters on a red background.
D. At least one (1) 20 lb portable fire extinguisher shall be provided in the storage area

E. The following applies to work within the New York City limits.
   1) The Contractor shall obtain a permit from FDNY to store and use power loads at construction sites.
   2) Power loads shall be stored in accordance with FDNY requirements
   3) Any employee storing, handling, and using power loads must hold a valid E-21 Certificate of Fitness.

2.42 CRANE OPERATION

A. The Contractor shall submit an Erection & Rigging Plan for all construction requiring the rigging and lifting of materials and/or equipment, including but not limited to, hoisting and setting of steel members, prefabricated materials, structural panels, and precast concrete. The plan shall be of sufficient detail and include drawings, calculations, product data sheets/specifications, and identification of components.

B. Cranes shall meet the requirements of the most current ANSI B-30.5 Standard.

C. When a crane is operated in such a location that any part of the crane or its load in any position of boom or swing may come within ten (10) feet of a live power line or contact rail then:
   1) The power line or contact rail shall be de-energized,
   2) The power line or contact rail shall be insulated or isolated,
   3) The crane shall be grounded with Number 2 AWG or larger single conductor, 600 volt covering, and resistance of 25 ohms or less, and
   4) The power line and contact rail shall be protected from damage in an approved manner.

D. The Contractor shall notify the Engineer and transmit copies of the following documentation seven (7) days prior to bringing a crane on site:
   1) Current Certification of Inspection,
   2) License of crane operator,
   3) Crane Manufacturer’s Load Chart for the Model and configuration of the crane, and
   4) Certification (approved by P.E.) of ground support and submittal of grillage and design of ground support.

E. Contractor shall not hoist over a building without notification and permission of the building owner.

F. Modifications or additions, which affect the safe operation of a crane, shall not be made without the manufacturer’s written permission.

G. All cranes assembled at the Site shall be inspected and tested by the crane supplier or qualified personnel with proof of inspection and testing transmitted to the Engineer. All lifting devices shall be engineered and tested in the configured working load.
Contractor shall permanently attach or affix, clearly and visibly, the capacity chart of the lifting device.

H. Any welding performed on crane components shall be performed in accordance with the American Welding Society standards or the manufacturer’s written specification.

2.43  ERECTION & RIGGING

A. The Contractor shall submit an Erection & Rigging Plan for all construction requiring the rigging and lifting of materials and/or equipment, including but not limited to, hoisting and setting of steel members, prefabricated materials, structural panels, and precast concrete. The plan shall be of sufficient detail and include drawings, calculations, product data sheets/specifications, and identification of components.

B. All rigging shall meet the requirements of the most current ANSI B30.9 Standard.

C. Only qualified riggers shall be employed.

D. Contractor’s wire rope, chains, and fiber slings shall have their manufacturer’s safe working load identified and attached to each item. The Contractor shall have each sling inspected and certified as prescribed by law and regulations. Slings shall be inspected by a competent person prior to each use. Defective slings shall be taken out of service. Slings exhibiting visible damage, including but not limited to cuts, abrasion, chemical exposure, shall be deemed defective and removed from service. Safety latches shall be used.

E. Only Alloy lifting chains of Grade 8 or better shall be used for lifting purposes.

2.44  WELDING AND THERMAL CUTTING

A. Welding and cutting equipment and operations shall meet the requirements of the most current ANSI Z49.1 Standard, and the requirements of this section. Welders shall retain certifications from the American Welding Society (AWS) and if required, the local entity having jurisdiction.

B. Gas welding and cutting equipment shall be listed by Underwriters Laboratories, (UL) or by Factory Mutual Laboratories, (FM).

C. Prior to any welding, cutting or burning, the Contractor shall obtain a Hot Work Permit from the Metro-North Office of Fire Prevention. See Section 2.46 Fire Protection & Prevention for requirements.

D. In accordance with 1926.354, prior to thermal cutting or welding, existing coatings shall be removed.

E. The Contractor shall transmit a list of certified operators who will be performing cutting and welding, with evidence of their training and certification. Welders and torch operators within New York City shall retain Fire Department of New York (FDNY) Certificates of Fitness.

F. Welding apparatus and equipment shall be inspected daily, prior to use. Defective apparatus and equipment shall not be used and shall be removed from service until repaired or replaced.
G. Prior to the start of work, flammable and combustible materials shall be removed from the area of the hot work. When such materials cannot be removed, or are otherwise fixed, they shall be isolated from heat, flame, sparks, and molten metal by fire retardant materials.

H. Whenever the operator leaves the work area, the cylinder valves shall be closed. Torch valves shall be checked for leaks at the start of each shift. Only friction lighters or other approved devices shall be used to light torches.

I. Splices or repaired insulation on arc welding cables shall not be permitted within ten feet (10’) of the electrode holder. Cables shall be positioned so as not to interfere or create obstructions on walkways, scaffolds, stairs or ladders. Splices shall be equal to or greater than the original insulation on the cable.

J. Portable welding screens or shields shall be used to protect other workers and/or the public in the immediate area.

K. Local exhaust and/or mechanical ventilation shall be installed and maintained as necessary to prevent accumulation of fumes within the work area and contamination of adjacent occupied areas.

2.45 COMPRESSED GAS CYLINDERS

A. All compressed gas cylinders shall be stored, used, and handled in accordance with the Compressed Gas Association guidelines, NFPA Standards, the requirements of the Metro-North Office of Fire Prevention, and the requirements of this section. Prior to on site storage, the Contractor shall inform the Metro-North Office of Fire Prevention of their intent to store compressed gas on site.

B. Each compressed gas cylinder shall be considered to be either in transport, storage, or use. The following conditions apply:

1) Gas cylinders shall be clearly identified as to contents.

2) Compressed gas cylinders shall be transported and used in portable welding carts with the cylinders securely chained or clamped to the cart. An operable dry chemical fire extinguisher, rated not less than ten pounds (10 lbs) of chemical shall be mounted on each portable welding cart in use.

3) Manifolds shall be removed when the cylinders are not in use.

4) Valve protector caps shall be screwed on in place except when the cylinders are in use.

5) Compressed gas cylinders shall be protected from sources of heat.

6) Cylinders shall be secured upright on a firm base and against toppling via a chain, steel cable, or non-combustible material that is capable of withstanding fire/open flame without burn through.

7) No more than five (5) cylinders of each gas type shall be stored on site. All gas cylinders not in actual use, or proposed for immediate use, shall be removed from the site and stored off site. Excessive or unreasonable storage of cylinders on the site is prohibited. Improperly stored cylinders shall be immediately removed from the work area.
area. Empty gas cylinders shall be removed prior to or at the same time replacement cylinders are brought on site.

8) Compressed gas cylinders in storage (full or empty) shall be stored in cylinder cages or sheds constructed of noncombustible materials specifically designed for such purpose. Storage areas shall be well ventilated and without electric lights or fixtures and shall be located as far from other buildings as is practicable.

9) The cylinder cages/sheds shall be secured (ie. padlocked) as to prevent theft or tampering with the cylinders.

10) Storage areas shall be labeled.

11) Different types of gases shall not be stored together, or without proper separation, except when in use and when such proximity is required.

### 2.46 FIRE PROTECTION AND PREVENTION

A. The Contractor is responsible for providing all labor, material, and equipment for fire protection during the work including trained and qualified fire watches, fire extinguishing equipment, shields, screens, and protective blankets. The Contractor shall maintain fire protection equipment throughout the project.

B. All materials, whether to be used for temporary or permanent construction, shall be fire resistant, and when possible, non-combustible materials shall be chosen over combustible materials. Each temporary structure shall be constructed of fire resistant or fire retardant treated material. All materials (i.e. lumber, plywood) shall be fire retardant treated and contain the manufacturer’s stamps evidencing such. If the stamps are illegible or otherwise not provided, the material shall be immediately removed from the premises and replaced at no additional expense to Metro-North. On site application of fire retardants by the Contractor is prohibited, except when the material is not commercially available pretreated from the manufacturer.

C. Temporary barriers within occupied facilities used to segregate work areas from non-work areas shall be constructed as to provide a two (2) hour fire rating.

D. Combustible wastes/debris shall be removed on a regular basis as to not pose a fire hazard. The frequency for removal shall be based upon the rate of accumulation, but at no time shall exceed weekly removal from the premises.

E. The on site storage of flammable materials is prohibited without the prior authorization of the Metro-North Office of Fire Prevention. Flammable materials shall be stored in approved containers in accordance with NFPA guidelines and requirements of the local fire authority. Flammable Liquids shall be stored in Factory Mutual (FM) approved safety cans equipped with self-closing lids and flame arrestors. Flammable or combustible liquids shall be stored within approved containers within closed, approved flammable storage cabinets. Flammable materials that will be stored on site in exterior locations shall be stored in approved containers, within flammable storage cabinets. Flammable materials to be stored within facilities shall be stored in approved containers, within flammable storage cabinets, located in areas equipped with fire suppression.

F. Smoking is prohibited within all Metro-North facilities, including construction work areas.
G. Open flames and smoking shall be prohibited within one hundred feet (100’) of explosive or flammable materials.

H. The Contractor shall retain a Hot Work Permit, available through the Metro-North Office of Fire Prevention, for all work that generates heat, sparks, molten metal/slag, or requires an open flame. Such work includes but is not limited to, grinding, brazing, soldering/sweating, gas and electric welding, cadwelding, torch cutting/burning, and temporary heat.

I. The Contractor shall provide appropriately trained personnel to act as Fire Guards or Fire Watches. Fire Guards/Watches within New York City shall retain Fire Department of New York (FDNY) Certificates of Fitness. Fire Watches shall be familiar with hazards that exist in the work area, and be trained in the operation of each type of fire extinguisher on the work site. Fire Watches shall remain at the site of the hot work for the duration of the work and a minimum of thirty (30) minutes after completion of the hot work. The Contractor shall transmit a list of certified fire watch personnel, and evidence of their training and certification.

J. Fire extinguishers rated at 20 lbs ABC or larger shall be in the immediate area whenever welding or cutting is being carried out. In addition, water shall be used to pre-dampen combustible materials prior to the start of the hot work. If available, a hose connected to a suitable water supply shall be maintained at the ready adjacent to the area of hot work. In the absence of a water supply, a pressurized water fire extinguisher shall be provided.

K. In addition to notifying the Engineer, the written permission of the water utility shall be obtained before shutting off water servicing a fire hydrant.

L. The Contractor shall not block roadways, hydrants, post indicator valves, or access to fire fighting equipment without the prior notification and approval of the Metro-North Office of Fire Prevention, the local agency having jurisdiction over fire prevention/protection, and the Engineer.

M. Work stoppage and shutdown of equipment shall be mandatory upon alarm of fire. Personnel shall report to the designated assembly area(s).

2.47 SCAFFOLDS

A. Scaffolds to be utilized during the work shall comply with the requirements of 1926 Subpart L and/or the local governing body having jurisdiction (i.e. NYCDOB); the more stringent requirements shall apply. The Contractor shall be responsible for retaining all permits and licenses and associated fees for scaffold erection and use.

B. Scaffolds shall be designed and constructed in accordance with the intended use. The Contractor shall provide a submittal for all scaffolds to be constructed on site. Site constructed scaffolds shall be designed, signed and stamped by a professional engineer. Scaffolds shall be constructed in accordance with the design submittal. The submittal shall include the design parameters such as duty rating, live and dead loads, and wind load, plan, elevation, and section views of the system, identification of components, and foundation, baseplate, and anchoring systems. Modifications required due to field conditions shall be reviewed and approved by the designer.
C. Scaffolds shall be equipped with protective devices suitable for the type of work being performed. This may include shields, barriers, mesh, netting, etc. as to contain dust, debris, and provide protection from falling objects. The design of the scaffold shall take into account the protection of non-project personnel and property, including but not limited to, the public, customers, railroad employees, adjacent properties and structures, and vehicular and railroad equipment.

D. Scaffolds erected over and/or adjacent to the railroad shall be constructed as to provide protection of railroad equipment operating below and/or adjacent to the scaffold. Unless otherwise directed or local requirements are more stringent, scaffolds erected over and/or adjacent to the railroad shall be constructed as to withstand a one hundred mile per hour (100 mph) wind load.

E. In accordance with 29 CFR 1926.454(a), persons erecting and utilizing scaffolds shall have completed training in the subject area. Documentation evidencing such training shall be submitted to the Engineer.

F. Persons erecting and/or using scaffolds within New York City shall have completed the applicable Department of Buildings training. Documentation evidencing such training shall be submitted to the Engineer.

2.48 FALL PROTECTION

A. The Contractor shall provide fall protection for all work exposing persons to an unprotected fall greater than six feet (6'), including steel erection. Excavations six feet (6') or greater in depth with slopes steeper than forty-five degrees (45°) shall also be provided with fall protection. In the event that providing this protection is not feasible or creates a greater hazard, the Railroad may at its discretion allow for a task specific variance from this policy. Requests for a task specific variance shall be transmitted in writing with justification for relief. The Railroad’s acceptance must be received in writing prior to starting the specific task under the variance.

B. The Contractor shall provide a site specific Fall Protection Plan. The plan shall identify the method(s) of fall protection to be implemented at the site and shall be congruent with the nature of the work and anticipated usage. The Contractor shall provide a submittal including product data/catalogue cut sheets, engineering calculations, a procedure detailing the installation, and a procedure for its usage. Personal fall arrest systems (i.e. anchorages, horizontal and vertical lifelines) shall be designed and stamped by a professional engineer.

C. For work on railroad bridges the fall protection requirements of 49 CFR 214.101 shall be followed.

D. In accordance with 29 CFR 1926.503(a), persons exposed to fall hazards shall have completed training in the subject area. Documentation evidencing such training shall be submitted to the Engineer.

2.49 CONFINED OR ENCLOSED SPACES

A. The Contractor shall adhere to all requirements for entering a Confined Space as listed in

B. The Contractor shall prepare a Confined Space Entry Program identifying the confined spaces to be entered and procedures to be followed. The program shall be submitted to the Engineer for review prior to engaging in confined space entry.

C. Persons entering confined spaces (i.e. entrants) and/or persons monitoring confined space entry (i.e. attendants), shall be trained in accordance with the OSHA standard. Documentation evidencing such training shall be provided to the Engineer prior to engaging in confined space entry.

2.50  MOTOR VEHICLES, TRACK VEHICLES / HI-RAIL EQUIPMENT & CONSTRUCTION EQUIPMENT

A. Company identification shall be clearly displayed on each vehicle.

B. Vehicles shall not block access for emergency equipment.

C. Pedestrians shall have the right of way at all times. The speed limit on Railroad property is 5 MPH unless otherwise posted.

D. Vehicle and equipment operators shall inspect and test essential controls, safety equipment, and safety devices before placing the vehicle or equipment in use. The Contractor shall conduct a daily safety inspection of motor vehicles and construction equipment. The daily safety inspection shall be documented via a checklist or other suitable form. Equipment, whether owned, leased, or rented, shall be removed from service if unsafe.

E. Modification of equipment affecting its safety shall not be performed unless approved in writing by the manufacturer.

F. All motor vehicle and construction equipment operators shall be trained for the type of vehicle or equipment they operate. Upon request, evidence of such training shall be provided to the Engineer.

G. Vehicles shall be equipped with backup lights and a reverse signal alarm. The alarm shall produce a 0.2 to 0.5 second audible warning within the initial three feet of backward movement of the vehicle on which it is mounted and at regular intervals thereafter of not more than three seconds, throughout the backward movement. The alarm shall automatically cut out when backward movement ceases. Sound intensity shall range from 90 to 100 dbs. at a distance of five feet from the alarm. Actuation shall be automatic by direct connection to any part of the equipment that moves or acts in a manner distinctive only of rearward movement of the vehicle, with no manual controls between the source of actuation and the alarm.

H. Glazing within cabs of construction equipment shall be intact and free from cracks or other defects. Equipment with broken glazing shall be removed from service until repaired. Glass shall be cleaned as necessary to maintain operator’s visibility.

I. Only properly identified contactor work vehicles, and equipment that are necessary to directly support the construction activities shall be permitted adjacent to the actual
construction operations.

J. Construction employees shall park personal vehicles only in designated areas of the work site and shall enter the site only at points specifically designated by the Engineer. Personal vehicles will not be permitted adjacent to, or allowed to pass through, the areas of construction without Engineer’s special permission and proper identification.

K. High-Rail equipment (equipment designed for both highway and railroad use) to be used on Metro-North Railroad shall be inspected prior to use. The Contractor shall conduct its own inspection of the vehicle prior to mobilizing it to the site. The Contractor shall notify the Engineer a minimum of two (2) weeks prior to its scheduled use. Prior to use, the Contractor shall coordinate inspection of the high-rail vehicle at the North White Plains Maintenance Facility by the Metro-North Railroad Maintenance of Way Department. The equipment shall not be used on track until successful completion of said inspection.

L. High-Rail equipment operators shall be trained in the operation of the vehicle. High-Rail equipment shall be operated in accordance with Metro-North Railroad’s Operating Rules and General Safety Instruction applicable to operation of track equipment. A Metro-North Railroad Pilot / Conductor Flagman must be present at all times during the movement and operation of High-Rail equipment.

**PART 3 - MATERIAL**

Not Used

**PART 4 - EXECUTION**

Not Used

**PART 5 - MEASUREMENT AND PAYMENT**

5.01 **MEASUREMENT**

No measurement will be made for this work.

5.02 **PAYMENT**

No separate payment will be made for the work described in this specification. The costs associated with this work shall be included in the lump sum.

END OF SECTION 01 33 60
APPENDIX B

ARTICLE 1.00 PROTECTION OF UNDERGROUND METRO-NORTH RAILROAD FACILITIES
ARTICLE 1.00 PROTECTION OF UNDERGROUND METRO-NORTH RAILROAD FACILITIES

A. GENERAL

Metro-North maintains its own network of electrical, communications, gas, oil, sewer, and water facilities. The purpose of the procedures herein is to protect and prevent damage to private underground facilities owned by Metro-North Railroad. While these procedures have been developed in accordance with the requirements established by 16 NYCRR Part 753 and Dig Safely New York for public and private underground facilities, the Contractor is hereby notified that Metro-North Railroad’s requirements for protection of its facilities are more restrictive than that of 16 NYCRR Part 753.

The Contractor shall take all necessary precautions to identify, locate, avoid contact with, and protect existing public, private, and Metro-North Railroad facilities. In addition to the requirements of 16 NYCRR Part 753, the Contractor shall provide for the location of Metro-North’s facilities in accordance with the requirements herein.

B. DUTY TO PROVIDE NOTIFICATION

NOTE: The requirements herein do not supersede, nor lessen the responsibilities of the Contractor to locate public and private facilities in accordance with the requirements of the 16 NYCRR Part 753, commonly cited as Industrial Code 53 or Code Rule 53, and Section 16-345 of the Regulations of the Department of Public Utility Control for Connecticut.

Excavation shall be conducted in accordance with 16 NYCRR Part 753 for work in New York State, 16-345 for work in Connecticut, and the requirements specified herein. The definition of “Excavation” shall be the same as described in Section 753–1.2 Definitions of 16 NYCRR Part 753. In conformance with previously cited regulations, the Contractor must notify the local One Call Center to allow member agencies to mark locations of underground facilities prior to commencing excavation. Depending on the work location, the Contractor shall contact the appropriate One Call Center.

In addition to contacting the appropriate One Call Center, the Contractor shall request the identification of:

a) Utilities owned and operated by Metro-North Railroad in accordance with the following process, and

b) Identification of private utilities along or within the Metro-North Right-of-Way via private utility locate service companies

<table>
<thead>
<tr>
<th>State</th>
<th>Name</th>
<th>Telephone</th>
</tr>
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<tbody>
<tr>
<td>New York</td>
<td>Dig Safely New York</td>
<td>(800) 962-7962</td>
</tr>
<tr>
<td></td>
<td>New York City &amp; Long Island (Five Boroughs of New York City and Nassau and Suffolk Counties of Long Island)</td>
<td>(800) 272-4480</td>
</tr>
<tr>
<td></td>
<td>Call Before You Dig</td>
<td>(800) 922-4455</td>
</tr>
</tbody>
</table>

C. TIMING OF NOTIFICATION

The Contractor shall identify the areas in which they intend to work on the Four Week Look Ahead Schedule presented to Metro-North Railroad during the Bi-Weekly Progress Meeting and/or Weekly Coordination Meeting.

The Contractor shall complete and submit a Metro-North Railroad Utility Location Request (see request form at end of this section) identifying locations where excavation or other types of ground disturbance
are required. Said request shall be submitted to the Engineer a minimum of three (3) weeks prior to the start date of excavation.

D. IDENTIFICATION / MARK-OUT PROCESS

1. The Contractor shall physically demarcate / mark out all locations to be disturbed with white paint, flags, or stakes in accordance with the Common Ground Alliance Best Practices prior to submittal of the Utility Location Request. Should the size of the work area preclude the ability to mark the entire excavation area, the Contractor shall utilize flags or stakes to demarcate the limits of the work and paint arrows between the limits. Alternatively, if available, and agreeable to Metro-North Railroad, the Contractor may identify locations to be disturbed on project drawings or plans. Copies of the same shall be attached to and submitted with the Metro-North Railroad Utility Location Request.

2. The Engineer will submit the Metro-North Railroad Utility Location Request completed by the Contractor to the Metro-North Railroad Force Account Manager assigned to the project.

3. The Force Account Manager will distribute the Metro-North Railroad Utility Location Request to the appropriate Metro-North Railroad Departments responsible for conducting utility identification. The Metro-North Railroad Departments included in the utility identification process are Communications and Signal, Power, and Structures.

4. The Metro-North Departments shall conduct the identification; locating and marking the buried utilities, within (2) weeks of receiving the request from the Force Account Manager. Utilities shall be field identified in accordance with the Common Ground Alliance Best Practices utilizing the standard colors for locating utilities. (See Uniform Colors at the end of this section).

5. Upon completion of field identification, a Metro-North Railroad Utility Location Ticket (see ticket at end of this section) shall be completed by each of the responsible departments; Power, Communications, Signal, and Structures, and returned to the Force Account Manager.

6. The Force Account Manager shall review the Metro-North Railroad Utility Location Tickets to verify that they have been satisfactorily completed by each of the appropriate departments and forward them to the Engineer, or other Metro-North Railroad personnel responsible for managing the Contractor activities.

7. The Engineer shall provide copies of the completed Metro-North Railroad Utility Location Tickets to the Contractor and retain the originals for the project files. The Contractor shall review the Utility Location Tickets and compare it against the Utility Location Request form to ensure it has been satisfactorily completed. The Contractor shall review available As Built drawings for the work location(s) and compare the information to the field identified utilities. If a discrepancy exists between what is shown on the As Built drawings and the utilities physically marked out in the field, the Contractor shall immediately notify the Engineer.

E. DOCUMENTATION & PRESERVATION OF MARKINGS

Upon completion of the utility mark-out and receipt of the Metro-North Railroad Utility Location Tickets, but prior to disturbance, the Contractor shall prepare and provide a photograph or video record of the utility mark-out. The record should include a description of the general location (i.e. state, county, town/village), milepost, control point, track number and include visual landmarks to assist in identification.

It is the responsibility of the Contractor to maintain and preserve the markings provided for the duration of the work. This includes transferring mark outs outside of the work area using offsets. For work within the rail traffic envelope, it is recommended that the contractor transfer markings, or provide offsets on the side of the running rail. If some of the markings may be destroyed during the course of your work, or if the excavation will be taking place over a long period of time, take measurements and photos first. Should the Contractor be negligent in maintaining the markings, and additional work is required to re-identify utilities, the Contractor shall be responsible for the costs associated with providing the extra location services and such shall be deducted from the next progress payment.
F. VERIFICATION OF UNDERGROUND FACILITIES VIA TEST PITTING / POT HOLEING

1. The Contractor shall not begin disturbance until having, 1) received the completed Metro-North Railroad Utility Location Tickets, 2) completed video or photo documentation of the mark out, and 3) transferred the marks as necessary to preserve them throughout the course of the work.

2. Where an underground facility has been staked, marked or otherwise identified and the tolerance zone overlaps with any part of the work area, or the projected line of a bore/directional drill intersects the tolerance zone, the excavator shall verify the precise location, type, size, direction of run and depth of such underground facility or its encasement. Verification shall be completed before the excavation or demolition is commenced or shall be performed as the work progresses.

3. The verification of underground facilities shall be accomplished by exposing the underground facility or its encasement to view by means of hand dug test pits at one or more points where the work area and tolerance zone overlap, or more points as designated by Metro-North Railroad. The Contractor shall excavate Test Pits / Pot Holes to identify the actual locations of the buried utilities/facilities. Unless otherwise identified in the project documents, the Contractor shall assume the following:
   a) one (1) test pit will be required every twenty-five feet (25’) if proposed excavation is within five feet (5’) of an existing utility,
   b) one (1) test pit will be required wherever an excavation is crossing an existing utility,
   c) within interlockings, one (1) test pit will be required every fifty feet (50’) between opposing home signals.
   d) test pits will be required adjacent to each substation, railroad facility, and abandoned utility, or appurtenances thereto, to determine location and direction of buried utilities emanating from or leaving said facilities

4. The Contractor is urged to consider use of soft excavation methods (i.e. vacuum excavation).

5. Powered or mechanized equipment may be used within the tolerance zone for removal of pavement or masonry, but only to the depth of such pavement or masonry. Only when agreed to in writing by Metro-North Railroad, may powered equipment be used within the tolerance zone below the depth of pavement or masonry prior to the verification of the location of facilities.

