PORT AUTHORITY OF ALLEGHENY COUNTY

D/B/A PITTSBURGH REGIONAL TRANSIT

TECHNICAL PROVISIONS

Rt. 88 GRADE CROSSING IMPROVEMENTS

SYS-26-02

AUGUST 2026



Port Authority of Allegheny County
d/b/a Pittsburgh Regional Transit (PRT)
Heinz 57 Center
345 Sixth Avenue
Pittsburgh PA 15222-2527

Technical Provisions

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Construction Contract No. SYS-26-02
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SECTION 01570

SITE SURVEY

ARTICLE 1 GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, providing all labor, material, tools, equipment, and incidentals necessary for site survey of the existing and final elevations and any other required survey to complete the Work shown in the Contract Documents.

1.02 RELATED SECTIONS

A. Section 02350, “Drilled Caisson Foundations”.

B. Section 02761, “Pavement Markings”.

C. Section 13572, “Grade Crossing Warning System”.

1.03 REFERENCE STANDARDS

A. PENNDOT Publication 408.

1.04 SUBMITTALS

A. Submit Professional Land Surveyor resumes for approval by the Engineer.

1.05 QUALIFICATIONS

A. Employ a Professional Land Surveyor, licensed in the Commonwealth of Pennsylvania with at least ten years of experience. The registered professional must be qualified in the use of procedures for establishing horizontal and vertical geometry, structure location, utility layout, and dimensions as may be required.

ARTICLE 2 PRODUCTS

2.01 CONSTRUCTION SURVEYING

A. In accordance with PennDOT 408, Section 686.2, except as modified herein:
   1. 686.2(g) change Bridge to Structures
   2. 686.2(l) delete section.

ARTICLE 3 EXECUTION

3.01 CONSTRUCTION

A. Prior to any Work, a survey shall be performed by a surveyor registered in the Commonwealth of Pennsylvania to establish the existing grades.

B. Construction Surveying includes surveying based on precise horizontal and vertical geometry established from surveys based on Pennsylvania State Plane Coordinate System in the North American Datum of 1988 (NAVD 1988).

C. For survey and for verifying existing and proposed elevations, use the existing mag nail points as benchmarks. Mag nail locations and elevations are defined on the Contract Drawings.

D. The Contractor is responsible for verifying control points and benchmarks (mag nail) elevations to be utilized during the Work. Notify the Engineer immediately of any errors, omissions or discrepancies. Record geometric and/or coordinate ties on all lines produced.

E. Contractor assumes full responsibility for dimensions and elevations taken from control points.

F. Perform as directed miscellaneous Work in accordance with the related Sections of the Technical Provisions included in the Work.

ARTICLE 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this Section shall not be measured separately for payment.

4.02 PAYMENT

A. No separate payment will be paid for the Work of this Section. Payment for the Work of this Section shall be incidental to payment for Section 01855 - Mobilization.

END OF SECTION

SECTION 01710

LOCK OUT/TAG OUT

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section consists of furnishing all labor, tools, material and equipment to follow Authority Lock Out/Tag Out Policy Statement and Guidelines for traction power, overhead contact system (OCS), signal power and general-use power.

1.02 RELATED SECTIONS

A. Section 13570 - Signal System
B. Section 13572 – Grade Crossing Warning System

1.03 REFERENCE STANDARDS

A. American National Standards Institute (ANSI) Standard Z 244.1 – 1982.

B. Occupational Safety and Health Association (OSHA) Title 29 CFR Part 1910.

1.04 SUBMITTALS

A. "Register of Scheduled Power Outage on Port Authority Property" three working days prior to the scheduled outage.

ARTICLE 2 – PRODUCTS

2.01 GENERAL

A. All tools, materials and equipment used shall meet the requirements of Authority Policy Statement and Guidelines for Lock Out/Tag Out and Authority Lock Out/Tag Out Guidelines.

ARTICLE 3 – EXECUTION

3.01 AUTHORITY LOCK OUT/TAG OUT

A. Contractor shall refer to attached Authority “Lock Out/Tag Out Statement,” “Lock Out/Tag Out Guidelines,” and “Register of Scheduled Power Outage on Port Authority Property.”

B. The requirements of this Section are in addition to the track allocation request procedure.

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the work of this Section. Payment for the work of this Section shall be incidental to payment for Section 13572 – Grade Crossing Warning System.