6. Metro-North Railroad, or their agents and Contractors working under their direct supervision, may use powered equipment to locate their own facilities within the tolerance zone.

7. Unless otherwise identified, the minimum size of Test Pits shall be one (1) cubic yard. Should the Contractor not be able to locate the marked utility within the Test Pit area, the Contractor shall enlarge the test pit excavation towards the direction the utility is most likely located, or as directed by the Engineer. Once the test pits confirm utility locations, the Contractor will be released to excavate in that area.

8. Measurement and Payment: Test Pits shall be paid by the cubic yard.

9. Existing utilities shall be taken out of service (i.e. de-energized, depressurized) and tested to verify the same, prior to being spliced into, demolished, removed, or otherwise disturbed. The Contractor shall implement a means of positively identifying existing utilities to be disturbed during the work. A means of identifying the utility as “in service” or “out of service” shall be implemented and made known to project personnel.

G. UNVERIFIABLE UNDERGROUND FACILITIES

Should the Contractor be unable to verify the location of a facility, after diligent search at a reasonable depth, excavation shall not be allowed to proceed and the Contractor shall notify the Engineer. The Engineer will contact the Force Account Manager and inform them of the inability to locate the previously
marked utility. The Force Account Manager will notify the representative of the appropriate Metro-North Department having marked the utility. Within (24) twenty-four hours of notification, this department shall return to the area and attempt to further identify the location of the utility, or use other means mutually agreeable to the Contractor and Metro-North Railroad (i.e. continue to hand excavate until utility is located). This department will identify if and where any additional test pits are necessary to locate/expose the utility, or if problem areas exist that could restrict the Contractor’s excavation.

H. COMMENCEMENT OF EXCAVATION OR DEMOLITION

1. The excavator may proceed with excavation or demolition on the stated commencement date if, prior thereto, he or she has received completed Metro-North Railroad Utility Location Tickets from each Metro-North Department identifying that:
   a. No underground facilities were located in or within fifteen feet (15’) of the work area; or
   b. That any underground facility located in or within fifteen feet (15’) of the work area has been marked

2. The excavator may proceed with the excavation or demolition prior to the stated date of commencement only if he or she has received notification from each department that no underground facilities are located in or within fifteen feet (15’) of the work area.

3. The excavator shall not commence the excavation or demolition on the stated commencement date if he or she has been notified by Metro-North Railroad that the marking of an underground facility located in or within fifteen feet (15’) of the proposed work area will not be completed on the stated commencement date. In such case, Metro-North Railroad shall promptly report such to the excavator and inform of a prompt and practicable completion date, which in no case shall be more than two (2) working days after the excavator’s stated commencement date, unless a longer period is agreed to by both parties.

I. RESPONSIBILITIES OF THE EXCAVATOR

1. Every excavator shall be familiar with the provisions of this procedure and 16 NYCRR Part 753, especially those relating to size and depth indications, color coding, center line or offset staking or marking and the location of underground facilities by designations other than staking or marking.

2. Whenever the excavator determines that a review of the staking, marking or other designation is necessary or that additional information is required, he or she shall notify the Engineer.

3. Starting on the stated commencement date, the excavator shall be responsible for protecting and preserving the staking, marking or other designation until no longer required for proper and safe excavation or demolition work at or near the underground facility.

4. Whenever mechanized excavation equipment is utilized within five feet (5’) of a facility, a ground spotter shall be provided to oversee the excavation.

J. POWERED EXCAVATION LIMITATIONS

The Contractor shall not proceed with excavation until the locations of the utilities shown on the as-built drawings and those marked in the field are confirmed through manual excavation of test pits. Metro-North Railroad and the Contractor must concur that the procedures herein were followed before production excavation begins.

After verifying the location of an underground facility, the Contractor may utilize powered excavation equipment as long as it does not endanger the facility. At no time shall the Contractor employ powered or mechanical excavating equipment closer than twelve inches (12”) in any direction from the staked, marked or otherwise designated or known outside diameter or perimeter of such facility or its protective
coating unless agreed to in writing by Metro-North Railroad. Upon request, any such written agreement shall be furnished to the Contractor by Metro-North Railroad.

K. TOLERANCE ZONE

1. Before mechanized digging equipment is used in a Tolerance Zone, the presence and location of the facility must be verified. Refer to the diagram for an understanding of the Tolerance Zone.

2. For markings that indicate the width of the facility, the tolerance zone is the width of the facility plus an additional five feet (5') on either side of the facility. For example, the facility on the left is marked as being twenty-four inches (24") wide. So five feet (5') on either side gives us an approximate location or Tolerance Zone of twelve feet (12'). (see diagram)

3. For markings that do not indicate the width of the facility, the tolerance zone is five feet (5') on either side of the markings. No width is provided for the facility on the right, so five feet (5') on either side gives us an approximate location or Tolerance Zone of ten feet (10'). (see diagram)

L. DISCOVERY OF UNKNOWN FACILITIES

1. Should the Contractor uncover, unearth, or otherwise identify an unmarked / unknown facility, excavation that may further disturb said utility shall cease, and the Contractor shall immediately notify the Engineer. Excavation shall not proceed until the utility is identified and a determination can be made on how to proceed by Metro-North Railroad.

2. The Engineer will contact the Force Account Manager and inform them of the unmarked/unknown facility.

3. The Force Account Manager will notify the representatives of the appropriate Metro-North Departments.

4. Within twenty-four (24) hours of notification, these departments shall return to the area and attempt to identify the utility. The responsible department will identify if and where any additional test pits are necessary to locate/expose the unmarked utility, and test the utility as necessary to determine if the utility is in service or out of service / abandoned. If abandoned or no longer in service, the responsible department may authorize the immediate removal of the interference, or will provide direction as how to handle the unmarked utility as soon as possible, but no longer than twenty-four (24) hours from time of field identification by the department.

5. The Contractor is hereby notified that Metro-North Force Account Departments are subject to call out for Railroad emergencies. In this case, the Contractor is advised to identify other work that can be completed in addition to the anticipated week’s production.

M. DAMAGE TO UNDERGROUND FACILITIES

1. Excavators shall take all reasonable precautions to prevent contact or damage to underground
facilities and their protective coatings, including but not limited to, compliance with accepted engineering practices and any reasonable directions provided by Metro-North Railroad.

2. In the event of contact with or damage to an underground facility, the excavator shall immediately notify the Engineer. All excavation or demolition in the immediate vicinity of the contacted or damaged portion of the underground facility shall be suspended until such portion is repaired and the Engineer advises the excavator that excavation or demolition may proceed.

3. No backfilling shall be done by the excavator in the vicinity of the contact or damage until Metro-North Railroad conducts an inspection and makes any necessary repairs; and, the excavator shall undertake no repairs unless and until authorized by Metro-North Railroad.

4. Should damage to an underground facility occur and it be determined that the Contractor is negligent in its actions; it did not exercise reasonable precautions to prevent contact or damage to underground facilities and their protective coatings, the Contractor is responsible for all costs associated with the repair and restoration of the damage facility. Such costs shall be deducted from the Contractor’s next progress payment.

N. IDENTIFICATION OF UNDERGROUND FACILITIES IN DANGER OF FAILING

1. An excavator who by removing the surrounding materials exposes an underground facility which in his or her judgment appears to have failed or to be in potential danger of failing from corrosion or other causes shall immediately report such condition to the Engineer.

2. The excavator shall delay any further work in the immediate vicinity of such underground facility which could jeopardize it but may proceed in areas not affecting the questionable facility.

3. The excavator may proceed in such immediate vicinity after the Engineer responds and takes necessary action in regard thereto and advises the excavator that he or she may proceed.

O. SUPPORT AND PROTECTION FOR UNDERGROUND FACILITIES

1. An excavator shall provide prompt and adequate support and protection for every underground facility located in the work area as is reasonably specified by the Engineer.

2. In the absence of any specifications, the excavator shall provide support and protection in accordance with generally accepted engineering practice, including but not limited to shoring and bracing.

3. Support shall be at least equivalent to the previously existing support and shall protect the underground facility against freezing and against traffic and other loads.

4. Support shall be maintained during excavation, during backfilling and, if necessary, after backfilling is completed.

5. Metro-North Railroad may, in agreement with the excavator, provide such support.

P. BACKFILLING REQUIREMENTS

1. An excavator performing excavation or demolition at an underground facility shall backfill such excavation with materials and in such manner as specified by the Engineer or, in the absence of such specifications, with suitable materials and in such manner as will avoid damage to, and provide proper support for, such underground facility and its protective coating both during and after backfilling operations.

2. The excavator shall not place large rock, frozen earth, rubble, debris or other heavy or sharp materials or objects which could cause damage to or scraping against any underground facility.

3. The backfill beneath and around any underground facility shall be properly compacted in accordance with generally accepted engineering practice.

4. Heavy loads and excessive forces shall not be imposed on any exposed underground facility at any time during backfilling operations.
Q. EMERGENCY REQUIREMENTS

1. In the event of an emergency involving danger to life, health or property as a result of damage to an underground facility containing gas or liquid petroleum products or as a result of an electrical short or escape of gas or hazardous fluids, the excavator shall:
   a. Proceed to evacuate his or her employees and all other endangered persons from the immediate vicinity to the best of his or her ability;
   b. Immediately call 911 and the Engineer to inform of the exact location, nature of the emergency and type of underground facility which is affected.

R. RESPONSIBILITY TO EMPLOYEES

Every excavator subject to the provisions of this Part shall make certain that all of his or her employees directly involved in excavation or demolition are thoroughly familiar with the applicable provisions of this Part and especially the provisions of this Subpart relating to their safety.

S. DOCUMENTATION & MARKING OF FACILITIES

1. As to facilitate future identification, the Contractor shall identify all in service and abandoned utilities on As Built drawings.

2. The Contractor shall mark all new buried utilities with warning tapes specifically designed and manufactured for subgrade utility identification. The warning tape shall be of durable impervious material, designed to withstand extended underground exposure without material deterioration or fading of color. All tapes, unless otherwise directed by the specific utility, shall be detectable to a depth of at least three feet (3’) with a commercial radio-type metal locator. The tape shall be of the color assigned to the type of facility and shall be durably imprinted with an appropriate warning message. The tape shall also comply with the specific requirements of the utility that owns the facility.

3. Warning tapes shall be installed the entire length of the utility, in one continuous unbroken length. Tapes shall be located a minimum of twelve inches (12”) above the buried utility unless the excavation’s depth, other underground facilities, or other engineering considerations make this minimum separation infeasible. The tapes shall extend a minimum of two feet (2’) above grade and be tied or otherwise secured to the utility where it exits the ground. This is to facilitate access to the tape to allow sending of an electronic signal to aid in future identification of the utility.
## UNIFORM COLOR CODE - UTILITY IDENTIFICATION ASSIGNED COLORS

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>To delineate proposed excavation site</td>
</tr>
<tr>
<td>Pink</td>
<td>Survey markings</td>
</tr>
<tr>
<td>Green</td>
<td>Storm and sanitary sewers and drainage systems, including force mains and</td>
</tr>
<tr>
<td></td>
<td>other non-hazardous materials</td>
</tr>
<tr>
<td>Blue</td>
<td>Water</td>
</tr>
<tr>
<td>Orange</td>
<td>Communication lines or cables, including, but not limited to, those used in</td>
</tr>
<tr>
<td></td>
<td>or in connection with, telephone, telegraph, fire signals, cable television,</td>
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<tr>
<td></td>
<td>civil defense, data systems, electronic controls, track signal and control,</td>
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<tr>
<td></td>
<td>and other instrumentation</td>
</tr>
<tr>
<td>Red</td>
<td>Electrical power lines, electrical power conduits and other electrical power</td>
</tr>
<tr>
<td></td>
<td>facilities, railroad traction power (i.e. 3rd rail or catenary), traffic</td>
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<tr>
<td></td>
<td>signals and appurtenances and illumination facilities</td>
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<tr>
<td>Yellow</td>
<td>Gas, oil, petroleum products, steam, compressed air, compressed gases and</td>
</tr>
<tr>
<td></td>
<td>all other hazardous liquid or gaseous materials except water</td>
</tr>
<tr>
<td>Brown</td>
<td>Other</td>
</tr>
<tr>
<td>Purple</td>
<td>Radioactive materials, reclaimed water, irrigation</td>
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<tr>
<td>LIST OF LOCATING COMPANIES FOR PRIVATELY OWNED FACILITIES</td>
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<tr>
<td>------------------------------------------------------------</td>
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<tr>
<td><em>(This is not a comprehensive listing; check local listings for more alternatives.)</em></td>
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<tr>
<th>Absolute Locating 24/7</th>
<th>Pipedream Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>2713 West Main Street, Unit 2, Wappingers, NY 12590</td>
<td>10 Fronckowiak Ave, Cheektowaga, NY 14227</td>
</tr>
<tr>
<td>Phone: (845) 750-3157</td>
<td>Phone: (716) 894-9236</td>
</tr>
<tr>
<td>Contact: Ryan Craven</td>
<td>Contact: Steven L. Craft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Accumark, Inc.</th>
<th>Premier Utility Services, LLC</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.accumark.us">www.accumark.us</a></td>
<td><a href="http://www.premierelectricians.com">www.premierelectricians.com</a></td>
</tr>
<tr>
<td>668 Stony Hill Rd, Suite 107, Yardley, PA 19067</td>
<td>100 Marcus Blvd, Hauppauge, NY 11788</td>
</tr>
<tr>
<td>Phone: (215) 369-3569</td>
<td>Phone: 1-800-262-8600</td>
</tr>
<tr>
<td>Contact: Van Singer, P.E.</td>
<td>Contact: Ed Heaney</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACS Underground Solutions</th>
<th>ProTek Locating</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.acsunderground.com">www.acsunderground.com</a></td>
<td><a href="http://www.proteklocating.com">www.proteklocating.com</a></td>
</tr>
<tr>
<td>P.O. Box 448, Georgetown, CT 06829</td>
<td>10-37 51st Ave, 1st Floor, Long Island City, NY 11101</td>
</tr>
<tr>
<td>Phone: (203) 544 7190</td>
<td>Phone: (718) 472-2304</td>
</tr>
<tr>
<td>Contact: Ian Beaver</td>
<td>Contact: Craig Anderson</td>
</tr>
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<table>
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<tr>
<th>Eastern Locating Services Inc.</th>
<th>Puls Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.easternlocating.com">www.easternlocating.com</a></td>
<td><a href="http://www.pulsinc.com">www.pulsinc.com</a></td>
</tr>
<tr>
<td>PO Box 9485, Trenton, NJ 08650</td>
<td>2299 Broadhead Road Suite G-1, Bethlehem, PA 18020</td>
</tr>
<tr>
<td>Phone: (607) 585-0577</td>
<td>Phone: (610) 419-1232</td>
</tr>
<tr>
<td>Contact: Ken Samu</td>
<td>Contact: Stanley Kalsky</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECSM Utility Contractors, Inc</th>
<th>Underground Surveying, LLC</th>
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<tbody>
<tr>
<td><a href="http://www.ECSMInc.com">www.ECSMInc.com</a></td>
<td><a href="http://www.undergroundsurveying.com">www.undergroundsurveying.com</a></td>
</tr>
<tr>
<td>1200 Walnut Bottom Rd, Suite 101, Carlisle, PA 17015</td>
<td>152 Deer Hill Ave Suite 207, Danbury, CT 06810</td>
</tr>
<tr>
<td>Phone: (717) 258-8001</td>
<td>Phone: (203) 312-9844</td>
</tr>
<tr>
<td>Contact: Gerald L. Redden</td>
<td>Contact: Peter C. Viola</td>
</tr>
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<table>
<thead>
<tr>
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<tr>
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<td><a href="http://www.u-survey.com">www.u-survey.com</a></td>
</tr>
<tr>
<td>2426 East Helms Manor, Boothwyn, PA 19061</td>
<td>87 East Main Street, Washingtonville, NY 10992</td>
</tr>
<tr>
<td>Phone: (610) 358-0172</td>
<td>Phone: 1-800-825-9283</td>
</tr>
<tr>
<td>Contact: Art Worthman</td>
<td>Contact: Garry Williams</td>
</tr>
</tbody>
</table>
# Utility Location Request

**TO BE COMPLETED & SUBMITTED BY CONTRACTOR**

### General Contractor Company Name

<table>
<thead>
<tr>
<th>Date Request Submitted</th>
<th>Project Description</th>
</tr>
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<tbody>
<tr>
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<table>
<thead>
<tr>
<th>Contract Number</th>
<th>Project Description</th>
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<table>
<thead>
<tr>
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<th>Address</th>
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<tbody>
<tr>
<td></td>
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<table>
<thead>
<tr>
<th>Field Contact</th>
<th>Telephone</th>
</tr>
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<td></td>
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### Excavating Contractor Company Name

<table>
<thead>
<tr>
<th>Address</th>
<th>Telephone</th>
</tr>
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### Excavation Site Information

<table>
<thead>
<tr>
<th>City, Town, Village</th>
<th>Street Address</th>
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<table>
<thead>
<tr>
<th>Excavation site is located between… (Describe two closest intersecting streets)</th>
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<tbody>
<tr>
<td>1)</td>
</tr>
<tr>
<td>2)</td>
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<table>
<thead>
<tr>
<th>Milepost</th>
<th>Control Point</th>
<th>Track Number(s)</th>
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<table>
<thead>
<tr>
<th>Excavation Dimensions (in feet)</th>
<th>Length</th>
<th>Width</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Has proposed excavation been field identified with white paint?</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
</tr>
<tr>
<td>YES</td>
</tr>
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<table>
<thead>
<tr>
<th>Project drawings/plans identifying proposed excavation attached?</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
</tr>
<tr>
<td>YES</td>
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</table>

### Other

- **MNR Resident Engineer/Construction Manager**
  - Name |
  - Phone |

- **MNR Force Account Manager**
  - Name |
  - Phone |

Revised August 22, 2014
**UTILITY LOCATION TICKET**

*(TO BE COMPLETED BY METRO-NORTH RAILROAD & RETURNED TO CONTRACTOR)*

Check the box applicable to the represented department

- ☐ Power Department
- ☐ Signal Department
- ☐ Communications Department
- ☐ Structures Department

<table>
<thead>
<tr>
<th>Contact's Name</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date location request received</td>
<td>Date location completed</td>
</tr>
</tbody>
</table>

Field Mark Out complete? YES NO
Utilities identified within the demarcated area? YES NO
If Yes, Describe

Problems encountered during utility identification/mark out? YES NO
If Yes, Describe

Recommended locations of Test Pits have been marked out? YES NO
Additional Test Pits Required? YES NO
If Yes, Describe

Notes / Special Instructions

Response provided to the Metro-North personnel responsible for managing the Contractor’s work? YES NO
If Yes, provide contact's name and date notified Date
APPENDIX C

CONSTRUCTION SPECIFICATION I&C – METRO-NORTH CONTRACTOR REQUIREMENTS FOR WORK AFFECTING THE RAILROAD
CONSTRUCTION SPECIFICATION – I & C SECTION A

METRO-NORTH RAILROAD COMPANY

CONTRACTOR REQUIREMENTS FOR WORK AFFECTING THE RAILROAD

The contractor shall be governed by the State of Connecticut Department of Transportation Standard Specification for Roads, Bridges and Incidental Construction, Form 814 (or latest edition), with the following additions:

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

2. The contractor shall obtain design and construction approval of construction methods from the railroad. He shall submit detailed plans appurtenant data and calculations for any operation on or adjacent to the Railroad property prior to the start of work. Metro-North will evaluate the effect of this work on the operating Railroad. The plan shall locate and identify all utilities, above and below ground at the work site. He shall make necessary plan revisions, schedule changes, additions, deletions, etc. at his own expense. The contractor shall remove at his own expense any pipe, wire, or structural facility installed without Metro-North approval or which deviates from the Plan approved by Metro-North.

Under the direction of a Railroad representative (engineer, inspector) the contractor shall – at no cost to the Railroad – perform pre and post construction surveys of tracks and structures to establish existing horizontal and vertical clearances. The elevations shall reference an established survey benchmark which will remain undisturbed throughout the construction. It may be necessary for the contractor to monitor movements of tracks and structures on a more frequent basis – monthly, weekly or daily as determined by the Railroad representative. Copies of the field notes must be delivered to the Railroad on a regular basis.

Under the direction of a Railroad representative (engineer, inspector) the contractor shall – at no cost to the Railroad – take pre and post construction photographs of the entire work site and track area, two sets of which will be delivered to the Railroad. The photographs shall be gloss prints 8 inches by 10 inches in size. They shall also be labeled on their reverse sides. The label shall include project title, Project Identification Number (PIN), Bridge Identification Number (BIN) or contract number, name of contractor, date and direction photograph was taken. Each photograph shall also be numbered for identification.

3. 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 outside edge of tie and extending downward at a slope of 1 (vertical) on 1 ½ (horizontal). Such excavations must be designed to withstand, in addition to all static loads such as structural dead load, soil pressure and hydrostatic pressure, a Railroad live load of Cooper E-80 or other loading magnitude as may be directed by the Railroad.

Moreover, sheeting alongside active track systems shall maintain lateral support. Lateral support shall consist of a compacted stone ballast shoulder level with the top of tie for at least one (1) foot from the end of tie supported by a slope no steeper than one (1) vertical to two (2) horizontal. Timber sheeting left in place shall be treated with wood preservative in accordance with the American Wood Preservers Association Standards for timber in contact with soil.
4. Protective scaffolding shall be necessary where, at the sole discretion of the Railroad, such scaffolding is necessary to protect the Railroad or the general public from possible falling debris, paint or other materials; to protect personnel working above the right-of-way or to provide a platform for personnel, materials and or equipment. A protective scaffold intended to contain finely broken concrete decking shall be designed for a live load of 200 pounds per square foot applied uniformly over the entire structure, and a 2 kip concentrated load placed anywhere on the structure. The two loads are not to be applied simultaneously for design purposes. Design of the scaffold intended for any other purpose shall be submitted to Metro-North for approval. The design shall contain details of any construction activities supported or protected by the scaffold. Loads or rigging which exceed the capacity of the scaffold shall be subject to the conditions of Section B “Rigging.” All materials for protective scaffolding must be fire retardant. The contractor must supply the Railroad with certification from the manufacturer or supplier that lumber meets or exceeds the ASTM E-84 fire retardant specification for exterior application 30-minute duration. Plans and calculations for sheeting and scaffolding must be submitted to the Railroad for approval prior to construction. Further, plans and calculations must be stamped by a Professional Engineer licensed in the state in which the project is located.

5. The contractor shall safeguard the tracks, rolling stock and other equipment and plant of the Railroad from being damaged in any manner and will be held financially responsible for same. He shall not perform any operations which might foul the Railroad until he has complied with the Railroad requirements.

6. An operating track will be considered fouled when, in the sole opinion of the Railroad, demolition, blasting or construction activity on or adjacent to a main track or controlled siding may interfere with the safe movement of trains at normal speed. A crane, derrick or a similar piece of equipment located on Railroad right-of-way or on adjacent property shall be considered as fouling the track when the position in which it is working is such that without regard to the manner in which it is intended to carry out the operation, failure or malfunction could cause damage or obstruction within the operating area. Similarly, Railroad utilities (power, communications and signal lines) will be considered fouled when, in the sole opinion of the Railroad, the contractor’s operation could interfere with these utility lines.

7. The contractor shall give sufficient advance notice so that the Railroad may arrange to supply special supervisory and protective forces. Section 12 “Protective Personnel” defines the advance notice requirements for operations requiring protective services. The Railroad will provide protective forces to the extent possible considering operational and maintenance priorities. The Railroad makes no guarantee that protection personnel will be available to meet the contractor’s preferred schedule. Further, no such work may actually commence until the assigned Railroad representative affirmatively advises the contractor that the necessary protective forces are stationed and that he may proceed.
8. The contractor will not store materials or equipment upon Railroad right-of-way without first obtaining written permission of the Railroad. The contractor shall secure construction materials and equipment which could be used by vandals to obstruct Railroad operation in a vandal-proof enclosure. The contractor shall protect the work site with fences, barricades, barriers, watchmen or other means necessary to bar access to operating areas via the work site.

9. The contractor must furnish an English-speaking supervisor at each job location who is capable of communicating (including translating if necessary) instructions from the flagman or other Metro-North representative to the contractor’s personnel on the job. Such supervisor must remain on the site at all times while work is being performed or any contractor employees are on or about the Railroad right-of-way.

10. The contractor shall comply with any and all Federal, State and Local laws, regulations and rules governing environmentally controlled substances and construction practices. De-watering operations shall comply with applicable regulatory controls and shall be subject to Metro-North review and approval. The contractor shall comply with Federal and State regulations for containment, storage and disposal of hazardous/industrial wastes. He shall comply with Metro-North Procedure 50-601, Item “O,” Environmental Controls. The contractor shall indemnify and hold harmless the Railroad from any loss, liability or expense on account of claims which result from the handling, transportation, disposal or abatement of asbestos, asbestos containing material or asbestos contaminated materials, lead paint materials and other environmentally regulated substances and material in the possession of contractor or his subcontractors where said claim, is not the result of negligence of an Indemnified Party.