END OF SECTION

SECTION 01800

EROSION AND SEDIMENT CONTROL

ARTICLE 1 - GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, providing all labor, materials, tools, equipment, and incidentals necessary for erosion and sediment pollution control, in accordance with the contract documents.

1.02 RELATED SECTIONS

A. Section 01855, “Mobilization”.

B. Section 02350, “Drilled Caisson Foundations”.

A. Section 02648, “Horizontal Directional Drilling”.

B. Section 03300, “Cast-in-Place Concrete”.

C. Section 13572, “Grade Crossing Warning System”

1.03 REFERENCE STANDARDS

A. PENNDOT Publication 408.

B. PaDEP, Erosion and Sediment Pollution Control Program Manual.

C. ASTM.

D. AASHTO.

1.04 REGULATORY REQUIREMENTS

A. The Contractor shall make every effort to control soil erosion and sediment in accordance with this Technical Provision and Best Management Practices.

1.05 SUBMITTALS

A. A copy of proposed changes shall be submitted to Engineer.

1.06 COMPLIANCE

A. Contractor must adhere to the requirement of this specification and sound engineering judgment.

1. 25 Pa. Code § 102

ARTICLE 2 - PRODUCTS

2.01 MATERIALS

A. Storm Inlet Protection

1. Inlet Filter Bags

a. Geotextile: PENNDOT 408, Section 860 and as follows:

1) Use a 401-lock chain stitch seam or a heat-bonded seam.

2) Permanently attach a manufacturer's label to each bag designating the maximum allowable flow rate of the bag in gallons per minute.

b. Reinforcement Bars: PENNDOT 408, Section 709.1.

B. Pumped Water Filter Bag

1. Geotextile, non-woven: PENNDOT 408, Section 855.

a. Shall be capable of trapping particles larger than 150 microns.

2. Coarse aggregate (No. 57): PENNDOT 408, Section 703

3. Pumped water filter bag: PADEP, Erosion and Sediment Pollution Control Program Manual, Page 53.

C. Compost Sock Washout

1. Install on grades not exceeding 2%.

2. Compost sock washouts must be installed a minimum of fifty (50) feet from storm drain inlets, floor drains and watercourses.

3. The contractor shall not place concrete washouts near inlets or floor drains.

4. Compost sock washout facilities should be inspected daily and after heavy rains to check for leaks, identify any damaged materials by construction activities and determine whether they have been filled to over 75%. Any damage to the compost sock washout should be repaired immediately.

5. When the compost sock washout is filled over 75% the compost sock washout shall be replaced.

6. If the washout location is not within view of the pour location signage, the contractor shall provide signage to direct truck drivers.

D. Compost Filter Sock

1. Compost: PENNDOT 408, Section 867.2(a).

2. A suitable impervious geomembrane shall be installed at the location of the washout prior to the installation of the compost filter sock.

3. 18" diameter compost filter sock may be stacked onto a double layer of 24" diameter sock in a pyramidal configuration for added height.

4. Filter Sock: PENNDOT 408, Section 867.2(b).

5. Compost filter sock: PADEP, Erosion and Sediment Pollution Control Program Manual, Page 62.

E. Compost Filter Sock

1. Compost Filter Sock shall be in accordance with PADEP Erosion and Sediment Pollution Control Program Manuel Table 4.2.

ARTICLE 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Contractor shall install Erosion and Sediment Control devices in accordance with DEP Best Management Practices. Erosion and Sediment Control devices must be installed prior to earth disturbance.

2. Erosion control features shall be incorporated into the Project, as outlined in the Project Schedule and the sequence of operations identified in the Contract Documents.

3. Sediment control devices shall be relocated to other locations or removed, as schedule of activities dictate.

4. Provide protection of waste stockpile with erosion control features as directed.

B. Storm Inlet Protection

1. General

a. Utilize storm inlet filter bags (silt sacks) where existing inlets are exposed to sediment. In the event that inlet filter bag cannot be placed, use berm type inlet sediment filter.

2. Inlet Filter Bag

a. Inlet filter bag shall be installed in accordance with DEP Best Management Practices.

b. Storm inlet filter bags may be reused at other inlets, after proper cleaning.

C. Pumped Water Filter Bags

1. Locations for the filter bags will be at the discretion of the Contractor can be placed at any point where water is to be removed from excavated areas that will not drain.

2. A sump shall be constructed in a low point for the intake for the pump. The intake shall also be floating and screened.