11. The Metro-North Safety Department offers an orientation class for all contractor personnel who have reason to enter Railroad property. The contractor can obtain training material from the Safety Department.

The contractor shall comply with the requirements of all applicable Federal, State, Local and Railroad jurisdictions to provide a suitable work environment for workmen and for the general public. He shall prepare and submit a comprehensive “Safety Plan” which will:

1. Designate a company representative(s) who will prepare and implement a program of compliance.

2. Supply personal safety equipment for all workmen employed by the contractor or his subcontractors and enforce use of this equipment by contractor personnel.

3. Train all employees and subcontractor employees with emphasis upon unusual conditions found in the Railroad environment.
12. **Protective Personnel**

Metro-North will furnish flagmen, inspectors, maintenance personnel and similar labor (protective personnel) as required by Metro-North to protect the operation of train traffic during the contractor's construction activities. The contractor must obey the instructions from Metro-North flagmen or other representatives on the job site promptly. Failure to follow instructions from Railroad personnel on the site will lead to withdrawal of Metro-North's Entry Permit, thus closing the job site to the contractor and its employees. The Railroad will at its sole discretion, determine the need for and the availability of protective, support personnel. The contractor must notify the assigned Railroad inspector no less than 14 calendar days in advance of undertaking an approval construction activity which may require protective personnel. If the contractor notifies Metro-North less than 14 days in advance, the Railroad may be unable to supply protective personnel and/or the Railroad may incur additional costs in accordance with existing collective bargaining agreements in order to fulfill a request. The cost of protective personnel and any additional penalty costs incurred by the railroad due to late notification shall be borne by the contractor or agency responsible to reimburse Railroad costs. Requests to cancel construction activities and protective personnel must be received and acknowledged by the assigned Railroad inspector no less than 96 hours prior to the start of the scheduled construction activity. Any costs incurred by Metro-North due to late cancellation notice shall be borne by the contractor or agency responsible to reimburse Railroad costs.

13. **The Railroad** will, at its sole discretion, remove tracks from service and de-activate high voltage traction power facilities to permit certain construction activities which can only be performed at times when the Railroad can schedule this track use. In general, the Railroad can de-activate single tracks at night between the hours of 2:30 AM and 5:00 AM. Construction activities which require de-activating all tracks of a main line system must be performed on weekend nights at times specified by the Railroad. Requests for additional “track use” will be evaluated subject to operating and maintenance priorities. Requests to de-activate track(s) and/or high voltage power systems must be received and acknowledged by the assigned Railroad inspector no less than 14 days prior to the scheduled activity. Metro-North will only consider requests for “track time” to facilitate construction activities that have been approved by the Construction Management Department.

14. Highway-rail mounted equipment and “work trains” are generally prohibited from use by non-Railroad agencies on Metro-North mainlines tracks.
15. The contractor shall adhere to Metro-North security practices. He shall identify all contractor/subcontractor personnel who have reason to enter a designated security area of Railroad property. He shall supply a listing of the names of all personnel who have reason to enter Railroad property. The list shall be updated whenever there is a change in personnel. He shall supply each workman with company insignia which shall be worn on outer garments whenever workmen are on Railroad property. Contractor personnel failing to wear identifying insignia shall be removed from the property.

16. An Entry Permit shall be necessary before non-Railroad personnel enter Railroad property. The project owner shall contact the office of the Chief Engineer of Maintenance to initiate the process at:

Metro-North Railroad  
Engineering Department  
420 Lexington Avenue  
12th Floor  
New York, New York 10017

17. A Force Account Agreement shall be necessary between Metro-North and the project owner to provide for reimbursement of Railroad protective costs incidental to the construction project. The project owner shall contact the:

Metro-North Railroad  
Connecticut Bridges Program Office  
525 Water Street  
Bridgeport, Connecticut 06601

The project owner shall deposit with Metro-North payment of the full amount of the estimated cost of Railroad services prior to entering the property.
CONSTRUCTION SPECIFICATION - I & C SECTION B

Requirement for Erection, Demolition and Other Rigging Operations Over or Adjacent to Railroad Right-of-Way

The contractor must furnish the following information to obtain written 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 vehicle weight and locations shown.

2. Crane rating sheets showing cranes to be adequate for 150% of the lift. Crane and boom nomenclature shall be indicated. Include manufacturers' recommended data for special applications such as barge mounted equipment.

3. Plans and computations showing weight of pick. Include weight of rigging equipment.

4. Location plan showing obstructions, indicating that the proposed swing is possible. A profile of overhead utility lines or obstructions demonstrating that the rigging operation is possible. Computations and plans demonstrating that foundations for equipment and temporary structures are adequate and protect subsurface utilities and structures.

5. Plans and calculations showing locations and structural adequacy of mats, barges, planking or special decking as may be required by the Railroad.

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

7. Data sheet listing number, type, size, arrangement and capacity of slings, spreader bars or other connecting equipment. Copies of catalog or information sheets of specialized equipment.

8. A complete procedure, indicating the order of lifts and repositioning or rehitching of the cranes and partial pre-cutting of structural members.

9. Temporary support of any components or intermediate stages including bolting data shall be shown.

10. A time schedule of each stage or lift, as well as a schedule for the entire lifting procedure.

11. All plans and calculations submitted to the Railroad as required above shall be stamped by a Professional Engineer licensed in the state where the work is performed.

In general, unless otherwise directed by the Railroad, operations directly over or adjacent to the operating right-of-way which foul the operating area, or which in the event of a failure could fall across the operating area will be performed between approximately 2:30 AM and 5:00 AM. Operations involving a track and power outage across all tracks my be performed only on weekends -at times specified by the Railroad.

The contractor shall locate and mark the exact crane location in the field at least two working days prior to the intended operation. He shall verify the radii and clearances for critical picks, and he shall confirm the stability of the foundation for crane outriggers and supports. Any deviation from this plan must be approved, in writing, by the Metro-North Engineer prior to the date that the work will be scheduled.
ATTENTION

1) This technical specification contains the requirements for safety sensitive vital signal cable intended for use within the Metro-North Railroad wayside signal system. Changes or substitutions of requirements contained within this specification are not permitted.

2) This specification shall NOT be used for any utility power cables such as 3-conductor #2 Awg stranded or other stranded utility power cable configurations.

3) This specification shall NOT be used for any communications cables such as 25 pair 19 gauge or other communications cable configurations.

4) This cable shall NOT be used for traction return or fouling cables such as 500 MCM, 250 MCM, 2/0 or other traction return or fouling cable configurations.

5) This technical specification shall be used for two methods of procurement:
   a) Direct procurement between Metro-North Railroad Procurement Department and the cable Manufacture or Distributor.
   b) Procurement between a Contractor hired by Metro-North and the cable Manufacture or Distributor.

6) In all cases, the following items shall be submitted to Metro-North Communications and Signal for review and approval:
   a) Product technical submittals
   b) Material testing records prior to manufacture
   c) Finished cable testing records after manufacturing

7) The following reference table (Metro-North Railroad Signal Cable Reference Table) contains the signal cable configurations for both Low Smoke Zero Halogen and Polyethylene outer jackets. Refer to the procurement documents for specific jacket type and armor types.

8) This specification contains the requirements for three basic cable applications:
   a) Direct burial
   b) Aerial
   c) Duct, tray or conduit
9) The Contractor, manufacture or distributor is NOT PERMITTED to choose the cable type for the applications. A direct burial cable application is the default type. Aerial or Tray applications are only permitted if specifically required by Metro-North in the bid or procurement documents.
# Metro-North Railroad Signal Cable

## Reference Table

<table>
<thead>
<tr>
<th>TYPE</th>
<th>COMPOSITION</th>
<th>ARMOR</th>
<th>LOW SMOKE</th>
</tr>
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<tbody>
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<td>Track Wire</td>
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<td></td>
</tr>
<tr>
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<td>one twist per foot</td>
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<tr>
<td>Signal Cable</td>
<td>5 Conductor #9 Awg. Solid</td>
<td>Yes</td>
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<td>Signal Cable</td>
<td>7 Conductor #9 Awg. Solid</td>
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<td>2 Conductor #4 Awg. Solid</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Signal Power Cable</td>
<td>2 Conductor #4 Awg. Solid</td>
<td>Yes</td>
<td>Yes</td>
</tr>
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1.0 General Provisions and Requirements

1.1 General

1.1.1 This technical specification contains the manufacturing, material, testing and delivery requirements for Metro-North railroad wayside signal cable. The cable will be utilized in the wayside signal system safety sensitive and vital applications.

1.1.2 This technical specification shall be used for two methods of procurement:

a) Direct procurement between Metro-North Railroad and the cable Manufacture or Distributor.
b) Procurement between a Contractor, hired by Metro-North, and the cable Manufacture or Distributor.

Proper material and testing submittals are required for both methods of procurement. When procured directly, the submittals shall be provided directly to Metro-North. When procured through a Contractor hired by Metro-North, the submittals shall be provided through the Contractor as required within the formal contract documents. In all cases, Metro-North Communications and Signal Department will review and approve all submittals.

Required submittals are defined elsewhere this document.

1.1.3 The specification contains references to cable standards for manufacturing and testing. The Manufacture shall follow all required standard practices.

1.1.4 This technical specification contains the requirements for the following cable applications:

a) Burial installation
b) Aerial installation
c) Installation in cable tray, duct or conduit
1.1.5 All cable provided shall be direct burial unless specifically otherwise requested through the Metro-North procurement documents or other contract documents.

1.1.6 This specification contains the requirements for signal cable configurations for both Low Smoke Zero Halogen and Polyethylene outer jackets. Refer to the procurement documents for specific jacket type and armor types.

1.1.7 Signal Cables covered by this specification includes but is not limited to the following types:

a) Straight laid multi-conductor – Express Cable
b) Multi-pair – Line Cable
c) Composite – Switch or Gate Cable
d) Duplex Twisted – Track Wire
e) Signal Power

1.2 Work Included

1.2.1 This specification covers the material requirements, manufacturing requirements, shipping, qualification test requirements, and manufacturing test requirements for Signal Cables.

1.2.2 The work included in this specification includes but is not limited to the following:

a) Provide for review and approval Material/Product Submittals prior to manufacturing.
b) Provide for review and approval Qualification Testing prior to manufacturing.
c) Provide for review and approval Production Testing and samples prior to shipment.
d) Provide for review and approval Shipping Details prior to shipping.
e) Provide for review and approval Cable Marking requirements prior to shipping.
1.3 Requirements for Proposal (Bid Requirements)

1.3.1 The Contractor/Manufacture shall submit a section-by-section specification compliance statement with the Bid/Proposal or submittal. A detailed description shall be provided for any section of the specification where full compliance is not stated.

1.3.2 The Contractor/manufacturer shall submit with the Bid/Proposal or submittal a complete Quality Control plan.

1.3.3 The Contractor/Manufacture shall provide current Qualification test results with the Bid/Proposal or submittal. The information shall include and not be limited to the following:

a) Notarized letter indicating that the test data and results are current and directly related to the cable material and products to be provided under this procurement and the material and products meet the specification requirements.

b) Detailed summary of each test, with included reference to the section of this specification as well as the relevant standard. The test data shall include a listing of test equipment with calibration records for the equipment.

c) Notarized test results and data for each test included.

d) The Contractor/Manufacture shall deliver one certified notarized hard copy plus four copies on CD-ROM.

1.3.4 All qualification testing of material shall be traceable directly to the material or products utilized in the manufacturing of the Signal Cable. Metro-North reserves the right to audit the qualification testing to confirm the relationship to the material provided.

1.3.5 The contractor shall submit a detailed description of the standards and practices followed for the manufacturing of the cables. All reference standards defined by groups such as ASTM or ICEA shall be included.
1.3.6 The Contractor shall submit a detailed description of the standards and practices followed for the testing of the materials and final cables. All reference standards defined by groups such as ASTM or ICEA shall be included.

1.3.7 The Contractor shall submit a detailed drawing (refer to Figure 1 - Cable Product Submittal Format) for each cable type including but not limited to the following items:

a) Manufacturer name and the factory where the cable will be made.
b) Manufacturer part number.
c) Metro-North/Contractor quote or proposal number.
d) Date of proposal or bid closing.
e) Reference to Metro-North Specification.
f) Cable Description.
g) Dimensions of Finished Cable.
h) Weight per foot of finished cable.
i) Printing to be on the identification marker tape.
j) Printing to be imprinted on outer jacket.
k) Listing of any relevant contract addendums.
l) Detailed cross-section drawing with dimensions in inches and millimeters of the cable with arrows and text defining the following items:
   1) Outer jacket thickness, material and color.
   2) Cushion layer thickness, material and color.
   3) Armor layer thickness and material.
   4) All tapes, pull strings, fillers and wrappings showing material, thickness and color as appropriate.
   5) Conductor wire gauge, insulation color, thickness and material.
   6) Location color, material and thickness of tracer conductors.
   7) A sample of the reel tag per

1.3.8 All testing records shall reference the exact materials used in manufacturing the cable jackets or conductor insulation. Any changes, revisions, upgrades, or modifications in the materials or manufacturing processing shall require re-testing of the products.
1.3.9 The Contractor/Manufacture shall manufacture and deliver cable at a specified length on a per reel basis.

1.3.10 The Contractor/Manufacture shall state in their proposal the location of the plant or plants where the cable will be manufactured and tested. This stated location should not be changed without the Railroad’s written approval. The manufacturer shall have the necessary cable testing facilities and personnel available on the premises.

1.3.11 Materials and design used in this cable shall have demonstrated, either through actual field experience, and/or through comparable valid aging tests, that the cable offered shall have a design life of a minimum of 40 years. To demonstrate this, cable designs and insulation materials offered in this service shall meet the qualification tests hereinafter specified.

1.4 Testing and Inspection

1.4.1 The Engineer reserves the right to witness each stage of manufacture and each test (manufacturing and production) conducted upon the cable and to duplicate any or all factory tests after delivery. When duplicating the voltage tests, due regard will be given to any requirements in the industry standard for a reduction in the test voltage.

1.4.2 Adequate notice and cooperation shall be given to the Engineer who elects to witness these tests, including access to all facilities.

1.4.3 The Contractor/Manufacture shall forward to the Engineer cable samples not less than 12 inches in length and notarized certified Production test reports for all cable covered by the order, one original and four copies on CD-ROM of the test results are required, for approval prior to delivery of completed reels of cable.

1.4.4 The notarized certification will be part of, or attached to the test report.
1.4.5 Witnessing or waiving of witnessing of the factory tests by the Engineer or his representative, or the acceptance of the certified test data, shall not relieve the manufacturer from furnishing the cable in accordance with this Specification.

1.4.6 If in the opinion of the Engineer the cable fails to meet any of the requirements of this Specification, the cable will be rejected.

1.5 Shipment

1.5.1 The requirements listed below are applicable when Metro-North procures the cable directly from the manufacture or distributor and has not hired a Contractor to perform this task.

1.5.2 Based on the procurement quantities, Metro North will provide direction to the manufacture to release for manufacture cable by type and length with a minimum of 1000' per type of cable.

1.5.3 All cable ordered shall be available for Metro-North use within 90 days of receipt of order.

1.5.4 Contractor/Manufacture will notify Metro-North when the order is fully completed and ready for storage by the contractor and inspection by Metro-North.

1.5.5 At Metro-North's direction, the cable will be stored or shipped immediately to site along right of way.

1.5.6 If cable is to be stored, Metro-North will inspect the cable and location of storage and, if approved, then authorize the contractor to submit and invoice.

1.5.7 The cable shall be stored at the Contractor's/Manufacture's site for duration of up to 8 months from the date the cable order has been completed. All costs associated with storage shall be included in the Bid or proposed pricing.

1.5.8 Within 5 days of notification the cable will be delivered to the Metro-North right-of-way site or storage location.

1.5.9 The Contractor/manufacturer shall provide a secure storage area for the cable. Upon payment of the invoice, Metro-North shall
be assigned title to the material. The Contractor/Manufacturer shall obtain insurance for the cable at a full replacement cost without any cost to Metro-North.

1.5.10 All cable shall be shipped on reels. Bid Price shall be based on non-returnable reels.

1.5.11 After passing factory production tests, the cable shall be effectively sealed against the entrance of moisture. Both ends of each length of cable shall be protected by wrappings of rubber tape and plastic tape, numerous layers of plastic tape or other suitable means approved by the Engineer. The use of friction tape will not be accepted.

1.5.12 Cable shipped on reels shall be protected from damage, each being firmly secured to the reel and, if projecting through the flange of the reel, a suitable cover of galvanized or painted sheet iron having rounded ends and sides shall protect the inner end. The reels shall be securely blocked while in transit and the manufacturer shall be responsible for any chafing of cable sheath or other damage to the cable during transit as the result of improper sealing, packing, fastening or blocking. The manufacturer shall also be responsible for any change in the shape of the cable occurring in transit that results in an increase in the maximum diameter of the polyethylene that is specified.

1.5.13 The actual length of the cable on each reel, on delivery, shall be not less than plus or minus Five (5%) percent of that specified in the order or contract and in no case shall the contractor ship a quantity larger than this amount unless permission is given by the Engineer prior to shipment.

1.5.14 The reels shall be in good condition, of heavy construction and capable of withstanding stresses and strains usual in the transit and in the installing of the cable. Reels 42 inches in diameter and larger shall have steel or iron hubs. The diameter of the drum shall be large enough to prevent damage to the cable from reeling. The maximum width of the reels shall be 48 inches, maximum height shall be 72 inches, and maximum weight (including cable) shall be 4000 pounds (note: All three size requirements shall be adhered to unless permission to deviate is given by the Engineer).
1.5.15 The Contractor/Manufacture shall ship each finished reel with a durable heavy-duty weatherproof wrapping. The wrapping shall be secured by at least two reinforced plastic bands. The material supplied shall be suitable for outdoor uncovered storage and not subject to degradation due to sunlight or weather effects. The use of any clear plastic wrapping is not permitted.

1.6 Marking

1.6.1 Each reel shall be indelibly marked with the following information:

a) Name of the Manufacturer
b) Railroad’s order number or contract number
c) Railroad’s requisition number or supply order number
d) Railroad’s number or other designation of the reel
e) Manufacturer’s Quality control Number
f) Length of cable on reel
g) Make-up and diameter of the cable
h) Maximum voltage at which the cable is to be used
i) Indicate cable type – Aerial, Burial, Duct or “Low Smoke” as appropriate
j) The marker tape reading from the inside end of the cable nearest the drum.

1.6.2 The information required above, together with the gross and net weights and the name and address of the consignee shall be stenciled or lettered on the outside of both reel heads. In place of lettering directly on the head, there may be substituted a label with the information indelibly marked thereon, securely attached to each head shellacked for protection from the weather. The lettering or labels shall be located at diametrically opposite points near the circumference with the top of the letters towards the center of the reel. In addition, the word “TAG” shall be stenciled or lettered on the outside of each reel head at the point nearest to the location of the tag. The reel also shall be plainly marked to indicate the direction in which it should be rolled so as not to loosen the cable on the reel.
1.6.3 Each head of each reel shall bear a strong rust-resisting metal disk not less than 1.5 inches in diameter, on which shall be plainly stamped the manufacturer's Quality Control number in figures as large as practicable. Each disk shall be counter sunk below the surface of the reel head about 6 inches from the outer edge of the head and securely fastened hereto with nails, bolts or screws that are rust resisting. The two discs of each reel shall be located at diametrically opposite points. For steel reels, this requirement may be waived, but each steel reel will bear, in readily distinguishable figures, the manufacturer's number on each head, near the outer edge.

1.7 Warranty

1.7.1 The Contractor/Manufacture warrants that the design, material and workmanship incorporated in each item of the cable will be of the highest grade and consistent with the established and generally accepted standards for apparatus of this type; and that each such item and every part and component thereof will comply with the Specification.

1.7.2 The Contractor/Manufacture agrees that this warranty shall commence with the acceptance of each item of the cable, whether the defect is patent or latent shall extend for a period of one (1) year after the acceptance of each item.

1.7.3 The Contractor's/Manufacture's entire obligation under this warranty shall be, at own cost and expense, promptly to replace that item of cable which, under the contemplated specified use proves defective or insufficient within the warranty period or, during such period, proves to have failed to comply with the Specification, provided the railroad gives the contractor prompt written notice of the failure.

1.7.4 The warranty covers an item of cable that shall be replaced by the contractor under the above conditions shall be reinstated for a period of eight years effective as of the day when said replacement is affected. If the failure is found to be of major importance and affects any other item of cable, the reinstatement of the warranty shall then be extended to cover
the item so affected as well, and shall start as of the date of such replacement. The warranty reinstatement provided for in this paragraph shall apply only to the first replacement or the repair of any such item and, in the case of failure of major importance, to the first extension of the said warranty to said affected items.

1.7.5 The foregoing warranties are exclusive and in lieu of all other warranties, written, oral implied or statutory (except as to title and freedom from lien). In no event shall the contractor be liable by reason of breach of warranty for special or consequential damages.
2.0 Signal Cables

2.1 General

2.1.1 The cable shall conform to the requirements of the ANSI/ICEA-NEMA Standards Publication "Nonshielded Power Cables rated 2000 volts or less. Standard ANSI/NEMA WC70/ICEA S 95-658-1999. Note: More recent edition shall govern), except where otherwise modified in this Specification. In the event that the standard is modified or withdrawn by the issuing group, the contractor shall provide a copy of the current standard and indicate any differences between the two documents.

2.1.2 When there is a conflict between the requirements of this Specification and other specifications mentioned herein, the requirements of this specification shall apply.

2.2 Quality Plan

2.2.1 The intent of this Specification is to assure the production of properly designed, well made and thoroughly tested cable for vital circuit signal applications that will render long service life to the user.

2.2.2 Efficient methods of production, testing and product evaluation shall be used, but prime concern shall be focused on the necessary design and formal quality requirements to insure elimination of in-service cable failure and long cable life.

2.2.3 Before commencing manufacture of the cables, the Contractor/Manufacturer shall submit to the Railroad for its approval a quality assurance plan. The plan shall generally meet the intention of the most recent ASQC standard and be in conformance with Metro-North Railroad Quality Assurance Requirements. The plan shall cover all stages of manufacture, from receipt of incoming materials, assembly, calibration of test equipment and final test shipment. The plan will provide for written documentation of tests and inspection made under the plan and such documentation will be made available at the
contractor's plant for the railroad's inspection. Revisions to the plan shall be submitted to the railroad for its approval. The notarized test reports required in this Specification shall include a statement that the cable has been manufactured in compliance with the approved quality assurance plan.

2.2.4 The Contractor/Manufacture shall submit copies of the test records certifying compliance with the manufacturing and qualification testing requirements referenced in this specification.

2.2.5 To assure accountability and traceability in application for the quality assurance plan, the Contractor/Manufacture shall apply conductor insulating materials and cable outer jacket materials, and shall perform conductor insulating and cable assembly and testing in its own plant or plants. The contractor shall state in his bid the plant or plants that will be used to manufacture the cable proposed in the bid, and may not change the designated place of manufacture without written consent of the Railroad.

2.2.6 The Contractor/Manufacture shall permit the railroad to audit its Quality Assurance program to determine that cable furnished in accordance with the contractor's Quality Assurance Program.

3.0 Qualification Tests

3.1 General

3.1.1 This section of the Specification contains the qualification test requirements for manufactured cables.

3.1.2 In the event that materials or processes used in manufacturing of cable change during contract period of performance the Contractor/Manufacture shall resubmit new qualifications test results to replace test results that were submitted to qualify.

3.1.3 All qualification tests shall follow the requirements of this specification. Substitution of other equally qualified testing shall
be at the discretion of the Engineer. The Contractor/Manufacture shall bear the full burden of providing all technical information and data to support that the alternative qualification test is equal to the required test contained within these technical specifications.

3.1.4 The insulation shall be consistently uniform and established as suitable for service at potentials to 15,000 volts.

3.2 Voltage Aging

The dielectric strength stability of the insulating material shall be demonstrated by voltage aging a minimum of ten feet between terminals of a single conductor no. 14 AWG or larger size with 80 mil or thicker insulation, suitably shielded. The cable shall be tested in free air with the ends appropriately terminated.

a) Apply one of the following stresses to voltage-aging the sample.

<table>
<thead>
<tr>
<th>AC Test Voltage (volts/mil)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>225</td>
<td>2 years, or</td>
</tr>
<tr>
<td>180</td>
<td>3 years, or</td>
</tr>
<tr>
<td>135</td>
<td>5 years</td>
</tr>
</tbody>
</table>

b) Use the voltage-aged sample and apply 60 Hz voltage in 10 KV steps for five minutes at each step until breakdown. Start the test at the voltage-aging stress used in 3.1 a) above.

c) No cable breakdown shall occur during the voltage-aging test and the same sample shall withstand the minimum test stress of 350 volts/mil on the step breakdown test in paragraph 3.1 b).
3.3 Thermal Aging

The insulation shall be tested in a circulating air oven on 80 mil thick slabs as follows and shall meet or exceed both of the test results stipulated.

a) After 168 hours in Air Oven Test at 121° C

   Tensile Strength, % of Unaged Value  90
   Elongation, & of Unaged Value        80

b) After 168 hours in Air Oven Test at 150° C

   Tensile Strength, Min.
   % of Unaged Value                  85
   Elongation, % of Unaged Value      60

3.4 Long Term Moisture Resistance

A single conductor No. 14 AWG or larger size with 80 mil or thicker insulation wall shall have at least 10 feet immersed in water at 20° C. The insulated conductor without any coverings over the insulation shall be continuously energized as follows.

<table>
<thead>
<tr>
<th>DC Test Voltage (Volts/mil)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>325</td>
<td>2 months, or</td>
</tr>
<tr>
<td>280</td>
<td>3 months, or</td>
</tr>
<tr>
<td>240</td>
<td>4 months, or</td>
</tr>
<tr>
<td>200</td>
<td>6 months</td>
</tr>
</tbody>
</table>

No insulation failure shall occur within the test period.
3.5 Accelerated Aging Tests

When tested with methods described in ASTM D-470 and the procedures specified herein, the insulation shall have the following characteristics:

a) Physical Properties

<table>
<thead>
<tr>
<th>Original Properties</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength Minimum PSI</td>
<td>1000</td>
</tr>
<tr>
<td>Tensile Stress @ 200% Elongation- Minimum PSI</td>
<td>600</td>
</tr>
<tr>
<td>Elongation at Rupture Minimum %</td>
<td>300</td>
</tr>
</tbody>
</table>

b) Properties after accelerated aging:

<table>
<thead>
<tr>
<th>Oxygen pressure test-168 hours-176°F (80°C)-300 psi</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Properties OR Accelerated Air Oven Aging per AREMA 10.3.19, Table 1b. Manufacture to specify method used.</td>
<td></td>
</tr>
<tr>
<td>Tensile Strength, Minimum % of original</td>
<td>85</td>
</tr>
<tr>
<td>Elongation, Minimum % of Original</td>
<td>85</td>
</tr>
</tbody>
</table>

c) Insulation resistance constant:

Megohms-1000 ft at 60°F (15.6°C) minimum                  | 35000  |

d) Mechanical Water Absorption:

<table>
<thead>
<tr>
<th>Time and temperature</th>
<th>Mg/sq. in Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 Days -158°F (70°C)</td>
<td>8</td>
</tr>
</tbody>
</table>
e) Accelerated electrical stability test in water on insulated conductors only:

80 volts/mil measurement stress

60 cycles-194° F (90° C)

<table>
<thead>
<tr>
<th>Time frame</th>
<th>Measurement</th>
<th>Maximum results</th>
</tr>
</thead>
<tbody>
<tr>
<td>One day</td>
<td>Dielectric Constant</td>
<td>3.0</td>
</tr>
<tr>
<td>1-14 Days</td>
<td>% increase</td>
<td>3.0</td>
</tr>
<tr>
<td>7-14 Days</td>
<td>% increase</td>
<td>1.5</td>
</tr>
<tr>
<td>After 90 Days</td>
<td>% increase</td>
<td>3.5</td>
</tr>
</tbody>
</table>

f) Power factor @75° C:

<table>
<thead>
<tr>
<th>Time frame</th>
<th>Maximum %</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 Days</td>
<td>1.0</td>
</tr>
<tr>
<td>90 Days</td>
<td>1.0</td>
</tr>
</tbody>
</table>

g) Accelerated insulation resistance

Stability test on insulated conductors only: at 194° F (90° C)

<table>
<thead>
<tr>
<th>Time Frame</th>
<th>Megohms- 1000 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Day Immersion</td>
<td>1000</td>
</tr>
<tr>
<td>90 days Immersion</td>
<td>1000</td>
</tr>
</tbody>
</table>
4.0 Construction

4.1 Conductor

4.1.1 All conductors (#4 Awg. or smaller) shall be solid and shall be tin or lead coated annealed copper wire for electrical purposes and shall conform to the requirements of ASTM-B33.

4.1.2 No joints or splices shall be permitted in any conductor.

4.1.3 An allowance of 2% has been included for maximum conductor resistance in the Tables for all multiple conductor cables, except flat twin. All conductors are to be solid unless approved by the Engineer in writing.

4.2 Conductor Insulation

Listed Below, are the requirements for the conductor insulation:

a) Section 3 of ICEA S-95-658-1999 does not apply to this Specification.

b) The insulation shall be Ethylene-Propylene Rubber and shall conform to AREMA Part 10.3.19.

c) Organic matter or mineral substance which will in it or in the combination with other substances in the compound be injurious to the conductor or the insulation shall not be used.

d) The insulation shall be applied by the continuous tube method without joints; it shall be properly vulcanized, homogeneous in character, tough, elastic concentrically applied about the conductor and shall fit tightly thereto.

e) Repairs in the insulation shall be made in a workmanlike manner so that the repair and all other parts affected by the work shall be as strong and durable electrically and mechanically as the remainder of the insulation, and the insulation thickness shall comply with Table III. The average thickness of the insulation shall not be less than the specified thickness given in Table III.
f) The minimum thickness at any point shall be not less than 95% of that specified for insulation 60 mils or less in thickness, and not less than 90% of that specified for insulation 80 mils or greater in thickness.

g) Individual insulated conductors may be covered with a neoprene compound sheath in accordance with the latest edition of AAR Specification 239 Manual, Part 248, only if applied over the primary thickness of insulation specified and after the water tank testing of the primary insulation.

h) The conductor insulation shall be solid black or other solid natural color. The color shall be solid throughout the insulation. A coating of color is not permitted.

i) All conductors shall be numbered sequentially with number print: (1-ONE, 2-TWO, 3-THREE, etc.) The printing, on each conductor, shall be no greater than 6 inches apart. The printing color shall contrast with the conductor color and be applied so as to prevent the loss or transfer of identification during manufacture or installation. The printing shall meet the requirements of UL 1581 and be tested to part 1690 under section "Durability of Indelible -Ink Printing".

j) A tracer conductor shall be provided identifying each layer in a multi-layer cable. The tracer conductor may be a contrasting color or be labeled "TRACER". In either case, the tracer conductor shall be numbered to follow the sequential numbering of the conductors.

k) All conductor insulation shall be made for free and easy stripping.
4.3 **Cabling**

Listed Below, are the requirements for the cable configuration:

a) **Multi-Pair Shielded Type (6 Pair Twisted and Shielded):**

1) Two individual #14 Awg solid tinned insulated conductors shall be twisted together to form a pair. The conductor insulation shall be of contrasting colors (Black/White or Black/Natural). The conductor insulation shall be solid throughout the insulation.

2) The completed pair shall be covered with a copper/mylar tape. A bare #16 Awg (7 strand) bare copper drain wire shall be laid on top of the mylar in contact with the copper layer. An overall wrap of mylar tape shall be applied over the completed wrapped conductors.

3) Each conductor within each pair shall be uniquely labeled to identify the pair number and the conductor number.

4) When fillers are necessary to make the cable round, they shall be non-hygroscopic non-wicking and flame resistant consistent with the conductor insulation used to assemble the cable into a tight cylindrical core.

b) **Straight-Layered Type (Express, Signal Cable or Power):**

1) The required number of conductors shall be cabled helically with adjacent layers twisted in the opposite directions conforming to ICEA S-95-658.

2) The color of all conductor insulation shall be as indicated above.

3) All conductors shall be numbered as indicated above.

4) Tracer conductors shall be provided as indicated above.
5) Conductor 1-ONE shall be at the core of the cable with the highest number in the outer wrap of the cable.

6) When fillers are necessary to make the cable round, they shall be non-hygroscopic non-wicking and flame resistant consistent with the conductor insulation used to assemble the cable into a tight cylindrical core.

c) Track Wire:

1) Track wire shall be #6 Awg tinned solid with one twist per foot. Individual conductors insulated with Ethylene-Propylene Rubber and jacked with Polyethylene with thicknesses consistent with these specifications. The final twisted pair duplex shall not be jacketed.

2) One conductor of the pair shall be clearly marked on the outer jacket. The marking shall be of a permanent nature such as a white stripe or ridge in the jacket; or be colored white; or be colored red.

d) Composite (Switch or Gate):

1) Composite Switch Cables shall be configured with the 5 - # 9 Awg. Conductors at the core of the cable and the 12 - # 14 Awg. Conductors in the outer wrap. Mixing the #9 and # 14 conductors is NOT permitted.

2) Composite Gate Cables shall be configured with the 7 - # 14 Awg. Conductors at the core and the 10 - # 9 Awg. Conductors in the outer wrap. Mixing the #9 and # 14 conductors is NOT permitted.

3) The required number of conductors shall be cabled helically with adjacent layers twisted in the opposite directions conforming to ICEA S-95-658.

4) The color of all conductor insulation shall be as indicated above.

5) All conductors shall be numbered as indicated above.

6) Tracer conductors shall be provided as indicated above.
7) Conductor 1-ONE shall be at the core of the cable with the highest number in the outer wrap of the cable.

8) When fillers are necessary to make the cable round, they shall be non-hygroscopic non-wicking and flame resistant consistent with the conductor insulation used to assemble the cable into a tight cylindrical core.

4.4 Outer Coverings

Listed Below, are the requirements for the cable outer covering:

a) A shock absorbing cushion layer of flame and moisture resistant elastomer material shall be extruded over the cable assembly. The average bedding thickness shall be in accordance with Table I.

b) A pull cord shall be included beneath the cushion layer to provide for stripping for splicing or terminating.

c) For Direct Burial cables a 10 mil bronze armor tape helically wrapped (AREMA 10.3.17 type I) or corrugated and applied longitudinally (AREMA 10.3.17 type III) over the cushion layer with a minimum overlap of 20 percent. The 10 mill bronze armor shall be provided for all signal cable, switch cable, crossing gate cable, mechanized signal cable and power cable and others as specified in the Request for Bid or other procurement documents.

d) For Aerial/Duct/Tray applications ONLY, a 7 mil flat copper tape helically applied (AREMA 10.3.17 type V) over the cushion layer with a minimum overlap of 20 percent is permitted. The 7 mill copper armor shall be provided for all line cable, express cable and others as specified in the Request for Bid or other procurement documents.
e) Direct Burial cables shall be used for all installations where ANY contact with earth or ballast occurs. Continuous un-interrupted conduit is required from cable tray or aerial installation into ballast or earth to a junction box or case. The Direct Burial cable shall be used for any mixed types of installation. No splices are permitted to change cable type.

f) Bronze or copper tapes, when required, shall be electrically continuous throughout the length of the cable.

g) Low smoke cable shall have a jacket of crosslinked polyolefin; these jackets shall conform to the requirements of ICEA T-33-655 Thermoset Type II.

h) All other cable shall have a jacket of extruded black, low density, high molecular weight polyethylene conforming to Type I, Class C, Grade E-5 in accordance with ASTM-D1248.

i) The average thickness of the jacket shall be not less than that listed in Table II and the minimum thickness at any point shall not be less than 90 percent of the specified value.

j) Color identification shall be clear, durable and of easily distinguished shades and shall have no deleterious effect on any part of the completed cable.

k) Cable Identification

The following information shall be indelibly placed (indented) on the exterior of the jacket at an interval of 3 feet for the entire length of the cable:

a) Name of the manufacture;
b) year of manufacture;
c) voltage rating;
d) cable composition and type;
e) The text "Property of Metro-North Railroad".
f) Low smoke cables shall have the text "Low Smoke".
g) Cables suitable for direct burial shall have the text "Burial".
h) Cables suitable for aerial, duct or tray shall be marked "Aerial".
Technical Specification for Signal Cables
Revision 5.0 January 15, 2013

The characters shall be a minimum of 1/8 inch high. The indented characters shall be of a bold printing and clearly visible. The use of a filled character labeling system is not permitted.

In addition, a mark shall be indelibly placed at an interval of 10 feet for the entire length of the cable as an inventory control measure.

I) Manufacture’s Identification Marker

A waterproof marker tape bearing the name of the manufacturer, and a serial number for identification purposes will appear at such intervals that all information may be obtained without destroying more than one foot of cable, shall be inserted in the cable. This serial number shall also be stenciled on each cable reel or coil tag (per section 1.4 "marking" of this Specification.). The text "Property of Metro-North Railroad" shall also appear on this marker tape, in addition a marker tape will be a measure for the length in feet of the cable. As stated in section 1.4.1 j, the reading on the end of the cable near the drum shall be listed with the other required markings on the outside of the reel.

m) Outside Diameter

The outside diameter of the finished cable shall meet the following tolerances:

<table>
<thead>
<tr>
<th>Diameter of Finished Cable</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 0.600”</td>
<td>+0.030”</td>
</tr>
<tr>
<td>0.601 to 2.000”</td>
<td>+5%</td>
</tr>
<tr>
<td>2.001 and over</td>
<td>+3%</td>
</tr>
</tbody>
</table>

NOTE: FOR TWIN CONDUCTOR CABLE THE MAJOR AXIS SHALL BE TAKEN.
5.0 Production Tests of Conductors and Cable

5.1 Insulated Conductors

5.1.1 AC and DC Tests:

Each length of conductor, insulated with prime insulation, prior to application of any outer jacket and prior to cabling or twisting, shall be random wound on spools and immersed in water for a minimum of twenty-four (24) hours, then subjected to tests voltages given in table III for five (5) minutes for AC tests, then ten (10) minutes for DC tests without showing signs of punctures. Voltage is to be applied between conductor and water (ground). If the test is interrupted for any reason, duration shall be increased 20% for each interruption.

5.1.2 Insulation Resistance:

The insulation resistance shall be made in accordance with section 2.3 of ICEA Standard T-27-581, using a suitable megohmmeter, galvanometer, electrometer, or high sensitivity bridge. When temperature at which the cable is tested differs from 60 degrees F, the resistance shall be corrected to that at 60 degrees F. The I.R. Constant "K" shall be not less than 25,000 on a 1,000 foot basis.

5.1.3 Test Results:

The results of these tests are to be sent with the cable samples to the Metro-North Communications and Signal for review and approval.

5.2 Finished Cable Tests

5.2.1 Each completed multi-conductor cable when on the shipping reel shall be subjected to and successfully pass the test voltage levels indicated in table III for five (5) minutes, with voltage
applied between alternate conductors and layers of conductors. This alternating-current voltage test shall be made in accordance with Section 2.2 of ICEA Standard T-27-581.

5.2.2 The insulation resistance shall be made in accordance with section 2.3 of ICEA T-27-581/NEMA WC 53 using a suitable megohmometer, galvanometer, electrometer, or high sensitivity bridge. When temperature at which the cable is tested differs from 60 degrees F, the resistance shall be corrected to that at 60 degrees F, using the procedure detailed in ICEA T-27-581 WC 53. The I.R. Constant "K" shall be not less than 25,000 on a 1,000 foot basis.

5.3 Test Results

5.3.1 The results of these tests are to be sent with the cable samples to Metro-North Communications and Signal.
### 6.0 Tables

#### Table I – Average Thickness (Cushion Layer)

<table>
<thead>
<tr>
<th>Core Diameter – inches</th>
<th>Thickness – Mils</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 1.500</td>
<td>47</td>
</tr>
<tr>
<td>1.501 and larger</td>
<td>62</td>
</tr>
</tbody>
</table>

#### Table II – Average Polyethylene Jacket Thickness

<table>
<thead>
<tr>
<th>Calculated Core – inches</th>
<th>Thickness – Mils</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000 to 0.425</td>
<td>60</td>
</tr>
<tr>
<td>0.426 to 0.700</td>
<td>80</td>
</tr>
<tr>
<td>0.701 to 1.050</td>
<td>95</td>
</tr>
<tr>
<td>1.051 to 1.500</td>
<td>110</td>
</tr>
<tr>
<td>1.501 to 2.000</td>
<td>140</td>
</tr>
<tr>
<td>2.001 to 3.000</td>
<td>155</td>
</tr>
<tr>
<td>3.001 to larger</td>
<td>190</td>
</tr>
</tbody>
</table>

#### Table III – Insulation Thickness and Test Voltages

<table>
<thead>
<tr>
<th>Application/Rated Circuit Voltage</th>
<th>Size of Conductor A.W.G.</th>
<th>Insulation Thickness Mils</th>
<th>AC Test Voltage (see 2.5.1)</th>
<th>DC Test Voltage (see 2.5.1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 300V</td>
<td>19 to 12</td>
<td>30</td>
<td>2,000</td>
<td>N/A</td>
</tr>
<tr>
<td>AERIAL/DUCT/TRAY 0 to 600V</td>
<td>18 to 8</td>
<td>45</td>
<td>6,000</td>
<td>18,000</td>
</tr>
<tr>
<td>AERIAL/DUCT/TRAY 0 to 600</td>
<td>7 to 2</td>
<td>60</td>
<td>8,000</td>
<td>24,000</td>
</tr>
<tr>
<td>AERIAL/DUCT/TRAY 0 to 600V</td>
<td>1 to 0000</td>
<td>80</td>
<td>10,000</td>
<td>30,000</td>
</tr>
<tr>
<td>BURIAL 0 to 600V</td>
<td>18 to 8</td>
<td>80</td>
<td>10,000</td>
<td>30,000</td>
</tr>
<tr>
<td>BURIAL 0 to 600V</td>
<td>7 to 2</td>
<td>95</td>
<td>11,000</td>
<td>33,000</td>
</tr>
<tr>
<td>BURIAL 0 to 600V</td>
<td>1 to 500 MCM</td>
<td>110</td>
<td>12,000</td>
<td>36,000</td>
</tr>
</tbody>
</table>
NOTE: Test Voltages on completed cables shall be values shown in table above

Table IV – Thickness of Neoprene, Hypalon or Polyethylene Jacket for Single Conductor Wire and Cable.

<table>
<thead>
<tr>
<th>Conductor Size AWG</th>
<th>Jacket Thickness (0-600 Volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 to 9</td>
<td>32 mils</td>
</tr>
<tr>
<td>14 to 9</td>
<td>50 mils</td>
</tr>
<tr>
<td>8 to 4</td>
<td>50 mils</td>
</tr>
<tr>
<td>3 to 1</td>
<td>64 mils</td>
</tr>
<tr>
<td>0 to 000</td>
<td>64 mils</td>
</tr>
<tr>
<td>0000</td>
<td>80 mils</td>
</tr>
<tr>
<td>500 MCM</td>
<td>95 mils</td>
</tr>
</tbody>
</table>
7.0 Specifications for Low Smoke Zero Halogen Jacket

Material: Crosslinked polyolefin

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>GUARANTEED VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Tensile, PSI</td>
<td>1600</td>
</tr>
<tr>
<td>Original Elongation at Break</td>
<td>150%</td>
</tr>
<tr>
<td>AIR OVEN AGED 168 HRS. @ 121° C</td>
<td></td>
</tr>
<tr>
<td>Tensile - %Original</td>
<td>80</td>
</tr>
<tr>
<td>Elongation - %Original</td>
<td>70</td>
</tr>
<tr>
<td>AIR OVEN AGED 168 HRS. @ 150° C</td>
<td></td>
</tr>
<tr>
<td>Tensile - %Original</td>
<td>60</td>
</tr>
<tr>
<td>Elongation - %Original</td>
<td>50</td>
</tr>
<tr>
<td>OIL RESISTANCE (ASTM IRM-902 oil) 18 Hrs at 121° C</td>
<td></td>
</tr>
<tr>
<td>Tensile - %Original</td>
<td>60</td>
</tr>
<tr>
<td>Elongation - %Original</td>
<td>50</td>
</tr>
<tr>
<td>DUROMETER – SHORE A</td>
<td>90±3</td>
</tr>
<tr>
<td>LOW TEMP FLEX per ICEA S-95-658-1999 Paragraph 4.2</td>
<td>-40° C – PASS</td>
</tr>
<tr>
<td>GALVIMETRIC WATER ABSORPTION per ASTM D-470 168 Hrs. @ 70° C mg/in</td>
<td>20 max</td>
</tr>
<tr>
<td>OXYGEN INDEX – ASTM D-2863</td>
<td>33 min</td>
</tr>
<tr>
<td>OZONE- RESISTANCE-ASTM D-470 1 Hr. 300ppm</td>
<td>No Cracks</td>
</tr>
<tr>
<td>TEAR STRENGTH LBS/IN ASTM 624</td>
<td>35</td>
</tr>
<tr>
<td>SMOKE GENERATION - (100 mil slabs)</td>
<td></td>
</tr>
<tr>
<td>Flaming Ds – 4min</td>
<td>25</td>
</tr>
<tr>
<td>Flaming Dm – 20min</td>
<td>160</td>
</tr>
<tr>
<td>Non-Flaming Ds – 4min</td>
<td>20</td>
</tr>
<tr>
<td>Non-Flaming Dm – 20min</td>
<td>275</td>
</tr>
<tr>
<td>ACID GAS EQUIVALENT MIL C-24643</td>
<td>0.3% max</td>
</tr>
<tr>
<td>HALOGEN CONTENT</td>
<td>0.2% Max</td>
</tr>
</tbody>
</table>
Technical Specification for Signal Cables
Revision 5.0 January 15, 2013

Cable Description:

Component Description:
A: Conductor:
B: Filler:
C: Binder:
D: Cushion:
E: Armor:
F: Jacket:

Print Legend Description:
A: Marker Tape:
B: Jacket Marking:

Physical Characteristics Description:
A: Cable Weight:
B: Copper Weight:
C: Nominal Cable OD:
D: Conductor Color Code:
E: Jacket Color:
F: Maximum Conductor Pulling Tension:
G: Maximum Jacket Pulling Tension:
H: Minimum Training Bending Radius:
I: Minimum Pulling Bending Radius:

Manufacture Information Details:
A: Address:
B: Manufacturing plant:
C: Contract or Purchase Order Number:
D: Other Information

Figure 1 - Typical Cable Product Submittal Format
APPENDIX E

NEW YORK CITY TRANSIT AUTHORITY FIBER OPTIC TESTING SPECIFICATION AND PROCEDURES
NEW YORK CITY TRANSIT AUTHORITY

Fiber Optic Testing Specification and Procedures

New York City Transit Authority
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Testing Fiber-Optic Links

The equipment and procedures described in this Specification shall be used to test New York City Transit Authority (NYCTA) fiber optic plant. A schematic view of that plant is shown in Figure 1-1. The fiber plant includes outside plant cables in tunnels, aerial, submarine, underground conduits, and buried in the soil; buildings (plenum and risers); and a combination of these applications. All cables, regardless of their intended or eventual use shall be tested as described herein unless directed otherwise by NYCTA.

Figure 1-1. – Schematic View of Fiber Plant to be Tested

1. Introduction to Testing Fiber Components and Fiber-optic Cable

This Section describes NYCTA’s fiber-optic testing requirements for fiber-optic network construction that will carry communications. It also details the actual procedures required to make these fiber measurements. The fiber measurements can be separated into the following three categories:

1. Pre-construction: testing new materials received.
2. During construction: testing the fiber plant that is being constructed.
3. Post-construction: testing the fiber plant after construction is completed.

The fiber test equipment listed in Table 1-1 shall be used to test the fiber plant: both singlemode and multimode fiber cables. All test equipment shall be calibrated on a regular basis, following the testset manufacturer’s recommendations, and be in good working condition. Three categories of testsets are listed. The first two are required for normal fiber testing and the third is for testing of high-volume, high-speed communications systems:

1. An optical time domain reflectometer (OTDR) is used to measure fiber length, locate problems, and measure the reflection characteristics of the fiber link and its joints. OTDRs can also be used to estimate end-to-end link attenuation.
2. Optical loss test equipment including either an optical loss testset (OLTS) or a stabilized light source (SLS) and an optical power meter (OPM) are used to measure optical power output from transmitters and end-to-end link attenuation.

3. Dispersion test equipment is used to determine the signal dispersion\(^1\) caused in a fiber link. Two types of dispersion are commonly experienced in singlemode fiber: chromatic dispersion and polarization mode dispersion. Chromatic dispersion (CD) test sets determine the signal broadening due to the spectral width of the transmission system’s transmitter. Polarization mode dispersion (PMD) test sets determine the delay between the two principal states of polarization of the received signal caused by polarization effects in the fiber link. Except for high-speed systems (10 Gbps or greater), it is not measured in the field. Fiber and cable manufacturers generally control both types of dispersion as they draw the fiber and construct the cable. Fiber cable users generally limit these effects on their networks through controls in their fiber procurement specifications.

Table 1-1. – Summary of Optical Tests Sets for Checking the Fiber Plant

<table>
<thead>
<tr>
<th>Testset</th>
<th>Test Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Time Domain Reflectometer</td>
<td>• Check length and attenuation coefficient of cable</td>
</tr>
<tr>
<td></td>
<td>• Record completed fiber trace</td>
</tr>
<tr>
<td></td>
<td>• Shows reflectance of each splice, optical return loss of the fiber link, splice insertion loss (estimate), and end-to-end loss of fiber link (estimate).</td>
</tr>
<tr>
<td>Optical Loss Testset</td>
<td>• Determines the end-to-end loss of the fiber link.</td>
</tr>
<tr>
<td>Stabilized light source</td>
<td>• Some OLTSs can also measure the fiber link’s optical return loss.</td>
</tr>
<tr>
<td>Optical Power Meter</td>
<td>• Determines the pulse dispersion in an optical signal resulting from the fiber link’s polarization characteristics.</td>
</tr>
<tr>
<td>PMD Tester</td>
<td>• Determines the pulse dispersion in an optical signal resulting from the fiber link’s chromatic dispersive characteristics.</td>
</tr>
<tr>
<td>CD Tester</td>
<td>• Determines the pulse dispersion in an optical signal resulting from the fiber link’s chromatic dispersive characteristics.</td>
</tr>
</tbody>
</table>

A second category of test sets, to test the performance of the end transmission equipment is not covered in this document. This second category of test sets is used to verify and trouble-shoot the system performance once the fiber plant is in place and has been determined to be of acceptable quality to

---

\(^{1}\) Signal dispersion is characterized by a broadening of the signal pulse. If pulses are spaced sufficiently close for the broadened pulses to overlap, received signal errors will occur.
support the intended system. A listing of these system performance testsets is given in Table 1-2. Tests performed using these testsets are normally performed by network equipment suppliers to setup new transmission equipment and to troubleshoot in-place equipment once the fiber plant is found to be acceptable. Most transmission equipment includes systems that monitor their performance. If their performance drops below specified threshold level, alarms alert service personnel of deterioration in system performance.