3. The pump discharge hose shall be inserted into the bags in the manner specified by the manufacturer and double clamped.

4. Use a pump with a rating in gallons per minute not to exceed 50% of the maximum flow rate listed on the bag label or 750 gpm; whichever is less.

5. Permanently attach a manufacturer's label to each bag designating the maximum allowable flow rate of the bag in gallons per minute.

D. Compost Sock Washout

1. Placement: Place compost sock washout at the project site:

a. Prior to placement of concrete

b. Away from construction traffic or public access areas

c. In sufficient numbers/sizes so that total capacity can contain all liquid and concrete waste generated by concrete washout operations without seepage or spills

d. At least 50' from inlets, streams, drains or other streams.

2. Signs: Install a sign adjacent to each temporary compost sock washout locations. Signs must:

a. Comply with all size standards in the overall job specification

b. Be approved by the engineer or job site manager

c. Be made of plywood, with a minimum size of two feet by four feet

d. Read " Compost Sock Washout" in black letters, at least three inches high, on a white background

3. Compost Sock Washout are used to:

    a. Contain waste and wastewater from washing out of concrete delivery and mixing trucks

    b. Contain slurries containing Portland cement concrete or hot mix asphalt, such as would result from saw cutting, coring, grinding, grooving and hydro-concrete demolition.

E. Compost Filter Sock

1. Compost Filter Sock shall be installed as per the Plan and Detail Sheets.

3.02 SEQUENCE OF OPERATIONS

A. The sequence of erosion and sediment pollution control activities for the Project shall be in accordance with the Best Management practices. Contractor may modify this schedule during construction to minimize soil erosion, abate water pollution, and ensure progress on the Project, after obtaining necessary approvals from the Engineer and the Allegheny County Conservation District.

B. General

1. Erosion and sediment control measures and facilities shall be installed and operational prior to any earthmoving activities.

2. Waste and excess materials shall be hauled from the work areas and stockpiled or disposed of at an approved facility.

3. Contractor shall provide an Erosion and Sediment Control Plan to the Allegheny County Conservation District for any stockpile sites of outside Project limits. Upon approval of the plan, Contractor shall furnish three (3) copies of the permit to the Engineer prior to beginning off-site operations.

4. Any proposed deviation from the approved construction sequence shall first be submitted, by Contractor through the Engineer and the Allegheny County Conservation District, for review and approval.

5. All procedures and construction shall be in accordance with the PaDEP Erosion and Sediment Pollution Control Program Manual, and the PaDEP “Erosion and Sediment Control Plan Development Checklists, Standard Worksheets, Details and Notes,”

C. Preparation of Construction Staging Areas

1. Construction staging yards shall be encompassed by compost filter sock.

3.03 TEMPORARY CONTROL MEASURES AND FACILITIES FOR USE DURING EARTHMOVING

A. General Site Management

1. Construction site egress points shall be maintained in a manner that prevents the tracking, deposition or flowing of sediment (including liquid contaminants and airborne particles, onto public rights-of-way. All sediment spilled, dropped, washed, or tracked onto public rights-of-way must be removed immediately.

B. Equipment and vehicle management

1. The wheels on all vehicles leaving the construction site must be cleaned in order to remove sediment prior to the vehicle entering the public right-of-way. Cleaning may include equipment washers and/or wheel scrubbers. When washing is required, it shall be done on a stabilized area that drains into an approved sediment-trapping device.
2. Decontamination areas will be adequate size to accommodate the largest piece of equipment utilized on the site. The decontamination area will be covered with an impermeable membrane and a containment berm will be located around the perimeter of the decontamination area.
3. All water utilized in the decontamination process will be drained to a low point within the decontamination area, collected, tested, and disposed of in accordance with regulations of the PaDEP.
4. Decontamination areas will be removed and disposed of at project completion.

C. Material Transportation

1. Materials with sufficient water content or contamination to leak will be carried in sealed truck beds.
2. Fugitive dust from material transportation will be controlled through the use of tarps and covered truck beds.