When a system alarm occurs, the transmission system's trouble-shooting procedures are followed to isolate the board that may be causing the problem. A defective system board is replaced with a good one and the defective board is returned to the manufacturer or service bureau for repair. If system tests are required, system equipment providers or specialists generally perform them.

Table 1-2. – Summary of Optical Testsets to Check the Network Equipment and System Performance

<table>
<thead>
<tr>
<th>Testset</th>
<th>Test Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Spectrum Analyzer</td>
<td>• Can be used to check output from network equipment.</td>
</tr>
<tr>
<td></td>
<td>• Shows the wavelength and power level of each channel in a multi-channel or single channel system.</td>
</tr>
<tr>
<td></td>
<td>• Can be used to measure signal to noise ratio of individual channels.</td>
</tr>
<tr>
<td>Bit-Error Testset</td>
<td>• Used to check overall performance of a system by measuring errors transmitted.</td>
</tr>
<tr>
<td>Protocol Analyzer</td>
<td>• Used to check the individual packets of transported information.</td>
</tr>
<tr>
<td></td>
<td>• Testsets specifically designed for end-use transport systems are available: SONET, SDH, ATM, etc.</td>
</tr>
</tbody>
</table>

2. Pre-Construction Testing

Pre-construction testing shall be done on new materials as they are delivered to the construction materials staging area. The most important operation for the pre-construction testing is a careful visual inspection of the packaging of the products as they are received. Pre-construction testing shall include the following procedures:

1. **Small items:** If no shipping damage is observed in the packaging, store the item for future use. If the outer packaging is damaged, open the shipping container and carefully inspect the item. Items such as fiber couplers, jumpers, or any other items that have optical fibers as part of their assembly should
be carefully handled, but need to be examined for broken fibers. If any damage is noted or suspected, notify the product’s supplier to determine the condition and disposition of the product.

2. Large Items: If no shipping damage is observed in the packaging, store the item for future use. If the outer packaging is damaged, carefully unpack the item and inspect the item for damage. Items that have optical fibers or components as part of their assembly should be carefully handled, but need to be examined for broken fibers. Often equipment will have an instructional manual that will indicate key points of inspection during product inspection or trouble shooting procedures to follow to determine the condition of the product. If any damage is noted or suspected, notify the product’s supplier to determine the condition and disposition of the product.

3. Cable: Inspect the cable reel and its protective covering (lagging and/or environmental/heat shield). If no damage is noted, proceed to Procedure “A” (see below). If damage is noted, proceed to Procedure “B”. Try to determine the extent of the damage; specifically, if the damage extends to the cable sheath or the fibers. If damage includes fiber and/or cable sheath, contact the cable’s supplier to determine the disposition of the cable and follow their instructions. Document the extent of the damage by measuring each of the fibers in the damaged cable with an OTDR.

Cables reels that are lying on their side, have damaged wooden lagging, or a damaged temperature shield should be considered candidates for potential fiber damage. Procedure B should be used to verify that all fibers are undamaged.

PROCEDURE A: If no problems are noticed during visual inspection of cable and reel:

- Randomly select several fibers in each cable to examine with an Optical Time Domain Reflectometer (OTDR) to determine if the cable received matches (or exceeds) the characteristics of the cable ordered. Of particular concern are their length and fiber attenuation coefficients (loss per unit length). Fiber measurements shall be made at the wavelength of the intended system (i.e., if a 1310 nm transmission system is to be installed, measure the fiber at 1310 nm). The OTDR used shall be known to be calibrated and in proper working order.

    NOTE: The fiber group index² setting on the OTDR shall be set to the value provided by the cable supplier. If no value is supplied, use a value of 1.4680.

    If the correct group index is selected, the fiber length should be accurate to within ± 2 to 5 meters (approximately 10 feet). The fiber length always exceeds the cable sheath length by approximately 0.3%. This is done to keep the fiber from being stretched when the cable sheath is pulled during placement and to avoid problems from temperature changes over the cable’s lifetime.

    The loss measurement should be accurate to within 0.05 dB per kilometer.

² The fiber group index is a number that characterizes the speed of the optical test signal in the fiber link. It is the ratio of the speed of light in a vacuum to the speed of OTDR’s optical test pulse as it travels through the fiber link. The group index is used to determine the distance portion of an OTDR measurement; if it is in error, the OTDR’s distance measurement will experience a similar error.
The measured cable length shall equal or exceed the purchased length and the measured fiber attenuation shall fall within the specified limits for the fiber attenuation.

![OTDR Setup for Fiber Measurements](image)

**Figure 2-1. — OTDR Setup for Fiber Measurements**

- Save the OTDR fiber trace for the fibers measured either as a paper record or as a magnetic recording on a computer floppy disk. Each fiber trace record shall be clearly marked to note the cable identification and the fiber measured. It shall also indicate the date of the measurement and the individual who made the measurement.

- Record the results of the OTDR fiber examination on the PRE-CONSTRUCTION Form provided in Error! Reference source not found. Only a few fibers will have been measured, so only a few fibers will be recorded on this form. This form is only used to provide documentation that the as-received condition of the cable was examined. An alternate form of equivalent content and clarity generated by a testset or provided by the tester will be acceptable.

- After testing, restore the cable reel protection to its as-shipped condition to preserve the protection during cable storage.

**PROCEDURE B: If cable or cable reel damage is noticed during visual inspection:**

- All potentially damaged fiber shall be measured with an Optical Time Domain Reflectometer (OTDR) to locate any damage and to determine if the cable received matches (or exceeds) the characteristics of the cable ordered. Of particular concern is its length and fiber attenuation coefficient (loss per unit length). Fiber measurements shall be made at the wavelength of the intended system (i.e., if a 1310 nm transmission system is to be installed, measure the fiber at 1310 nm). The OTDR used shall be known to be in proper working order.

  NOTE: The fiber group index setting on the OTDR shall be set to the value provided by the cable supplier. If no value is supplied, use a value of 1.4680. The length measurement will be in error by the same amount as the error in selecting the proper group index for the fiber.
If the correct group index is selected, the fiber length should be accurate to within ±2 to 5 meters (approximately 10 feet) for typical length measurements. It is very important to know that the fiber length always exceeds the cable sheath length by approximately 0.5%.

The loss measurement should be accurate to within 0.05 dB per kilometer.

- The measured cable length shall equal or exceed the purchased length and the measured fiber attenuation shall fall within the specified limits for the fiber attenuation. If the cable is damaged, the attenuation coefficient will exceed the value guaranteed by the cable manufacturer. If a fiber is broken, its length will be shorter than the ordered length.

- Save the OTDR fiber trace for the fibers measured either as a paper record or as a magnetic recording on a computer floppy disk. Each fiber trace record shall be clearly marked to note the cable identification and the fiber measured. It shall also indicate the date of the measurement and the individual that made the measurement.

- Record the results of the OTDR fiber examination on the PRE-CONSTRUCTION Form provided in Form 2-1. This form is used to provide documentation that the as-received condition of the cable was examined and the extent of the damage noted. An alternate form of equivalent content and clarity generated by a testset or provided by the tester will be acceptable.

  NOTE: The measurement will have little value if it is not clear what it is and when it was made.

- After testing, restore the cable reel protection to its as shipped condition to preserve the protection during cable storage.
## Form 2-1 - Pre-Construction Fiber Cable Inspection Data Sheet

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<th>Cable size (fibers):</th>
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<td>Cable ID:</td>
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<td>OTDR ID:</td>
<td>OTDR Calibration Date:</td>
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</table>

Test Technician: Authorized Witness:

Date: Date:

Title: Title:

Signed

Signed
3. During Construction Testing

3.1 Fusion Splices

If fusion splicing is properly done, using good construction methods (proper cleaving and cleaning techniques; a modern, well maintained fusion splicer set; and good housekeeping procedures in the splice closure), it is not normally necessary to measure each splice with an OTDR as they are made, unless specifically instructed by the NYCTA project engineer.

- All fiber splices shall be made with a modern fusion splicer with a properly working, calibrated profile alignment device.

- Each completed splice shall be examined by the profile alignment mechanism of the fusion splicer and an estimate of the splice loss shall be displayed to the individual that makes the splice.

- A fusion splice shall have a true insertion loss of 0.10 dB or less.

If the splice set's profile alignment splice loss estimate is 0.10 dB or less go to the next fiber to splice. If the splice loss estimate exceeds 0.10 dB, break the splice and remake it. If the splice cannot be made to be 0.10 dB or less after 3 attempts, let it alone, report its location to the splicing supervisor, and go on to the next splice.

Optional Test Procedure for Fusion Splices: The insertion loss of a fusion splice can be estimated with an OTDR located at one end of the cable (one-direction measurement). The fusion splice insertion loss can be accurately measured with a two-way measurement of the splice. Note, this one-way OTDR measurement is only offered as a trouble-shooting or preliminary test procedure. All final OTDR measurements shall be two-way measurements.

- If a one-way OTDR measurement of the fusion splice shows an increase in power across the splice or an insertion loss less than or equal to 0.20 dB, the fusion splice loss is acceptable. If the measured insertion loss exceeds 0.20 dB, remake the splice up to three times until it falls within the acceptable limits for the splice. Using 0.20 dB as the threshold value for one-way OTDR measurements will greatly increase the probability that all fusion splices 0.10 dB or less will not be remade. It will also ensure that poor quality fusion splices are located and repaired.

3.2 Non-Fusion Splices

A non-fusion splicing method can be used for repair splices. For these splices it is necessary to measure the insertion loss (dB) and reflectance (dB) as each splice made.

---

7 The splice is measured from each end of the fiber link. The insertion loss of the splice point as measured from each end of the link is averaged to yield the accurate insertion loss of the splice.
• A non-fusion splice shall have a true insertion loss of 0.25 dB or less, as measured with an average of OTDR measurements from opposite ends of the fiber link.

The insertion loss and reflectance measurement of non-fusion splices can be estimated with an OTDR located at one end of the cable (one-direction measurement). Note, this one-way OTDR measurement is only offered as a trouble-shooting or preliminary test procedure. All final OTDR measurements shall be two-way measurements.

If the one-way OTDR measurement shows an increase in power across the splice or an insertion loss less than or equal to 0.40 dB, the non-fusion splice loss is acceptable. If the measured insertion loss exceeds 0.40 dB, remake the splice up to three times until it falls within the acceptable limits for the splice. Using 0.40 dB as the threshold value for one-way OTDR measurements will greatly increase the probability that all non-fusion splices 0.40 dB or less will not be remade. It will also ensure that poor quality non-fusion splices are located and repaired.

During the same OTDR measurement check the reflectance of the splice. It shall not be more reflective than −40 dB. If the splice exceeds this value (any value more reflective than −40 dB, e.g., −39 dB and −20 dB are more reflective than −40 dB, but −45 dB is less reflective than −40 dB), remake the splice. Often mechanical connectors can be made to meet the reflectance requirement by carefully cleaning the mating connectors.

Any fiber splice problems shall be noted and reported to the construction supervisor.

3.3 Mechanical Connectors

Mechanical connectors are used to join fiber plant to communications equipment or to provide flexibility redirecting fiber plant facilities. Most often fiber connectors are located in fiber distributing frames. Unless connectors are part of a continuing fiber link, they generally will not need to be measured. If the system they support has difficulties meeting expected performance levels, the connectors should be measured with an OTDR using a 1-km long lead-in fiber. For these measurements it is necessary to measure the insertion loss (dB) and reflectance (dB) of the mechanical connector.

• Before any connector measurements are made the fiber connectors shall be cleaned and remated. The system shall be retested, and if it is still having problems, the fiber connectors shall be measured for insertion loss and reflectance.

• A mated connector shall have a true insertion loss of 0.35 dB and a reflectance of −40 dB or less (if the fiber is being used for analog video transmissions the reflectance shall be −55 dB or less).

* If video signals are going to be transported by the fiber, the acceptable reflectance threshold shall be −55 dB, not −40 dB.
4. Post-Construction Testing

Post-construction measurements become part of the historical record for each fiber. They shall be stored in an easily accessible location and retrieved when a fiber experiences a problem or when the fiber link is being examined for a system upgrade. Table 4-1 shows the optical fiber test sets that are used to make the post-construction fiber-optic measurements:

<table>
<thead>
<tr>
<th>Testset</th>
<th>Test Function</th>
</tr>
</thead>
</table>
| Optical Time Domain Reflectometer (OTDR) | • Record completed fiber trace  
  • Shows reflectance of each splice, optical return loss of the fiber link, splice insertion loss (estimate), and end-to-end loss of fiber link (estimate). |
| Optical Loss Test Set (OLTS) | • Determines the end-to-end loss of the fiber link.  
  • Some OLTSs can also measure the fiber link’s optical return loss. |
| Stabilized Light Source (SLS) and Optical Power Meter (OPM) |  |
| Polarization Mode Dispersion Test Set (PMD Tester) | • Determine the pulse spreading due to fiber link polarization effects. ONLY USED FOR HIGH SPEED DIGITAL SYSTEMS (10 Gbps\(^3\) or greater) or SYSTEMS CARRYING VIDEO. |

Four fiber parameters are measured after the completion of the fiber link construction:

- **Link loss often known as end-to-end loss.** This is the total attenuation that occurs from one end of the fiber link to the other. It includes losses caused by the normal attenuation in the fiber, splices, and any other devices installed in the link. It is measured in decibels (dB).

- **Link optical return loss (ORL).** This is a measure of the optical power that is reflected back to the transmitter end of the fiber as compared to the total optical power launched into the fiber. It includes the fiber’s backscattered light, light reflected from individual splices and connectors, and light reflected from any other devices in the link. It is measured in decibels (dB).

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\(^3\) Gbps is giga-bits per second. 1 Gbps is equal to one billion (10\(^9\)) bits per second.
• **Splice insertion loss.** This is the optical power loss at each splice point or fiber joint. It is measured as a ratio in decibels (dB) of the optical power that leaves a joint as compared to the optical power that enters the joint.

• **Splice and connector reflectance.** This is a measure of the optical power that is reflected off an individual event (splice, connector, and device) in the fiber. It is measured as a ratio in decibels (dB) of the optical power that strikes an event as compared to the optical power that is reflected from the event.

A fifth fiber parameter is measured if the fiber plant will be used to transport high speed digital systems (> 10 Gbps) or video:

• **Polarization Mode Dispersion (PMD).** PMD is the difference in arrival time at the receiver of the portions of the signal that are in the two principal states of polarization. The larger the delay (PMD), the greater the chance for receiver errors in the interpretation of the arriving information (bit errors).

These fiber characteristics are properties of either the fiber link or of individual events in the fiber link.

• **Fiber event properties:** Splice or joint loss and event reflectance.

• **Fiber link properties:** Link loss, optical return loss, and PMD.

Make the following post-construction fiber measurements:

• Measure each fiber in the fiber plant to determine if the fiber’s loss budget and maximum allowable optical return loss (ORL) is exceeded. The end-to-end loss of the fiber link can be measured using an optical loss test set (OLTS).

  A modern OLTS has a stabilized light source and an optical power meter. Two OLTSs are used to make a fiber link end-to-end measurement: one is connected to each end of the fiber link. OLTSs are designed with the hardware, software, and electronics that enable them to make the end-to-end measurement automatically at 1310 nm and 1550 nm in both directions and average the results. Many OLTSs can store the bi-directional end-to-end measurements and then can download them to a computer for storage or to a printer for output.

  As an alternative to an OLTS, a separate stabilized light source (SLS) and an optical power meter (OPM) can be used for the fiber link end-to-end measurement.

An OTDR is capable of measuring ORL and estimating end-to-end link loss.

• Measure each completed fiber splice in the fiber plant to determine the magnitude of its insertion loss and reflectance. These measurements are made using an optical time domain reflectometer (OTDR).

  OTDRs send a short pulse of light down the fiber. As the light passes down the fiber a portion of the forward going energy is reflected back to the OTDR, much like radar. By measuring the intensity of the reflected power and the time it takes to return to the OTDR, the OTDR can determine the loss and reflectance of individual splices in the fiber link. The OTDR is the only testset that can be used to determine individual splice quality (loss and reflectance). To make an accurate measurement of the insertion loss of individual splices, it is necessary to measure the splice loss from both ends of the
fiber link. The true splice loss is then calculated by averaging the splice loss of each splice as measured from each end of the fiber link. Some OTDRs are capable of saving the two fiber traces (one trace from each end of the fiber link) and performing the calculation to determine the true splice loss by averaging the bi-directional measurements of each splice loss. If an OTDR is used that can not perform this measurement automatically, the bi-directional measurements of the insertion loss of each splice point must be averaged manually.

The OTDR can also be used to determine the reflectance of each splice point. It is not necessary to compute the bi-directional average of the reflectance of each splice point.

Figure 4-1. – Typical Optical Loss Testsets (OLTSs)

Fiber links that are only expected to provide transport for systems with transmission rates of 2.5 Gbps or less need only be tested to determine their end-to-end link loss, link ORL, individual splice loss, and individual splice reflectance. However, fiber lengths that are longer than 75 miles that will be used for transmission rates of 10 Gbps or greater need to have their PMD characteristics determined in addition to end-to-end link loss, link ORL, individual splice loss, and individual splice reflectance. This is done using a PMD testset that measures the fiber link’s PMD delay in pico-seconds (ps).

Multimode Versus Singlemode Measurements

Measurements of fiber links with cable of either singlemode or multimode fiber are made using generally the same procedures. These procedures follow in Section 5. Fiber optic test sets should be matched to the type fiber used. Specifically, multimode fiber should be measured with multimode testsets and singlemode fiber with singlemode testsets. Fiber jumpers used to connect the testsets to the fiber link being measured should be matched to the type fiber in the link, e.g., multimode jumpers for multimode fiber and singlemode jumpers for singlemode fiber.

Often multimode fiber is more difficult to measure because of the many modes it supports. As a result the fiber jumpers should be laid out as straight as possible and taped in place before measurements begin.
Unless specifically instructed otherwise by the NYCTA project manager, multimode systems will be measured at 850 nm and 1300 nm. Similarly, singlemode systems will be tested at 1310 nm and 1550 nm.

Since most outside plant fiber systems are singlemode, the remainder of this document will concentrate on the measurement of singlemode fiber.

![Stabilized Light Source (SLS)](image)

**Figure 4-2. – Stabilized Light Source (SLS)**

![Typical Optical Power Meter (OPM)](image)

**Figure 4-3. – Typical Optical Power Meter (OPM)**

### 5. Use of Common Optical Testsets

Before any measurements are made, the fiber connector ends and optical jumpers shall be thoroughly cleaned with alcohol using lint-free wipers and blown dry with compressed, clean air.
End-to-end fiber link loss measurements are made at both 1310 nm and 1550 nm using both a stabilized light source and power meter or an optical loss testset. In addition, traces are made of each fiber with an optical time domain reflectometer (OTDR) at both 1310 nm and 1550 nm. The fiber trace will be used to troubleshoot any future fiber problems and to determine the individual loss and reflectance of each splice. The OTDR trace will also provide the optical return loss for the fiber link.

NOTE: Dirty connectors can cause significant measurement errors. All connections shall be thoroughly cleaned before beginning any measurement.

5.1 Use of a Stabilized Light Source (SLS) and Optical Power Meter (OPM)

Fiber link loss measurements can be made with a SLS and OPM. Figure 5-1 shows the basic measurement procedure used to determine end-to-end fiber loss using a separate SLS and OPM. The following test procedure is recommended for determining end-to-end fiber attenuation using an OPM and SLS:

1. The light source and the power meter shall be brought together before the measurement to store the value of the light source’s optical output in the optical power meter as a reference level.

2. Attach the stabilized light source to one end of the fiber link.

3. Take the optical power meter to the opposite end of the fiber link. Attach the power meter to the fiber link and measure the optical power being emitted out the end of the fiber link from the testset’s light source.

4. The difference between the reference level stored in the power meter (the unattenuated power level emitted by the light source) and the optical power level at the far end of the fiber link is the end-to-end loss of the fiber link.
Step 1: Measure optical power from SLS with OPM. If necessary adjust SLS power to convenient level. Zero OPM: set final SLS power level as reference datum on OPM.

Step 2: Connect SLS to one end of fiber link.

Step 3: Take OPM to opposite end of fiber link. Attach OPM to far-end of fiber link.

Step 4: Measure fiber link with zeroed OPM and SLS. Reference for OPM is set to SLS Power from Step 1.

Figure 5-1. — Use of SLS and OPM to Measure Fiber Link Loss
5.2 Use of a Optical Loss Testset (OLTS)

Alternatively, link-loss power measurements can be made with an OLTS. Figure 5-2 shows the basic measurement procedure used to determine end-to-end fiber loss using an OLTS. The following test procedure is recommended for determining end-to-end fiber attenuation using an OLTS:

1. Take one OLTS unit to each end of the fiber link and attach each to the fiber end.

2. Turn both units on.

3. Press the start automatic measurement button. The operation of the OLTS is automatic, once the operator presses the start button. OLTS manufactured by different manufacturers will work slightly differently. Basically, the following procedures are followed during the setup, zeroing, and measurement process:
   a) The transmitter of each OLTS is set to 1310 nm.
   b) The transmitter of each OLTS is automatically adjusted to a preset standard power level (approximately -10 dBm).
   c) The receiver of each OLTS is set to the reference power level.
   d) Measurements are started in one direction, e.g., East to West.
   e) The far receiver (e.g., West) measures the link loss. The loss is stored in the OLTS' memory.
   f) The process is repeated in the opposite direction (e.g., West to East). The loss is stored in the OLTS' memory. The link losses measured in the two directions is averaged and stored in the OLTS memory.
   g) After the 1310 nm measurements are completed, the entire procedure is repeated at 1550 nm.

4. Record the end-to-end fiber link loss on the forms provided or store in an electronic database.

5. If the fiber link loss is greater than the loss budget for the link, it will be necessary to determine the cause and location of the fiber event that is causing the high link loss. An OTDR will need to be used to trouble-shoot the fiber link to locate and determine the nature of the problem.
5.3 Use of an Optical Time Domain Reflectometer (OTDR)

After the fiber link loss has been made, use an OTDR to record a trace for each fiber. Figure 5-3 shows the basic measurement procedure used to obtain a fiber trace using an OTDR. The trace will provide a tool for future maintenance operations on the fiber and will enable splice loss, event reflectance, and optical return loss of the link to be determined. The OTDR is used as follows:

1. Attach an OTDR to one end of the fiber link.

2. Most OTDRs have a one button, automatic mode of operation in which the complete fiber measurement is made, analyzed, and presented in a summary table without operator interaction. Using the automatic mode of operation, the OTDR will produce a fiber trace for both 1310 nm and 1550 nm. Each trace will be processed by the OTDR's analysis software to locate and determine the magnitude of each fiber event (normally each splice). The analysis software also will determine the reflectance of each fiber event and the optical fiber return loss of the entire fiber link.
3. If the reflectance of any fiber joint exceeds $-40$ dB ($-55$ dB if the fiber is intended for video transport), the joint shall be rebuilt to reduce its reflectance.

![OTDR Setup for Post-Construction Measurements](image)

**Figure 5-3.** OTDR Setup for Post-Construction Measurements

### 6. Post-Construction Fiber Records

The OTDR fiber trace is used as a historical record of the fiber’s as-built condition. The fiber trace at both measurement wavelengths shall be stored for later access. Form 6-1 through Form 6-4 provide data sheets to record post-construction singlemode and multimode fiber measurement results. Alternate forms of equivalent content and clarity generated by a test set or provided by the tester will be acceptable.

Local requirements will determine what threshold measurement values will be used to judge if the post-construction measurement results indicate that the fiber plant has been properly constructed. The values listed in Table 6-1 provide normally accepted threshold limits for post-construction fiber test measurements. OTDR measurement thresholds are listed for one-way (for trouble-shooting purposes only) and two-way OTDR measurements. As discussed earlier, making a two-way average OTDR measurement of the fiber link are the only way to ensure that accurate insertion loss of individual splices and connectors are determined.

If any of the post-construction measurements made exceed the values listed in Table 6-1 (or the local requirements), the fiber link shall be carefully examined with an OTDR to locate the source of the problem. Once the problem is found, it shall be repaired.
### Form 6-1 - Post-Construction Singlemode Fiber Plant Link Loss Measurements

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**Remarks:**

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<th>Fiber No.</th>
<th>From 1310</th>
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<th>Average Loss dB</th>
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**Test Technician:**

**Authorized Witness:**

Date:

Title:

Signed:
Form 6-2 - Post-Construction Multimode Fiber Plant Link Loss Measurements

<table>
<thead>
<tr>
<th>POST-CONSTRUCTION MULTIMODE FIBER LINK LOSS</th>
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<td>Cable ID:</td>
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<td>Cable Size:</td>
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<td>Cable Length:</td>
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<td>Loss Budget:</td>
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<td>Calibration Date:</td>
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<td>OLTS ID:</td>
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<td>SLS ID:</td>
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<td>OPM ID:</td>
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**Link:**

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**Test Technician**

Date:  
Title:  
Signed:  

**Authorized Witness**

Date:  
Title:  
Signed:
### Form 6-3 - Post-Construction Fiber Plant Splice Loss Measurements

<table>
<thead>
<tr>
<th>POST-CONSTRUCTION FIBER SPLICE LOSS</th>
<th>Measurement Wavelength: nm</th>
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<td>Cable ID:</td>
<td>Date:</td>
</tr>
<tr>
<td>Tube No:</td>
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<td>OTDR ID:</td>
<td>OTDR Operator</td>
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<td>OTDR Group Index:</td>
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<thead>
<tr>
<th>Fiber No.</th>
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**Test Technician:**

**Authorized Witness:**

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### Form 6-4 - Post-Construction Fiber Plant Reflection Measurements

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<th>FIBER JOINT REFLECTANCE LINK OPTICAL RETURN LOSS</th>
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</tbody>
</table>

Test Technician

Authorized Witness

Date:

Date:

Title:

Title:

Signed:

Signed:

New York City Transit Authority
### Table 6-1. Acceptable Limits for Post-Construction Optical Fiber Measurements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Testset Used</th>
<th>Threshold Measurement Value</th>
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</thead>
<tbody>
<tr>
<td>Fiber Length</td>
<td>OTDR</td>
<td>Equal to the known length of the fiber link.</td>
</tr>
<tr>
<td>Link End-to-End Loss</td>
<td>OLTS or SLS/OPM</td>
<td>≤ Maximum fiber link loss budget</td>
</tr>
<tr>
<td>Individual Fusion Splice Loss (of each splice)</td>
<td>OTDR</td>
<td>≤ 0.10 dB (two-way)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤ 0.20 dB (one-way)</td>
</tr>
<tr>
<td>Individual Mechanical Splice Loss (of each splice)</td>
<td>OTDR</td>
<td>≤ 0.25 dB (two-way)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤ 0.40 dB (one-way)</td>
</tr>
<tr>
<td>Individual Mechanical Connector (including pigtail splices)</td>
<td>OTDR</td>
<td>≤ 0.35 dB (two-way)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤ 0.75 dB (one-way)</td>
</tr>
<tr>
<td>Individual Splice Reflectance (of each splice)</td>
<td>OTDR</td>
<td>≤ - 40 dB (digital data and voice transport)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤ - 55 dB (video transport)</td>
</tr>
<tr>
<td>Optical Return Loss of Fiber Link</td>
<td>OTDR or OLTS</td>
<td>≤ 24 dB</td>
</tr>
</tbody>
</table>

### 7. Fiber Test Strategy

Two general test strategies are commonly used:

- **Qualification Testing**: Testing new plant immediately after it has been built or older plant immediately after it has been changed.

- **Trouble-Shooting**: Testing plant to determine if it is malfunctioning and where the problem that is causing the system malfunction is located.

#### 7.1 Qualification Testing Plan

Figure 7-1 is a flow chart of the qualification testing of a fiber link after it has been constructed, rebuilt, or repaired. The result of the fiber test plan shown is a complete set of fiber records that shall be stored in a safe, accessible place such as an electronic database. The records provide a description of the fiber’s optical condition that will provide maintenance technicians with a template to compare any future measurements against. Any differences between the as-built/as-repaired records and the current record will be taken as a change in the system and will quickly locate any problems. The qualification test
record will also provide any system planners and plant engineers with information to plan and construct future communications systems.

Qualification testing is usually the most comprehensive test program that will be used on a fiber link. It is intended to fully characterize the fiber plant. The fiber is measured to determine its end-to-end link loss using an OLTS (or SLS and OPM). An OTDR trace is made of each fiber to determine the magnitude of the optical loss and reflectance of each splice point and connector and the optical return loss of the link itself. As will be discussed in the next section, the OTDR trace is probably the most useful tool available to trouble-shoot fiber link.

Two-way, post-construction OTDR traces shall be made of all fibers.

PMD testing will also be performed for fiber links that will be used to transport high speed digital data or voice signals (at a speed greater than 10 Gbps) or video signals.

7.2 Trouble-Shooting Test Plan

The objective of the trouble-shooting effort is to locate the source of the problem so it can be fixed. The initial concern for a technician is to determine if the source of the problem is in the equipment, fiber distributing frame, or in the fiber plant (outside plant). Figure 7-2 is a flow chart of the trouble-shooting test procedure.

Once a problem is noted (either from a customer trouble report, equipment malfunction, or equipment alarm) the source of the problem must be located before it can be repaired. This trouble-shooting test plan will initially attempt to determine if the problem is with the system equipment or the fiber plant. The test measurements described in this document cover fiber plant. Trouble-shooting and the repair of system equipment is normally discussed in manuals and documents provided by the manufacturer of the system equipment.

If no alarms are present in any piece of system equipment, but circumstances indicate a problem exists or is about to exist, the fiber plant shall be tested using the lower portion of the flow chart shown in Figure 7-2, i.e., the problem shall be analyzed as if it is a fiber problem. If an alarm condition exists in one or more piece of system equipment, the problem should be isolated using simple reasoning. For example if a receiver is indicating a problem, low power or bit errors, and the transmitter at the other end of the fiber link is not indicating any problems, the fiber link becomes a suspect along with the receiver. If the transmitter is also indicating an alarm, the source of the problem at the receiver is likely to be from a problem at the transmitter, and the fiber is not an immediate suspect.

Once a problem is isolated (or suspected) to be in the fiber link, an OTDR becomes the primary tool to investigate the problem. The problem fiber must be measured, but first it is necessary to transfer any working signals off the fiber to be measured to a back-up fiber.

Shoot the potential problem fiber with an OTDR. Compare the current fiber trace with the as-built trace (see previous section). The point at which they differ will be the location of the problem.
Figure 7-1. – Flow Chart for Fiber Qualification Testing
Figure 7-2 – Flow Chart Fiber Link Trouble-Shooting Procedure
7.3 Summary of Fiber Problems

Table 7-1 summarizes the fiber link problems discussed earlier in the Section along with the recommended action to restore the fiber to an acceptable condition. Often reflectance and loss problems are the result of fiber connections that have become dirty or are the result of the mating fibers becoming separated. Usually cleaning the mating fibers, connectors, and jumpers can repair reflectance and loss problems in an office or fiber distribution frame.

Table 7-1. – Summary of Fiber Link Problems and Their Solution

<table>
<thead>
<tr>
<th>OTDR Trace Shows:</th>
<th>Likely Source</th>
<th>Likely Fix</th>
</tr>
</thead>
<tbody>
<tr>
<td>High loss at splice or connector (no increase in reflectance).</td>
<td>Fiber bent or pinched in splice organizer or fiber distributing frame.</td>
<td>Remove pinch or bend in fiber.</td>
</tr>
<tr>
<td>High loss at splice or connector (increase in reflectance).</td>
<td>Connector or splice not making physical contact.</td>
<td>• Clean dirty connector and remate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Remake mechanical splice.</td>
</tr>
<tr>
<td>High reflectance at splice or connector.</td>
<td>• Connector or splice not making physical contact.</td>
<td>• Clean dirty connector and remate.</td>
</tr>
<tr>
<td></td>
<td>• Broken fiber.</td>
<td>• Remake mechanical splice.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Repair broken fiber.</td>
</tr>
<tr>
<td>High link ORL.</td>
<td>Connections in link have increased in reflectance.</td>
<td>• Clean dirty connector and remate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Remake mechanical splice.</td>
</tr>
<tr>
<td>Fiber appears too short.</td>
<td>• Broken fiber</td>
<td>• Repair or replace fiber</td>
</tr>
<tr>
<td></td>
<td>• Jumper removed in intermediate office.</td>
<td>• Restore any missing jumpers</td>
</tr>
<tr>
<td></td>
<td>• Splice failed</td>
<td>• Remake damaged splice.</td>
</tr>
</tbody>
</table>
APPENDIX F

SECTION 01 43 00 QUALITY ASSURANCE PROGRAM
PART 1 - GENERAL

1.01 Description And Scope

A. The Contractor shall be able to demonstrate, at any time during the procurement period, that its responsibilities under this contract are accomplished through an effective and verifiable quality assurance program, adjusted to reflect the scope and specific needs of this Contract.

B. The Contractor shall systematically ensure that the quality of products and services provided by its suppliers and subcontractors conform to the contract specifications and drawings.

C. These requirements are complimentary, not alternative, to the requirements specified in other parts of this Contract. Any conflict should be brought to Metro-North Railroad (henceforth referred to as "The Railroad") for attention.

D. References:


2. Institute of Electrical and Electronics Engineers (IEEE) 1558-2004, Standard for Software Documentation for Rail Equipment and Systems

1.02 Definitions

A. For the purposes of this SECTION 01 43 00, Quality Assurance Program, the definitions given in the American National Standards Institute, ANSI/ISO/ASQ Q9001-2008 (or newer versions) Quality Management Systems – Requirements (henceforth called ISO-9001), and the following definitions apply:

1. The terms "Quality Assurance Program", "Quality Management System" (QMS), and “Quality System” are interchangeable.

2. The Contractor’s company Quality Management System (QMS)
manual (or simply, the Quality Manual) is the company’s documentation of its quality management system. It is its Senior Management's statement of its commitment to quality, objectives for quality, and policies for the systematic attainment of its quality objectives, including the use of documented requirements for accomplishing work.

3. The Contractor’s Contract Quality Plan (CQP) is the documentation of the contract-specific amendments or modifications to the Contractor’s QMS that apply to work on the contract.

4. The Contractor’s Contract Inspection and Test Plan (CITP) is the document integrating and coordinating the set of activities necessary to demonstrate conformance to acceptance criteria and implementing documents.

5. Acceptance criteria and implementing documents define the processes and expected results for achieving contract goals and demonstrate that the work is accomplished in a systematic and effective manner. Examples are:

   o Contract Drawings and Specifications,
   o Contractor shop drawings, samples, work instructions and procedures, and inspection and test results,
   o Regulatory, industry, and generally-accepted professional standards,
   o the Contractor’s own internal standards, and
   o Other acceptance criteria agreed to with the Railroad.

6. For software and Software Quality Assurance, the definitions in IEEE 1558-2004, Standard for Software Documentation for Rail Equipment and Systems (henceforth called IEEE 1558) and its other referenced standards shall apply.

1.03 Submittal

A. Pre-Award:

The Contractor shall submit:

1. It’s company Quality manual (See Part 3, Par. 3.01, The Contractor’s Company Quality Manual),

2. (Software Quality Assurance Plan – NOT APPLICABLE)

3. If available, the company’s independent International Standards Organization (ISO) registrar’s certification that the company quality
management system conforms to the requirements of ISO-9001, and, as implemented, complies with the terms of the Contractor’s Quality System.

Prior to award of the contract, the Contractor shall obtain the Railroad’s agreement with amendments, exceptions, or modifications to the Contractor’s company quality management policies.

B.  Post-Award:

Within 30 days after Notice To Proceed (NTP), the Contractor shall submit the following for Railroad approval:


2. A Contract Inspection And Test Plan (CITP), showing inspections and tests required for the first 90-days of work on the schedule, as a minimum (see also Part 3, par. 3.03, *Contract Inspection and Test Plan*), and

3. SOFTWARE QA PLAN – NOT APPLICABLE

At the discretion of the Railroad, results of work may be deemed unacceptable if carried out prior to Railroad approval of relevant post-award submittal. Failure to comply may subject the Contractor to other sanctions within the terms of the contract at the Railroad’s discretion, including withholding of payment.

1.04  Railroad's Quality Assurance

A. The Railroad will monitor compliance with and effectiveness of the processes established in the CQP.

B. The Railroad may, at its option, perform audits and other formal assessments regarding compliance with or effectiveness of the Contractor's quality program.

C. The Contractor shall provide access to its facilities, personnel, information, products, and other objective evidence at all reasonable times.

D. The Contractor shall ensure that similar access is allowed by suppliers, subcontractors, testing agencies, and consultants through the Contractor’s procurement documents.

E. Information, products, and other objective evidence in any condition, in-process or finished, acceptable or nonconforming, shall be made available to ensure a complete view of the state of the CQP.
F. The Railroad will notify the Contractor of any deficiencies identified during these activities in writing. If deficiencies are noted, the Contractor must ensure prompt and documented corrective action on the item found to be nonconforming or conditions found to be noncompliant, and other items or conditions similarly affected. The Contractor shall identify root cause and revise, amend, or clarify its CQP or procedures or those of its subcontractors, suppliers and testing agencies, as applicable, incorporating preventive measures.

G. The Railroad's quality assurance activities shall not negate, delete, lessen, or act in stead of the Contractor's quality assurance responsibilities.

1.05 Materials Testing Laboratory Service

A. For contracts requiring the Contractor to conduct laboratory testing, the Contractor shall submit the name of the testing laboratory and records of its qualifications to the Railroad for approval not less than 30 days prior to the date of testing.

NOTE: Requirements for test laboratory independence are specified in applicable laws, regulations, referenced industry standards, or the individual technical specification sections.

B. Testing Laboratory Qualifications

1. Throughout its period of engagement, the testing laboratories shall satisfy the requirements of ISO/IEC-17025, *General requirements for the competence of testing and calibration laboratories*, as determined by a U. S. testing laboratory accrediting body.2

2. Throughout its period of engagement, the environmental testing laboratory shall be accredited by the state governmental agency that serves as accreditation body under the National Environmental Laboratory Accreditation Program (NELAP).3

C. Documentation of Qualification: Together with the request for Railroad approval of proposed test laboratory, the Contractor shall submit a copy of the appropriate compliance certificate from the applicable certifying agency, a copy of the quality manual under which the laboratory was certified.

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2 National Voluntary Laboratory Accreditation Program, Laboratory Accreditation- NVLAP, 100 Bureau Drive, Stop 2140, Gaithersburg, MD 20899-2000; Email: nvlap@nist.gov Phone: (301) 975-4016, [http://ts.nist.gov/standards/scopes/programs.htm](http://ts.nist.gov/standards/scopes/programs.htm) and the National Cooperation for Laboratory Accreditation (NACLA) ([http://www.nacla.net/](http://www.nacla.net/)).

3 In NY State, the accreditation body is the NY State Dept. of Health’s Environmental Laboratory Approval Program (ELAP, URL: [www.wadsworth.org/labcert/elap/elap.html](http://www.wadsworth.org/labcert/elap/elap.html))
1.06 Testing Conducted Outside the Controlled Conditions of Laboratories

A. Testing conducted outside the controlled conditions of test laboratories shall be covered under ISO 9001 Article 8.02 entitled “Monitoring and Measurement.”

B. Applicable industry standards or procedures governing such work shall be provided to the Railroad. The Contractor is responsible for ensuring that the standards or procedures meet applicable laws and regulations and the Contract technical requirements.

C. A copy of valid calibration certification shall be presented to the Railroad.

PART 2 - PRODUCTS

- NONE –

PART 3 - EXECUTION

3.01 The Contractor’s Company Quality Manual


B. The Contractor’s shall ensure, through its own procurement requirements, that subcontractors and suppliers implement systematic quality management commensurate with the significance and complexity of the product or service they provide.

C. Optional Quality Manual Template

Appended to this QA Program specification is a template for a Quality Manual (see Section 01 43 00 Appendix – Quality Manual Template). Contractors that do not have a documented Quality Manual or that have a manual reflecting a quality system that does not meet ISO 9001 may opt to use the template. Note: No representation is made regarding the acceptability outside Metro-North Railroad of a manual developed using this model.

3.02 Contract Quality Plan (CQP)

The Contract Quality Plan shall: 
A. Identify all locations where work on this contract will be carried out, including sub-contractors and suppliers providing major systems,

B. Identify positions and the names of the individuals responsible for activities affecting quality. As a minimum, the following information shall be provided:

1. The senior management representative responsible for establishing the Contract Quality Plan and keeping it relevant and effective,
2. The party responsible for conducting internal compliance assessments at home office and the jobsite,
3. The party or parties responsible for the quality of materials to be used for construction,
4. The party who has lead responsibility for quality the of work at the jobsite, and
5. The party or parties responsible for control and/or retention or project records at the home office and the jobsite.

C. For each person supervising or conducting inspections or tests, or providing disposition of nonconforming items, provide a description of the individual’s experience, qualification and training in the appropriate field,

D. Describe the contract-specific amendments or modifications to its company's Quality System,

E. Define organizational and administrative interfaces between the Contractor and the Railroad for transactions relating to the CQP and its implementation,

F. Describe how personnel are made aware of the requirements in the approved CQP,

G. Describe the internal review the contractor performs to ensure adequacy of documents prior to release (e.g. - accuracy checking, review of contract conformance and elimination of conflicts or gaps between trades, approval for release to the Railroad, etc.).

H. Describe how the latest approved construction requirements (e.g. - shop drawings other construction documents) and changes flow to the construction sites and work crews, and how records confirming the quality of the work flow back to the proper parties on the project,

I. Require the establishment of a software quality assurance plan if software quality assurance is applicable to this Contract (See requirements regarding a Contract Software QA Plan in Part 3.04, Software Quality Assurance),

J. Describe its approach, outline, or format for an Inspection and Test Plan,
K. Describe methods for recording, tracking and resolving Open Items, such as nonconforming conditions and audit findings.

L. Describe methods for on-the-jobsite records control and disaster-recovery during the contract period, and long-term records retention and retrievability as required by the contract, and

M. Include a list or lists of customer-specific administrative procedures for implementing the Contract Quality Plan.

The Contractor shall maintain the CQP periodically updated until the end of the contract period.

3.03 **Contract Inspection And Test Plan (CITP)**

The Contractor shall prepare, implement, and maintain an Inspection and Test Plan (CITP) or set of Inspection and Test Plans covering all inspections and testing required under the Contract. As a minimum, the CITP shall identify:

A. Each inspection and test required by government regulations, the Contract technical requirements, and by applicable Codes and Standards.

B. The schedule when the activity is expected to be carried out,

C. The criteria or reference to the source of the criteria upon which the item's quality status will be based (e.g. - drawings, specifications, inspection or test procedure, etc.),

D. The status of these criteria documents (e.g. - approved, in process, etc.),

E. The party responsible for conducting the inspection or test,

F. The nature of the Railroad’s participation (e.g. - witness or conduct the inspection or test),

The Contractor shall maintain the CITP periodically updated to reflect the latest information until all inspections and tests have been carried out.

The Contractor shall report on the status of the inspections and tests listed in the CITP (e.g. – completed/passed, completed/failed, not completed/to be repeated, rescheduled/requirements to be revised, etc.).

3.04 **Software Quality Assurance**

**NOT APPLICABLE**
APPENDIX G

SECTION 014300 ATTACHMENT - QUALITY MANUAL TEMPLATE
FOREWORD

INTRODUCTION

A quality management system is intended to assure that construction services are provided safely, as specified, on schedule and at the agreed cost.

This sample Quality Management System Manual (Sample QMS Manual) is a template designed for use by contractors that want to develop their own company Quality Management System Manual (Company QMS Manual). This Sample QMS Manual is patterned after ISO 9001-2000 Quality Management System Requirements. However, this Sample QMS Manual is in no way intended to restrict the format of Quality Manuals submitted to Metro-North. You may develop your Company QMS Manual in any format that satisfies the requirements of ISO 9001-2000.

The interpretations of ISO 9001-2000 requirements in this Sample QMS Manual are general in nature: Metro-North Railroad makes no representation regarding its acceptability, accuracy and correctness outside Metro-North. In addition, you must evaluate its contents as they apply to your own organizational structure. If you intend to use this sample as the basis for Third Party registration, the opinion of your registrar or reviewing agency takes precedence.

CONTRACT QUALITY PLANS

The quality management policies in your Company QMS Manual may need to be amended, or modified in some suitable way for specific contracts to accommodate special Customer requirements, and to define organizational and administrative interfaces between The Company and The Customer. It is typical to call these amended or modified Quality Manuals "Contract Quality Plans". There have been a number of common practices regarding Quality Plans. Some practices have been to:

- Incorporate the modifications into a contract-version of the Company QMS Manual,
- Issue the Company QMS Manual with an attached amendment containing the modifications applicable only to a specific contract, or
- Issue a separate document called "Contract Quality Plan" containing only the modifications and referencing a specific version of the Company QMS Manual as the base document, and transmitting the base version of the Company QMS Manual with the Contract Quality Plan.

USE OF GENERIC TITLES

The title "Chief Operating Officer" (COO) refers to the position of the highest-ranking individual responsible for the day-to-day operation of the entire company. You may substitute the appropriate title for your company (e.g. - President).

The title "Construction Contract Officer" refers to the position of the highest-level individual responsible for the successful conclusion of a Construction Contract and satisfaction of the customer. You may substitute the appropriate title for your company (e.g. - Project Manager).

The title "Designated Responsible Officer" refers to the position of an individual at a Construction job site responsible for successful conclusion of construction work and satisfaction of the Customer. You may substitute the appropriate title for your company (e.g. - Site Superintendent).
In some cases, an explanation of the requirements of ISO 9001-2000 is given for clarity and to aid understanding. The explanation is in Italics and is not part of sample text.

We hope you find the Sample QMS Manual a useful step in your journey to achieve a high level of customer satisfaction and a more profitable future.

- oOo -
QUALITY MANAGEMENT SYSTEM MANUAL

OFFICER SIGNATURE________________________

REVISION NO.____ ISSUED_____________
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SECTION 1 - QUALITY MANAGEMENT SYSTEM

(This QMS Section corresponds to Section 4 of the ISO 9001-2000 Standard. It describes the overall Quality Management System (QMS), and identifies those processes, procedures and other documents that ensure effective operation and control of processes.)

1.1 General Requirements

The (insert company name here), henceforth known as "The Company", is committed to establishing, implementing, maintaining and continually improving a QMS conforming with the requirements of the International Standard, ISO 9001-2000. This Manual documents the policies of that QMS.

The following are the key processes needed for the QMS to be effective and facilitate the production of a product or service that satisfies the customer. (Note this is not a complete list and should be modified to address your company structure and operations.)

1. The Contracting Process

This process starts with the review of the Request For Proposal (RFP) or Information For Bidders (IFB), through proposal or bid development, Customer's award of the Contract or notification of no award, and ending with review of opened proposals or bids.

2. Design and Development

This is the process of inter-discipline and inter-organizational effort of transforming the Customer’s contract Technical Provisions into design and construction documents such as Design Specifications, drawings, shop fabrication details, inspections and test procedures.

3. Shop Drawing Submittal, Review and Approval

This process starts with the contract kick-off meeting. It includes the Contractor's process for obtaining Customer’s input to and approval of technical submittals and deliverables, such as construction details, shop fabrication drawings, workmanship standards, special process procedures, and inspection and testing procedures.

3. Production Planning

This process consists of the development of the construction work breakdown structure, cost-loaded schedule, database and method for progress reporting, establishment of the system and rules for communication and coordination between the Company's project team and the Customer's project team.

4. Procurement

This process consists of identification, procurement, and traceability of materials, parts, components, equipment, and services, including the activities of selecting suppliers, subcontractors, testing agencies and consultants.
5. Construction

This process includes all activities defined in the contract technical provisions, contract drawings, and Customer-approved shop drawings.

6. Monitoring and Measuring

This includes several processes: product inspection at source, construction work inspection, in process testing, post-construction pre-operational testing, control of nonconforming conditions, and Quality system internal audits.

7. Customer Satisfaction and Quality System Improvement

This is a set of processes that includes corrective and preventive actions, company management review of quality system effectiveness and suitability, and response to customer returns, complaints and feedback.

For each key process identified above, The Company will identify the criteria and methods to ensure the processes are effective, define the methods of monitoring measuring and analyzing these processes and establish commitment to their continuing improvement.

(Note: The criteria and methods referenced above, may be included in the Company QMS Manual, a contract Quality Plan (See Foreword to this Sample QMS Manual) or, separately, in procedures, work instructions or process control documents.)

1.2 Documentation Requirements

1.2.1. General

The Company has established the following documentation for its QMS.

a) This Quality Management System (QMS) Manual

(List the types of written or electronic information that provides direction, guidelines, acceptance standards, processing standards, and similar requirements. What follows are typical written requirements that may be applicable to your company's operation. Remove those that are not applicable and add those that apply but may not have been listed here)

b) Quality Management System Procedures (administrative)

c) Project Management Procedures (including interface and coordination with Customers and regulatory agencies with jurisdiction over jobsites)

d) Government regulations

e) Customer contracts, including contract specifications and drawings

f) Industry standards

g) Procurement specifications

h) Processing Instructions (including construction process instructions)

i) Construction Work Packages

j) Measuring and test equipment calibration procedures
k) Inspection and test procedures

Records that demonstrate implementation and effectiveness of the QMS are identified in quality system documentation.

1.2.2. Quality Management System Manual

This Company QMS Manual establishes the scope of the Quality Management System, defines the activities and functions over which it applies, and commits to complying (and any exclusion) with the International Standard ISO 9001-2000. It describes the sequence and interaction of the main administrative processes, which fall under the scope of the QMS and cites references to lower-tier quality system documents when more details are necessary.

The (insert the title of the individual who has primary responsibility for Company QMS Manual, and for publishing and issuing copies to users) shall ensure that master version of the Company QMS Manual and copies sent to direct users are controlled documents. (See 1.2.3 "Control of Documents", following).

1.2.3. Control of Documents

A documented procedure has been established to control documents required for the QMS. The written procedure detailing the Company's document control practices is listed in Appendix 6.1 of this Company QMS Manual. This procedure implements the following policies:

a) Written requirements that make up QMS (see Quality System requirements documentation in 1.2.1) shall:

   - Exhibit those characteristics necessary to establish that any available copy is the correct document, approved, complete, and current.
   - Be reviewed and signed by authorized personnel prior to release.
   - Be sent to each user or to locations readily accessible to each user
   - Be maintained current and useable in any location where copies are stored.

b) Personnel who work in activities governed by the QMS shall use only the latest, authorized, controlled issues of QMS documents.

c) Superceded versions of these documents shall not be held or stored in areas where inspection, test, or construction work is in-progress. Wherever these other versions are stored, they shall be marked clearly as not authorized for use (e.g. - "void", "superseded").

1.2.4. Control Quality of Records

The applicable procedure, listed in Appendix 6.1 of this Company QMS Manual, to control the identification, review, approval, distribution, retention, retrieval, protection, and disposition QMS records has been established. This procedure implements the following policies:

Records shall be verified for accuracy and completeness prior to final release and retention.

Records (e.g. - letters, memos) that require a response or action shall be directed to the individual authorized to respond or act.
The status of transmittals that require a response or action by shall be maintained.

Records shall be stored in a suitable environment to prevent damage or deterioration and to prevent loss. Records shall be filed according to the established File Index.

Access to records shall be controlled. Removal of Records to a location other than the immediate area where the file is located shall be restricted to authorized persons. Measures to identify removed files and their current location shall be maintained.

Retention time of QMS records shall be established in a written procedure.
SECTION 014300 APPENDIX
METRO-NORTH QUALITY MANAGEMENT SYSTEM MANUAL TEMPLATE FOR CONTRACTORS

SECTION 2 - MANAGEMENT RESPONSIBILITIES

(This QMS Section corresponds to Section 5 of ISO 9001-2000. It addresses commitment to quality, consideration of the customer, Quality Policy, planning work to deliver a quality product, administration of the Quality Program, and positioning for continuous improvement.)

2.1 Management Commitment

At its highest management levels, the Company is committed to the development and improvement of the QMS by:

a) Communicating the importance of meeting customer, regulatory and legal requirements.

b) Establishment of a quality policy and objectives.

c) Conducting management reviews in accordance with Paragraph 2.6 of this Company QMS Manual

d) Ensuring the availability of resources necessary to implement company policies and attain its quality objectives.

2.2 Customer Focus

The Company ensures Customer satisfaction by:

a) Reviewing and clarifying Customer's Contract Requirements against Customer's and The Company's expectations.

b) Establishing close coordination in a systematic way through a contract Quality Plan that provides necessary modifications to company standard operating procedures to accommodate Customer needs.

c) Assigning trained and qualified personnel to carry out project tasks, and continuously maintaining skill levels and qualification.

d) Breaking down work elements, budget and available time in sufficient detail to track real progress and meet cost, quality and schedule commitments.

e) Performing internal quality audits to encourage compliance with the QMS requirements and determine how effective these requirements are in assuring long-term profitability and Customer satisfaction.

f) Systematically identifying and resolving nonconforming conditions before they impact the Customer, and using that information together with Customer feedback to improve the Company's ways of doing business.

2.3 Quality Policy
The Company policy regarding the Quality of the goods and services we offer our customers is in Appendix 6.2 of this Company QMS Manual.

This Quality Policy is reviewed for relevancy and appropriateness of objectives; and communicated to those performing the work. The policy is posted at all work locations.

(Prepare a statement, called "Quality Policy", that is appropriate to your company's business objectives, include commitment to meeting Customer requirements, continuously improving the services provided, and the method of delivering these services. Attach that statement, as Appendix 6.2, to this company Quality Manual).

2.4 Planning

2.4.1 Quality Objectives

The Company's Quality Objectives are in Appendix 6.3 of this Company QMS Manual. The attainment of our Quality Objectives is part of our commitment to continuous improvement and Customer Satisfaction. The Quality Plan for any Construction Contract will identify quality objectives for that construction contract.

2.4.2 Quality Management System Planning

QMS planning is a yearly activity that occurs as part of the company's budget development process and results in obtaining management approval of staffing, budgets and schedule to carry out:

a) Necessary modifications to the written requirements documents to incorporate lessons learned from quality system audits, corrective/preventive action issues, and management review,

b) Reallocation of staff responsibilities and hiring of additional personnel in order to efficiently and completely accomplish quality system (including contract-related) activities, and

c) Procurement of necessary additional assets (e.g. - office space, equipment, service contracts, etc.) and services to maintain current assets in a state of good repair


When conditions require change, the planning process allows change to occur in a controlled manner and integrity of the QMS is maintained. The COO authorizes changes to the QMS and assures the information is disseminated and adequate resources for implementation and control during the transition are available.

2.5 Responsibility, Authority and Communication

2.5.1 Responsibility and Authority

The Company is organized in the following manner. (Include Appendix 6.4, the organization chart for the company). (Insert title) is responsible for maintaining the company Organization Charts (Appendix 6.4). The contract Quality Plan will also include the Organization Chart for the Construction Contracted product or services.
The Company has assigned responsibilities and authority in the following manner.

(Use functional titles instead of names to reduce the number of Company QMS Manual revisions. Focus your description of activities on prevention of nonconforming conditions, problem identification, problem solution, verification of corrective action, and follow-up to ensure problem resolution. Correlate with the Organizational Chart.)

2.5.2 Management Representative

The Company has assigned a management representative for Quality. He/she shall ensure the Quality system is established, maintained, and implemented and shall report to top management on a twice-yearly basis and make recommendations for Quality System improvements. Reports shall be issued in writing to Top Management and maintained in an open status until the resolution of outstanding items. The management representative for Quality shall be independent of direct project supervisory activities and assure that for each Construction Contract assigned personnel are aware of customer requirements.

2.5.3 Internal Communication

The Company ensures effective communication including communication of the effectiveness of the QMS through one or more of the following:

Distribution and control of procedures, work instructions, flow diagrams, process diagrams, newsletters, and the establishment, monitoring and communication of quality goals and their status.

2.6 Management Review

2.6.1 General

The Company top management shall review the QMS, quality policy and quality objectives twice a year and more often as needs dictate to ensure its suitability, adequacy and effectiveness. Records of these reviews shall be maintained. The COO is responsible for the Management Review process.

2.6.2 Review Input

Management Reviews shall utilize:

a) Internal and external Quality Audit results
b) customer performance evaluations (feedback)
c) Process performance and product conformance results
d) Preventive and corrective action status
e) Follow up on actions from previous Management Reviews
f) Other changes (i.e. business climate, scope of work changes, etc) that could affect the QMS.

2.6.3 Review Output

Results of company management's review of the QMS shall be recorded and address the following, as appropriate:

a) Improvements in the QMS and its processes
b) Improvements in product related to customer requirements

c) Resource needs

Action items shall be followed up at subsequent management reviews to ensure closure.
SECTION 3 - RESOURCE MANAGEMENT

(This QMS Section corresponds to Section 6 of ISO 9001-2000. Its purpose is to assure that sufficient staff and assets are assigned to the work governed by the QMS and that staff is adequately prepared to perform the assigned tasks.)

3.1 Provision of Resources

The Construction Contract Officer and Designated Responsible Officer are responsible for assessing organizational and project needs within their specified scope, including oversight functions. Each shall identify sufficient resources necessary to deliver construction services as required by contract and improve the QMS processes. When necessary, additional resources shall be provided.

3.2 Human Resources

3.2.1 General

The Company shall assign work to personnel who are competent on the basis of applicable education, training, skills and experience. The Construction Contract Officer is responsible to review requirements to determine any special competency needs for personnel assigned to a specific Construction Contract and ensure the assignment of personnel who meet the requirements.

3.2.2 Competence, Awareness and Training

The Company shall:

a) Identify competency needs for personnel performing activities affecting quality. The Company has developed position descriptions for those personnel performing activities affecting quality, which identify competency requirements. (Identify the appropriate position in your company) maintains the latest issue of such position descriptions.

b) Identify training needs, provide training to satisfy competency needs, and assure continuing training is provided as necessary (Note training can be formal, informal, on the job, union classes, apprenticeship, etc).

c) Evaluate the effectiveness of the training provided. Individuals who are responsible to supervise personnel performing the work will evaluate effectiveness. One or more of the following will correct any noted deficiencies: additional On-the-Job-Training, closer supervision, formal re-training, and reassignment.

d) Ensure employees are aware of how their work activities contribute to the achievement of quality objectives. Our Quality Policy is posted at all work locations. Employee orientation contains a section that describes the important role each employee plays in achieving both our corporate and Construction Contract quality objectives.

(Describe how you achieve this. Consider newsletters, performance evaluations, project Kick-off meetings, Project position descriptions, project organization charts and other means of awareness enhancement).
e) Maintain records of education, training skills and experience. Human Resources is responsible to maintain appropriate records including records of training activities and the subject matter.

3.3 Infrastructure

The Company provides a work environment suitable for it to achieve its business objectives and satisfy project requirements. The COO or designee is responsible to assure necessary facilities, equipment, hardware, software, support/administrative services are available to each employee in order to assure they can be successful in their work.

3.4 Work Environment

The Company has identified and is managing those factors of the work environment needed to assure work output is acceptable.

These factors may include, as applicable, safety plans and inspections, compliance with OSHA and applicable building codes, toolbox meetings, HAZMAT protective equipment, and specific requirements in Construction Contracts.
SECTION 4 - PRODUCT REALIZATION (PLANNING AND PERFORMANCE OF WORK)

(This QMS section corresponds to Section 7 of ISO 9001-2000. It describes those activities related to the production of a product to ensure that it meets customer requirements. Products can be physical (e.g. - structures, equipment, parts, materials) or intellectual (e.g. - studies, analysis, design plans and specifications, and software). Intellectual product may be of direct use to the customer or incorporated into a final product or service for the customer.)

4.1 Planning of Product Realization

The Company shall plan and document the product realization process. The documentation for the realization process may be described in a Contract Quality Plan, product design, and production process documents.

The Quality objectives for the work are identified in the Construction Contract and represent the customer requirements or in product specifications for standard product.

The process, process controls, documentation, and resources necessary to complete the work successfully shall be established and implemented.

Verification and validation are incorporated into the planning process and are described in the contract Quality Plan or product testing documents. Acceptance criteria shall be developed, and product acceptance documented.

Records attesting to conformity of process and resulting product shall be maintained. Records will include:

- Monitoring and Measuring Records
- Internal Quality Audit results and closure
- Product Acceptance Records
- Records of Management Reviews

4.2 Customer Related Processes

4.2.1 Determination of Requirements Related to the Product

The Company will carry out construction in accordance with the Construction Contract (or produce industry-standardized items strictly in accordance with the applicable industry standard). Where written Customer requirements are not provided, the Company will document requirements provided verbally by the Customer, as well as any additional requirements, such as regulatory and legal requirements, necessary to build structures (or produce product) acceptable to the Customer.

4.2.2 Review of Requirements related to the Product

The Company will review Construction Contracts and other forms of written Customer requirements with the Customer to ensure that the expectations are clear and understood. Relevant parts of the Customer's requirements will be reviewed with each party within the Company and...
subcontractors to ensure that and that the Company and its subcontractors have the capability of performing the work as specified.

Prior to signing a Construction Contract a review shall be performed to ensure any agreed to changes have been incorporated. The review shall be documented. The process is under the supervision of the COO or designee.

Changes to Construction Contracts shall be processed and controlled in the same manner as the original contract. Changes shall be documented and issued to all staff and subcontractors responsible for its execution.

These processes are under the supervision of the COO, Project Sponsor or designee. These reviews shall be documented.

4.2.3 Customer Communication

The Company will establish and maintain communication with the customer regarding the Construction Contract and the work activities. The COO will assign a responsible officer to be the point of contact and coordination for the Construction Contracts. A communication process will be established agreeable to both parties and shall be uniformly implemented. Those responsible for liaison with the Customer shall keep the Customer informed of progress and special conditions that arise. Customer survey data will be use for standard products.

Customer feedback/complaints shall be evaluated and response provided in writing.

4.3 Design and Development

4.3.1. Design and Development Planning

The Company shall develop a plan to control the design and address staging, review, verification, and validation activities, personnel responsibilities and authorities, interfaces between discipline and any update in this plan during production.

During the planning, the organization shall determine

a) The design and development stages,
b) The review, verification and validation that are appropriate to each design and development stage, and
c) The responsibilities and authorities for design and development to ensure effective communication and clear assignment of responsibility.

(Identify the planning tools for managing and coordinating design and development, such as - resource-loaded schedule, CPM, Bar Charts, Flow diagrams, etc).

4.3.2. Design and Development Inputs

Inputs relating to design requirements shall be determined and records maintained. These inputs shall include:

a) Functional and performance requirements,
b) Applicable statutory and regulatory requirements

c) Where applicable, information derived from previous similar designs, and

d) Other requirements essential for design and development.

The COO will assign a Contract Officer to review the Contract and determine functional and performance requirements, applicable statutory and regulatory requirements, investigate the applicability of a similar design, and any other requirements necessary to assure the contract can be successfully completed. For Standard items the COO will assign a Responsible Officer to determine appropriate design and development inputs.

These inputs shall be reviewed for adequacy and be complete, unambiguous and not in conflict. These inputs shall be in written form and, once reviewed and found acceptable, transmitted to the appropriate responsible designer.

4.3.3. **Design and Development Outputs**

Outputs are those deliverables required by the customer in the Contract or those specified for standard items or needed by our production department to manufacture a product and include, but are not limited to, studies, reports, analysis, scope development, designs and specifications.

Outputs of the design process shall be in a form that enables verification against design inputs, and shall be approved prior to release.

The assigned Contract Officer or Designated Responsible Officer is responsible for ensuring that design and development outputs:

a) Meet the design input requirements,

b) Provide appropriate information for purchasing, production and servicing,

c) Contain or reference acceptance criteria for product or installation, and

d) Specify the characteristics of the product that are essential for its safe and proper use.

4.3.4. **Design and Development Review**

Design Documents are circulated for internal review and coordination of all units with input to the end product. The number of reviews is dependent on the complexity of the work and will be identified in the planning process.

The review process shall address the ability of the design to fulfill requirements and identify problem areas and proposed corrective actions.

Comments shall be addressed in written form, and records of resolution kept until completion of the Contract or per record keeping requirements for standard items. The management team member responsible for the design effort will ensure closure for all comments.

4.3.5. **Design and Development Verification**

The assigned contract officer or designee is responsible to assure the design output is consistent with the design inputs.
Verification will be performed to planned arrangements developed under 4.3.1. The contract specific QMSM will address Contract specific applications.

4.3.6. **Design and Development Validation**

The Company has developed a system to assess if the design was constructible or capable of being manufactured and met customer requirements and was suitable for its intended use.

The results of FAI may be used, if applicable, for validation.

The results of the validation effort are recorded and used as part of our Corrective and Preventive Activities Program.

4.3.7. **Control of Design and Development Changes**

a) **General**

Design and development changes shall be identified and records maintained. The changes shall be reviewed, verified and validated, as appropriate, and approved before implementation. The review of design and development changes shall include evaluation of the effect of the changes on constituent parts design already completed.

Requests from the construction site for clarifications and revisions to design documents shall be documented reviewed by the Designated Responsible Officer, the Contract Officer, and the Chief Estimator before being sent to the Customer for review and approval. Methods have been established to ensure revisions are reviewed to the same level as the original documents for the area of change. Records of these activities shall be maintained.

Upon receiving revised design documents, these documents shall be placed under document control to prevent inadvertent use. Supercended versions shall immediately be removed from controlled documents centers and specific work locations.

4.4 **Purchasing**

4.4.1 **Purchasing Process**

Prior to engaging suppliers or subcontractors to perform part of the Contract work or furnish materials, their capability to perform the assigned scope of services shall be evaluated. The performance of suppliers or subcontractors engaged to accomplish parts of the Contract work or furnish materials shall be monitored and assessed *(Indicate the frequency of evaluation)*. Records of these evaluations shall be maintained. Evaluation criteria shall be defined. The COO or Designated Responsible Officer shall oversee this process and is responsible for following up on identified areas of poor performance.

Records of supplier or subcontractor performance shall be maintained. Suppliers or subcontractors with a record of poor performance shall be excluded from future consideration.

4.4.2 **Purchasing Information**
Purchase Orders define product requirements (e.g. - performance, functional, physical, inspections and test in sufficient detail to ensure that the furnished item meets the purchase order requirements. Purchase Orders will include appropriate QMS requirements. The assigned Construction Contract Officer, Responsible Officer or designee will review all supplier/ subcontractor purchase orders prior to release.

4.4.3 Verification of Purchased Product

The Company has a program to verify that systems, components, parts, and materials provided by suppliers meet the Purchase Order requirements. The Purchase Order identifies verification to be conducted. A Contract Inspection and Test Plan will identify all milestone inspection and tests required by contract for suppliers of major equipment, components, or critical fabricated items.

4.5 Production (Construction) and Service Provision

4.5.1 Control of Production and Service Provision

The Company has established the following controls applicable to their work.

a) Activities are planned

b) Activities are scheduled

c) Acceptance criteria are defined

d) Adequate resources (tools, equipment, and trained personnel) are available to perform the work.

e) The work environment is safe and conforms to applicable Regulatory Requirements.

f) Methods are employed to monitor work against expected results

g) Applicable portions of the Construction Contract, procedures, work instructions, installation practices that are important to ensure quality work are available to the work force

h) Codes standards and other references are available to the work force

i) Standards of workmanship are defined

j) Where required, licensed or certified personnel are assigned to perform activities requiring such license or certification

k) A program to monitor the effectiveness of these process controls is in place and implemented.

l) Criteria for release, approval, or acceptance are established

4.5.2 Validation of Processes for Production and Service

The validation of certain processes can only be determined when it is operated. These processes will be identified in specific for each Contract as part of a contract Inspection And Test Plan.
The Company assures these processes can achieve planned results through one or more of the following:

a) Process qualification  
b) Equipment and personnel qualification  
c) Defined methods and procedures  
d) Processing of production samples (i.e. - First Article Inspection)  
e) (Others: Please state particulars regarding these).

4.5.3 Identification and Traceability

The Company has developed and maintains a system to identify its fabricated products and purchased materials so that these remain traceable to the original batch of raw materials used and the specifications to which these were fabricated. Items specially intended for a specific customer as identifiable as such. To the extent traceability is a Contract legal or regulatory requirement, the Company will apply this system using unique identification of product or batches.

The Company shall also identify the status of the fabricated products and materials with regard to monitoring and measurement results during construction.

4.5.4 Customer Property

(Note: This section is not applicable to the contract Quality Plan, if no customer-supplied property is in the Contract.)

Customer property includes hardware (such as materials, parts, components and equipment), software and other items provided by the Customer for the express purpose of producing items under the Contract. This includes real property provided for work staging, temporary storage, shop fabrication, and office space. The Company shall develop and maintain a system to receive, log, and maintain Customer property, as appropriate. The Customer will be advised of any items that are unsuitable for use, lost or damaged from the time they are received until such property has served its intended purpose or returned to the Customer.

4.5.5 Preservation of Product

The Company shall establish, maintain and implement a program for handling, storage, packaging, and preservation of items while in its custody, and for delivery of materials and equipment to the Customer. In particular, records shall be available to demonstrate how handling equipment is maintained in safe working order,

4.6 Control of Monitoring and Measuring Devices

The Company shall establish, maintain and implement a program to identify, control and calibrate measurement and monitoring devices used to assure conformity of its products.

The Program shall contain the following elements:

a) Identification of equipment & instruments that require calibration to maintain capability
b) Listing of such equipment & instruments, frequency of calibration and evidence calibration took place
c) Availability and use of manufacturers instructions, codes or national standards for calibration
d) A program of corrective action to repair or replace items which do not meet acceptance criteria.
e) A program to ensure measuring and monitoring devices are protected from damage
deterioration and unauthorized alteration of settings.
f) A program of corrective action for previously accepted product, if defective equipment and
ingredients were used to inspect or test the product.
g) Confirmation that computer software used as a basis of product acceptance is acceptable for the
intended application. Confirm prior to use and as necessary thereafter.
h) Records to demonstrate calibration and verification.
SECTION 014300 APPENDIX
METRO-NORTH QUALITY MANAGEMENT SYSTEM MANUAL TEMPLATE FOR CONTRACTORS

SECTION 5 - MEASUREMENT, ANALYSIS AND IMPROVEMENT

(This section corresponds to Section 8 of ISO 9001-2000. It addresses the methods used to measure, report and improve on both the performance and effectiveness of your processes and the ability of these processes to deliver products that satisfy the customer. It also addressed the need to collect and use data on customer satisfaction, nonconformance etc. to address improvement issues.)

5.1 General

The Company has defined, planned and implemented measurement, monitoring, analysis and other activities needed to assure conformity, and achieve product and construction service improvement. These activities include:

a) Customer satisfaction surveys
b) Internal Audits
c) In process reviews/inspections/tests/statistical techniques
d) Control of nonconformance
e) Data analysis
f) Corrective, preventive and improvement activities

5.2 Monitoring and Measurement

5.2.1 Customer Satisfaction

The Company has developed methods to obtain data and monitor customer satisfaction and/or dissatisfaction. The assigned Contract Officer, Designated Responsible Officer or designee shall be responsible to assure the data is included as part of the Management Review.

5.2.2 Internal Audit

(Note: Reference to or inclusion of a documented procedure covering Internal Audit is required.)

The Company shall establish, maintain and implement an Internal Quality Audit Program to verify that quality activities and related results comply with planned arrangements and to determine the effectiveness of their Contract Quality Plan and associated procedures. Procedure, listed in Appendix 6.1 of this Company QMS Manual, has been issued covering the Internal Quality Audit Program. The program has the following attributes:

a) Internal quality audits shall be scheduled based upon status and importance of the activity to be audited.
b) Those conducting the Internal Quality Audits shall be competent to conduct audits.
c) A person(s) independent of those directly engaged in the audited activities shall conduct the Internal Quality Audits
d) Reports of the results of Internal Quality Audits shall be generated and issued. Company management, shall receive copies of the Reports.
e) The Audited party is responsible to correct deficient areas promptly
f) Corrective Action shall be monitored and brought to closure
Follow-up Internal Quality Audits shall be conducted, as appropriate, to ensure implementation of Corrective Action and the results reported to top management.

h) The activities of subconsultants/subcontractors working under this Company QMS Manual shall be included in the Internal Quality Audit Program.

The COO is responsible to assure implementation of the Internal Quality Audit Program.

5.2.3 Monitoring and Measurement of Processes

The product realization processes described in Section 4 of this Company QMS Manual necessary to achieve customer requirements are measured and monitored.

These methods shall confirm the continuing suitability of each process to satisfy its intended purpose. When planned results are not achieved corrective prevention actions shall be taken to assure conformity.

5.2.4 Monitoring and Measurement of Product

The Company shall establish, maintain and implement a program to monitor and measure the characteristics of its products to verify product requirements have been met. This shall be documented in a contract Inspection And Test Plan.

These efforts will take place at various stages of product development based upon a preplanned product production program. Monitoring and measuring data and records will be maintained. No product will be released until all planned arrangements are satisfactorily completed. Exceptions may be authorized by the Construction Contract Officer or Designated Responsible Officer and by concession of the customer. For standard product the customer shall be notified in writing of any exception. Records of exceptions shall be maintained.

5.3 Control of Nonconforming Product

(Note: Reference to or inclusion of a procedure addressing control of nonconforming conditions is required.)

The Company has a program to detect and correct nonconforming conditions relating to their product. This includes product provided by the Company or data, materials, sub-assemblies produced by others and incorporated into the product.

Nonconforming product will be identified to prevent unintended use or delivery. Corrected product will be subject to the same verification process as the original to demonstrate conformity to requirements.

The applicable procedure, listed in Appendix 6.1 of this Company QMS Manual, has been issued covering identification of nonconforming conditions, actions to preclude use of nonconforming product, use of nonconforming product by concession, record keeping, and maintaining status until disposition.

The Customer shall be advised of any product nonconformance detected after it has been delivered or put into use, or as required by Contract.
The Contract Officer or Designated Responsible Officer is responsible to assure this notification is issued.

5.4 Analysis of Data

The Company collects and analyzes appropriate data to determine the suitability and effectiveness of its QMS and to identify where improvements can be made in the QMS.

The following data is gathered and analyzed:

- Customer satisfaction/dissatisfaction
- Conformity of product to requirements
- Measuring & monitoring data
- Trends of both positive and negative compliance
- Internal Quality Audit Data

5.5 Improvement

5.5.1 Continual Improvement

The Company facilitates continual improvement of the QMS by assessing and acting upon the following:

- Quality Policy changes
- Goal/objective changes
- Implementation of the results of management review
- Audit findings analysis of nonconformance
- Corrective and preventive actions implemented

5.5.2 Corrective Action

(Note: Reference to or inclusion of a documented procedure for corrective action is required.)

The Company has established a Corrective Action program to eliminate the cause of the nonconformity and thus prevent recurrence.

Corrective action will be appropriate to the severity of the nonconformity identified.

The applicable procedure, listed in Appendix 6.1 of this Company QMS Manual, addresses nonconformity identification (including customer complaints) cause determination, action to prevent recurrence, identifying and implementing the corrective action, recording results, determining if the corrective action was implemented and effective in resolving the nonconformity.

5.5.3 Preventive Action

(Note: Reference or inclusion of a documented procedure for preventive action is required.)
The Company has a Preventive Action Program, which anticipates the potential causes of nonconformities and works to reduce or eliminate these potential causes.

The applicable procedure, listed in Appendix 6.1 of this Company QMS Manual, identifies potential nonconformities, their probable cause, determination of preventive action needed, and implementation of preventive action, determining if preventive action was implemented and effective in preventing nonconformity.

5.5.4 The COO or designee is responsible for assuring implementation of the QMS improvement requirements.
SECTION 014300 APPENDIX
METRO-NORTH QUALITY MANAGEMENT SYSTEM MANUAL TEMPLATE FOR
CONTRACTORS

SECTION 6 - APPENDICES
6.1 List of Company Quality Management System Implementing Procedures
6.2 Quality Policy

(Note: The Quality Policy should address such issues as:

- Company's commitment to satisfying Customers' needs means that there must be:
  - Free and effective communication with the Customer to achieve a clear understanding of environment into which the product will be applied
  - Elimination of nonconforming conditions
  - Production in adequate quantities
  - On time delivery
  - Timely and effective field service.

- An systematic management process must be applied to meet Customer needs.

- The Company's belief that the combination of
  - Adequately trained personnel
  - Working with documented procedures
  - Supported by adequately detailed product drawings and specifications,
  - Provided with the appropriate materials, facilities and tools
  - Is the basis for a system that will produce products and services meeting Customers' needs

- The Company's belief that management systems must be continuously examined and modified to ensure that it is effective in satisfying Customer needs in the midst of changes in business, regulatory, and social environments.

- That management systems must be sponsored and championed by the highest levels of the Company management in order to underline the priority the company places it.
6.3 Quality Objectives
6.4 Company Organization Chart
APPENDIX H

UTILITY LOCATION PROTOCOL
The Utility Location Protocol listed below must be followed for all underground excavations:

**UTILITY LOCATION PROTOCOL**

1. The Contractor will identify the areas in which they plan to work in a Four-Week Look-Ahead at the Bi-Weekly Progress Meeting.

2. On Monday of each week, the Contractor will lay out the areas in which they plan to excavate the following week. These layouts will be in white to conform to the standard colors for locating utilities. Contractor will contact the underground utilities protective organization (call before u dig)

3. **Non-Power Utilities:** By 8:00 AM on Monday of the week following the Contractor’s layout, the MNR Force Account Task Manager will ensure that all non-power utilities within the area laid out by the Contractor have been marked out by MNR Force Account. The utilities will be color coded in accordance with the standard colors for locating utilities. This includes Signals, Communications, and Structures. The Contractor and Metro-North field staff representatives will be present while Force Account is doing these mark outs.

4. Drawings and dig test pits to confirm the locations shown on the As-Built. By 8:00 AM on Monday of the week following the Contractor’s layout, the Power Department will have a representative on site to review the laid out areas with CTE and the Contractor. This representative will identify if and where any additional test pits need to be dug to verify/expose utility locations. Once the test pits confirm utility locations, the contractor will be released to excavate in that area. If the utilities can not be located via the original test pit(s), the Power Department representative will coordinate with the Construction Management Team to give further direction (if required) as to where to dig additional test pits. Under no circumstance will the contractor excavate until the locations of the utilities shown on the as-built drawings in the area of work are confirmed.

**Power Utilities:** The Contractor will lay out the power utilities based on the As-Built

5. At the Monday morning coordination meeting, MN Force Account will confirm completion of the mark out or identify, to the best of their knowledge, any problem areas which that could restrict the contractor’s excavation. Based on these mark outs, the contractor will test pit the marked out utilities before any excavation is performed in the area of these utilities.

6. The Contractor will dig a test pit for each marked out utility. If the utility cannot be verified, the Force Account department responsible for the mark out will return to provide a new location within 24 hours of notification. These test pits will be well in advance of the excavation. Both MNR and The Contractor must concur that procedures were followed before machine excavation begins.

7. In the event the Contractor uncovers an unmarked utility, the Metro-North Inspector will immediately contact the MNR “Response Team” to have the utility identified and its status determined. If abandoned and not in service, the responsible Response Team member can authorize the removal of the interference. Direction will be provided as to how to handle the unmarked utility as soon as possible but no longer than 24 hours.

8. The Contractor will mark all utilities that are found to be abandoned. This will facilitate future identifications in parallel trenches.

9. The Contractor recognizes that MN Force Account crews are subject to call out for Railroad emergencies. Therefore the Contractor will have identified a minimum of two days work beyond the anticipated week’s production.
10. The Contractor shall adhere to all requirements of the contract documents pertaining to excavation and underground utilities. The Contractor is reminded of the requirement that all excavation equipment be properly grounded.

STANDARD UTILITY LOCATE COLORS:

Red=Electric; Green=Sewer; Pink=Temporary Survey Markings; Orange=Communications/Signals
White=Proposed Excavation; Blue=Water; Yellow=Gas/Oil
APPENDIX I

CONSTRUCTION OF SNOW MELTER AND GROUND BUSS CASE ENCLOSURES
1.0 CONSTRUCTION OF ENCLOSURES

1.1 General

1.1.1 The requirements in this section apply to all Snow Melter Panels and Ground Buss Cases to be supplied under this Contract.

1.1.2 The enclosures described in this section are shown in the Contract Drawings as listed in these Technical Specifications and Contract Drawings.

1.1.3 The Contractor shall submit for review and approval detailed Shop Drawings for each enclosure provided under this Contract. The Shop Drawings shall include, but not be limited to, material lists, fully dimensioned plans, section details, structural details, welding or fastening details, caulking, painting, insulation, shelves, main terminal boards, apparatus boards, and electrical details. The Contractor shall submit both hard copies and electronic copies of the Shop Drawings as defined within these Technical Specifications.

1.1.4 The Contractor shall provide enclosures that are watertight and insulated.

1.1.5 The Contractor shall provide the cases that meet the minimum required sizes shown on the contract drawings.

1.1.6 The Contractor shall provide larger sized enclosures or additional enclosures as necessary to meet the requirements of these Technical Specifications, Contract Drawings and the Contractor's design.

1.1.7 Instrument enclosures shall have exterior surfaces (roof, walls, doors, inner floor and outer floor) of 12-gauge minimum galvannealed sheet steel, CS Type A or Type B, in accordance with ASTM A653 (Specification for Steel Sheet, Zinc-Coated [Galvanized] or Zinc-Iron Alloy Coated [Galvannealed] by the Hot-Dip Process).

1.1.8 The zinc/iron alloy shall have a coating weight of A40 to A60. Acceptable material includes “Zincgrip Paintgrip” by Armco, “Satincoat” by Dofasco, “Durgrip” by Inland, “Colorbond/Stelanneal” by Stelco, “Galvannealed” by U.S.Steel, or approved equal.

1.1.9 All floor, wall and roof framing beams, not exposed to the outside environment of the enclosure, shall be constructed of structural steel shapes conforming with ASTM A36 for L, MC. Other miscellaneous tubular or HSS steel framing components, not exposed to the outside environment of the enclosure, where used shall conform with ASTM A53 Grade B and ASTM 500 Grade B, respectively.

1.1.10 Any structural member whose surfaces, edges, corners or seams are exposed to the outside environment of the enclosure shall be made of stainless steel or other weathering steel suited for the application. The Contractor shall identify any
materials and locations within the enclosures where this application exists.

1.1.11 The undersides of the enclosures shall be painted with a black mastic covering.

1.1.12 The exterior of the enclosures shall be de-greased, primed and painted Aluminum/Silver in accordance with the requirements of AREMA Signal Manual of Recommended Practices Part 2.4.30.

1.1.13 Standing seams, necessary for joining segments of house panels or other elements, shall not be formed externally. They shall be formed facing inward and fully caulked on the exterior with a flexible waterproof caulking material. The caulking shall be compatible with the interior and exterior painting materials.

1.1.14 Cases shall be constructed without any standing seams. Continuous panels are required.

1.1.15 No penetrations, vents or other components are permitted on or through the roof of any enclosure.

1.1.16 The Contractor shall paint the interior surfaces of all enclosures with approved primer and finish with two (2) coats of flame resistant paint, as approved by the Engineer.

1.1.17 Each enclosure shall be fitted with screened and adjustable ventilator openings. Each opening shall be provided with replaceable air filters. The filters shall be commercially available and standard sized. Quantity, size and placement of the ventilator openings shall be submitted to the Engineer for approval.

1.1.18 The Contractor shall submit the maximum weight of each enclosure before delivery.

1.1.19 Each enclosure shall have sufficient structural strength to permit lifting by overhead crane or lifting from below, with all equipment installed, without additional bracing. Eye bolts, or suitable arrangement shall be provided for lifting, including, but not limited to, structural skid pads under the enclosure to permit lifting and sliding into place.

1.1.20 The Contractor’s design for enclosure lifting shall take into consideration the low clearances due to overhead wires and cables adjacent to and over the railroad right-of-way. The Contractor shall provide special lifting rigs and beams designed to permit the installation of the enclosures under the overhead obstructions.

1.1.21 Each enclosure shall have main terminal boards constructed of ¾” NEMA grade GPO-3 fiberglass reinforced thermoset polyester sheets, or approved equal.
1.1.22 All terminals and equipment shall be installed on the front facing side of the main terminal board or apparatus board. No terminals or equipment shall be installed on the rear of the boards.

1.1.23 A full complement of shelves shall be provided for the cases. The width of the shelves shall be a minimum of 12 inches. Wider shelves shall be provided for equipment deeper than 12 inches. No equipment shall overhang any shelf. The shelves shall be of ¾” fire resistant, marine grade plywood, or other approved material, painted with fire retardant white paint shall be furnished on the sides of all houses. Any holes drilled in the boards for wiring or cabling shall be painted after drilling.

1.1.24 A full complement of apparatus boards of ¾” fire resistant, marine grade plywood, or other approved material, painted with fire retardant white paint shall be furnished on the sides of all houses. Any holes drilled in the boards for wiring or cabling shall be painted after drilling.

1.1.25 The apparatus boards shall be securely fastened to the walls in such a manner to permit mounting of battery charging equipment, transformers, terminals and other equipment.

1.1.26 Sufficient space shall be maintained at the rear of the terminal boards and apparatus boards to allow easy access to the cables, wiring and connections.

1.1.27 The Contractor shall submit for review and approval the design proposed for the following:

   a. Main terminal board structural design, mounting methods and layout.
   b. Apparatus boards and shelves structural design, spacing, mounting methods and layout.
   c. Details concerning the work space behind apparatus boards, wire chases, wire management and tagging mounting hardware, overhead cable trays and all other related material.

1.1.28 The surface of mounting racks, apparatus boards, hardware and fittings shall be primed and then finished with two (2) coats of flame resistant White ASA No. 61 paint.

1.1.29 The Contractor shall provide mounting studs, in each enclosure, used for mounting equipment to the apparatus or main terminal boards. The studs shall consist of carriage bolts mounted through the mounting boards and shall be independently secured to the backboard with flat and lock washer and hex head nut. The minimum size for the studs shall be ¼-20. The stud shall remain captured in place when the equipment removed. The use of lag bolts or wood screws is not permitted.

1.1.30 Interior insulation shall be painted after installation with a fire-retardant white paint. The fire-retardant paint shall be compatible with the proposed insulating material.
Insulating material, detailed methods of installation and the proposed fire-retardant white paint shall be submitted to the Engineer for approval.

1.1.31 Foundations of pre-cast concrete shall be furnished for all enclosures. Design of the foundation piers shall be submitted for approval. The pre-cast foundations shall be delivered case enclosure sizes have been approved. The Engineer will authorize delivery the foundations.

1.1.32 The Contractor shall provide a detailed foundation layout plan for each location. The design of the foundation locations shall accommodate the cable entry chutes for each enclosure. The plan shall clearly indicate the foundation location and reference pull boxes and enclosure hatches. All dimensions shall be in English units.

1.1.33 The Contractor shall furnish insulated mounting pads to separate the case from the concrete foundation upon which it is to be installed. Mounting pads for each support point shall be of minimum 3/16" thickness of No. 60 Dura Neoprene as manufactured by Syntex Rubber Co. of Bridgeport, Connecticut, or approved equal.

1.1.34 Instrument case floors shall be designed to hold 500 lbs. per square foot minimum with not more than 1/4" deflection. Should this requirement not be adequate to properly support the weight of the batteries to be provided under this Contract, the Contractor shall provide additional structural support or thicker floors or structural members to prevent the over stressing of the instrument house or case floor and meet this criteria.

1.1.35 Each enclosure shall have a sufficient number of aerial cable entrances and a sufficient number of underground cable entrances at the rear of the main terminal boards.

1.1.36 The Contractor shall provide cable chutes to accommodate burial cable entry into the cases provided under this Contract. The cable chutes shall be made of stainless steel. The grade of stainless steel shall be compatible with the railroad environment and soil conditions. The chutes shall be 6" wide, 24" long and 30" tall at a minimum. The edges at the bottom of the chute shall be rolled to prevent any sharp edges or corners that may damage the cable. The chutes shall be dropped into place from within the enclosure and fit flush to the floor. The chutes shall line up behind the main terminal boards to permit a direct alignment for the cables and the board. Blank spacers shall be provided to close off unused areas of the chute. Fasteners shall be provided to secure the chute and blank spacers.

1.1.37 The cable entry shall be located so that cable pulling tensions and bending radiiuses for cables installed therein is not exceeded.

1.1.38 Entrance hardware shall be included to provide weatherproof entrance of cables.
1.1.39 Cable supports shall be provided behind terminal boards for tie wrapping of incoming cables. The Contractor shall provide commercially available wire and cable management systems to accommodate the internal and external wires and cable.

1.1.40 On the basis of final cable plans, the Contractor shall provide sufficient quantity and size of cable entrances.

1.1.41 The Contractor shall provide a sufficient quantity of complete entrance hardware for each enclosure including cable chutes, gaskets, aerial cable entrances, and fastening hardware. A minimum of 30% spare capacity is required in the entrance facilities once all cables have been installed.

1.2 Cases

1.2.1 The Contractor shall provide cases in quantities and sizes necessary and required to meet the requirements of these Technical Specifications and Contract Drawings.

1.2.2 Except as required within these technical Specifications, the Contractor shall only proposed cases that meet the AREMA recommendations for constructions and sizes.

1.2.3 Each case shall be designed and equipped to be lifted from above. Permanent lifting eyes shall be provided on each case.

1.2.4 Each equipment case shall have hinged doors both front and back. Each front case door shall contain ventilating openings at top and bottom, which shall be provided with replaceable air filters and protected by caps, which to prevent entrance of moisture.

1.2.5 Each door shall be equipped with three-point drawbar style vandal resistant locking arrangement. Doors shall be gasketed so that they will provide a dust proof and weatherproof seal. The three-point drawbar latching arrangement shall be operated by a door handle with a bronze bushing, and will require at least an 80º rotation to unlatch it.

1.2.6 Cases shall be provided with a sloped roofs permitting water to shed toward the rear of the case.

1.2.7 Hasps shall be provided to apply railroad padlocks to front and back doors.

1.2.8 All equipment shall be mounted and serviced from the front of the case. All cables shall be terminated on the front of terminal boards in all cases.

1.2.9 All equipment provided within the cases shall be wired to standard terminal strips with test links.

1.2.10 All Snow Melter Panel cases shall be provided with a minimum of two porcelain lamp fixtures controlled from pull chains. All cases shall be provided with a
minimum of one duplex convenience outlet with an appropriate fuse or circuit breaker. All equipment shall function properly on 60 Hz power fed from the Snow Melter Unit Substations.

1.2.11 All equipment provide with the case shall be mounted on the main terminal board. Mounting equipment on the side walls, doors or rear of the main terminal board is not permitted.

1.2.12 The Contractor shall provide each instrument case with approved rubber floor mats (ANSI/ASTM D 178-81 Class 0) to cover all exposed areas of the floor.

1.2.13 Each case shall be designs and equipped to permit the installation of Contractor provided cable chutes behind the main terminal board. The number and size of the chutes shall be provided for review and approval.

1.2.14 The interior and under floor of each case shall be lined with high efficiency "Thermax" insulation, or approved equal. Insulation shall be 2 inches thick on the sides, top, bottom and doors with an R value of 13. After installation under the floor, the insulation shall be covered by sheet steel conforming to the same material used on the enclosures walls and floor. Access through the floor for the cable chutes shall remain unaffected.

1.2.15 The Contractor shall furnish and install a metal wall mounted plan holder in each case to file field circuit plans. The plan holder shall be sized to hold the locations 11” x 17” circuit plans. Design of the wall mounted plan holder shall be submitted to the Engineer for approval.

1.2.16 Interior surfaces of each case, hardware and fittings shall be finished in accordance with AREMA Signal Manual of Recommended Practices, Part 2.4.30.

1.2.17 Each case shall be provided with 10% spare floor space and 20% spare space for main terminal board apparatus. This requirement shall not be met by utilizing the unusable space required for equipment elsewhere in these Technical Specifications and Contract Drawings.

1.3 Grounding, Surge and Lightning Protection

1.3.1 The Contractor shall provide for fusing, lightning arresters, equalizers and surge protection for all circuits as indicated on the Contract Drawings. This will include, but is not limited to, AC power supply primary and secondary, track circuits, audio frequency overlay track circuits, aerial cables and DC bus surge protection for all electronic devices.

1.3.2 The Contractor shall submit a complete plan showing the grounding requirements for the systems supplied. The grounding system shall be furnished as follows:
a. Each case shall be supplied with two (2) ground studs.
b. All ground studs shall feed through the wall of the housing and shall be made of a non-rusting material such as silicon bronze.
c. Grounding bus bars for each case shall be furnished. They shall be made of a hard-drawn pure copper bar having a minimum conductivity of 98 percent per ASTM B187-73. Each bar shall measure 1/8-inch by 3 inches by 12 inches minimum, and shall be insulated from the housing. Each bus bar shall have a minimum of 15% spare capacity. The ground bus for the cabinets shall be sized according to the requirements of the apparatus within the cabinet. Each grounding bus shall have a smooth flat surface drilled to accept the following connectors furnished by the Contractor.
d. Connectors suitable for connecting the ground bus to the racks within the housing.
e. Connector suitable for connecting the ground bus to all grounded components on terminal boards or apparatus boards.
f. Connector suitable for terminating the ground bus to the housing ground studs. Grounding shall be a minimum four-point grid type.
g. Grounding wire shall not be less than #10 AWG stranded green insulated copper wire, unless specified or approved otherwise.
h. No ground wire shall be run in any wire way with any other wires or cables. The ground wires shall be located as far from any other wires as possible. Ground wires shall not be run parallel to other wires or wire ways. These ground wires shall have no sharp bends and shall have the fewest number of gentle bends possible.

1.3.3 The following devices or apparatus shall be grounded to the main ground bus:
   a. Battery charger chassis
   b. Transformer chassis
   c. Power distribution panel
   d. Each equipment rack (ground stud)
   e. Code line, track circuit, aerial cable, and any other lightning arresters
   f. Local control panel
   g. Terminal space for cable shields
   h. Audio frequency overlay chassis
   i. Network equipment

1.3.4 Number 6 stranded copper wire, with green insulation is to be installed from each stud to the main ground bus.

1.3.5 Grounding system shall not exceed five (5) ohms to ground for all made grounds.

1.3.6 Ground wiring shall be run along the bottom of the housings.
1.3.7 Ground rods shall be furnished by the Contractor for installation by others. Connections to ground rods shall be exothermic connections.

   a. Ground rods shall comply with the standard of UL 467 and the recommendations of the AREMA Signal Manual of Recommended Practices, Part 11.3.4.
   b. Ground rods shall be manufactured of copper-clad steel.
   c. Ground rods shall be a nominal three-quarter inch diameter, not less than eight feet in length.
   d. Ground rods shall be threaded top and bottom with a coupling of corrosion resistant copper alloy for joining.

1.3.8 No loops or daisy chains are permitted where surge control can be compromised.

1.3.9 Each battery charger or other electronic device shall be wired with an appropriate surge protection device on the AC power side and on the DC side. The rating of each device shall be submitted to the Engineer for approval and shall comply with the approved power calculations.

1.3.10 Each individual piece of electronic equipment, such as the ground detectors, vital microprocessor interlocking system, non-vital microprocessor code system, audio frequency overlay track circuit equipment, power supplies/chargers and DC-to-DC converters and network devices, shall have separate DC surge protection.

1.3.11 Transient voltage surge protectors for AC power shall be provided with one (1) internal form C contact for indication to the operations control center. All surge protection shall be in accordance with the manufacturer’s standard.

1.3.12 AC and DC surge protection devices shall be as manufactured by Erico Inc., EPD series or Engineer approved equal.

1.3.13 Individual automatic ground fault detectors shall be provided in each CIL, house and case, to constantly monitor all power buses. The buses monitored shall include, but not be limited to, the 100BX/100NX, B12/N12, B12-AFO/NV-/N12-AFO/NV, LB12/LN12, 60BX/60NX, network equipment and microprocessor equipment power buses.

1.3.14 Each ground fault detector shall provide an alarm, which will be displayed on the local control panel as well as an indication in the Operations Control Center. The detector shall be powered by DC. Ground fault detector shall be Zytron Control Products Model GFD or Engineer approved equal. The proposed automatic ground fault detector shall be submitted to the Engineer for approval.

1.4 Relay and Equipment Racks
1.4.1 Relay racks (vital and non-vital), track circuit racks, power racks, microprocessor equipment racks, terminal racks, fuse racks, network equipment and miscellaneous racks shall be furnished by the Contractor for all instrument housings.

1.4.2 The type and size of the racks shall be as required for the purpose for which they will be used, and shall be approved by the Engineer. In general, the width of the racks and depth of the section used for the side rails shall be of the manufacturer’s standard and as approved by the Engineer. The maximum rack width shall not exceed thirty-one (31) inches. The overall height of the rack shall not exceed seven (7) feet six (6) inches in height. Racks installed in new enclosures shall have overhead support. Wire entrance to racks shall be by means of overhead chase and/or conduit.

1.4.3 Swing-out type relay or equipment racks shall not be utilized.

1.4.4 Relays, track circuit equipment, microprocessor equipment or wire terminations shall not be placed less than twelve (12) inches or more than seventy-two (72) inches above the floor.

1.4.5 Terminal boards for energy buses shall be provided at the top of the rack. In general, wiring between pieces of equipment on the same rack, shall not be required to be terminated other than on the pieces of equipment. The arrangement of the terminal board shall, in general, be in accordance with the Contractor’s standards, but the Engineer may require changes in the location of the terminal boards and the method of terminating wires to meet the requirements of the signal system, and the physical layout of signal equipment.

1.4.6 The Contractor shall provide means whereby each individual rack can be individually grounded to a common ground bus. Means of insulating the racks from each other and from any supports shall be provided by the Contractor and shall be as approved by the Engineer.

1.4.7 All materials, including the insulating materials described above, needed to assemble the several racks one to another to form complete units shall be furnished by the Contractor.

1.4.8 The Contractor shall submit drawings of each proposed type of rack for the approval of the Engineer.

1.4.9 The Contractor shall prepare detailed drawings showing arrangement of equipment on racks, for each type of rack and for each application, which shall be submitted, to the Engineer for approval prior to fabrication of racks.

1.4.10 New racks and supporting braces shall be installed so that each individual rack shall be insulated from each other. The Contractor shall furnish and install all equipment and material required to insulate the racks. Racks shall be grounded in accordance with manufacturer’s standard.
1.4.11 The Contractor shall provide a detailed plan defining the wire and cable management to be used for all rack mounted systems. This includes, but is not limited to, how ground wires, clean and dirty wiring will be managed and what products will be employed.

1.4.12 Means shall be provided to suspend and hold cables in place and to provide slack. Each rack shall be individually grounded to a common ground bus or as required by the manufacturer’s standard. Each common ground bus shall be grounded at not less than two (2) separate points. The racks shall be insulated from each other, and from the floor, all as approved by the Engineer.

1.4.13 The Contractor shall furnish and install all materials required to make the racks level and plumb. The method and manner of performing this work shall be submitted to the Engineer prior to installation of the racks.

1.4.14 The Contractor shall prepare a drawing showing the exact proposed layout of all racks and associated equipment at each instrument house and submit the layout to the Engineer for approval.

1.4.15 A minimum of 10% spare space for additional relays or other components, and 10% spare terminals, on each equipment rack shall be provided. This requirement shall not be met by utilizing the unusable space stated elsewhere in these Technical Specifications and Contract Drawings.