3.04 MAINTENANCE PROGRAM FOR THE CONTROL FACILITIES

A. Maintenance

1. The Contractor shall be responsible for the continuous maintenance of all E&S measures and devices for the duration of the Project. All maintenance shall be conducted as per the approved Erosion and Sediment Pollution Control Plans, Narrative, PaDEP, Erosion and Sediment Pollution Control Program Manual and as stated below. The Engineer shall inspect all devices weekly (minimum) and after every rainfall event and notify the Contractor when maintenance is required and/or specific deficiencies exist. Any device found to be clogged, damaged, half-

full of silt or not fully operational shall be cleaned of all debris. The solid waste disposal is the responsibility of the contractor. All deposited sediment from the trap shall be removed and spread accordingly, if acceptable, as fill material on the Project site.

B. Storm Inlet Protection

1. Inlet Filter Bag

a. Inspect inlets weekly where storm inlet filter sacks are installed and after every precipitation event. Dispose of storm inlet filter trapped sediment when accumulations fill ½ of the storm inlet filter bag. Immediately reinstall the cleaned filter sack. All deposited sediment from the trap shall be removed and spread accordingly or used as fill material, on the Project site.

C. Pumped Water Filter Bags

1. The filter bag will be inspected before and after each pumping operation. The filter bag will be replaced if any type of damage, clogging, or leakage has been discovered. The filter bag will be removed when clogged with sediment and new filter bag must be installed.

2. Monitor and evaluate the entire pumping operation to assure that the bag continues to function properly. Replace the bag when the contained silt reduces the bag flow to approximately 50% of the rate of initial discharge, or when directed by the Engineer.

3. Filter bags must be disposed of at an approved facility.

D. Compost Sock Washout

1. Inspect compost sock washouts daily if concrete work occurs daily and weekly if concrete work does not occur each day.

2. Compost sock washouts must be secured when moved to prevent spillage of material from the bag (solid waste or wastewater). Any spilled material should be returned to the bag.

3. Concrete waste and wastewater must be disposed of at a facility or facilities specifically licensed to receive these materials. Compost sock washouts are to be removed for material disposal within one day of reaching capacity.

E. Compost Filter Sock

1. The contractor will maintain the compost filter socks in a functional condition at all times and will be responsible for inspecting the compost filter sock after every runoff event. Any necessary repairs will be made immediately.

2. The contractor will remove sediment collected at the base of the compost filter sock when they reach one-half of the exposed height of the sock, or as directed by the engineer. Rather that create a soil disturbing activity, the engineer may add additional compost filter socks to be areas of high sedimentation, placed immediately on top of existing sediment laden compost filter socks.

3. Any section of compost filter sock that has been undermined or washed out should be immediately replaced with additional filter sock or a rock filter outlet within 24 hours of inspection.

4. The compost filter sock will be dispersed on site when no longer required, as determined by the engineer.

5. Adhere to any manufacturer's recommendations for installation, replacement, and maintenance of compost filter sock.

3.05 REMOVAL

A. Used compost sock washouts shall be disposed of at an approved facility in accordance with the Terms and Conditions.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this Section shall be measured as a Lump Sum Unit, acceptably performed complete in place.

4.02 PAYMENT

A. The Work of this Section will be paid for at the Lump Sum Unit Price paid for Bid Item 01800, “Erosion and Sediment Control” for which the Work in this Section pertains.

PAYMENT SCHEDULE

1. First payment (40%) of the contract Lump Sum amount bid for Erosion and Sediment Control will be released after 10% of the original total contract amount, including payments for delivered materials but excluding Erosion and Sediment Control, is earned.

2. Second payment (50%) of the contract Lump Sum amount bid for Erosion and Sediment Control will be released after 85% of the original total contract amount, including payments for delivered materials but excluding Erosion and Sediment Control, is earned.

3. The final payment (10%) of the contract Lump Sum amount bid for Erosion and Sediment Control will be released when all physical work has been satisfactorily completed and all certificate and documents, as required,

have been properly furnished.

END OF SECTION

SECTION 01806

FIELD OFFICE

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, providing all labor, material, tools, equipment, and incidentals necessary for providing a field office, cleaning the field office, maintaining the field office, and removal of the in accordance with the Contract Documents. A location for the field office is shown within the Contract Drawings.

1.02 RELATED SECTIONS

A. Section 01809, - “Temporary Facilities”

B. Section 01855, - “Mobilization”

1.03 INSTRUCTIONS

A. Office shall be for the exclusive use of the Engineer commencing 15 calendar days from the date of Notice to Proceed until immediately prior to Final Inspection, unless otherwise directed by the Engineer. Dates of installation and removal of the Field Office space shall be as approved by the Engineer.

ARTICLE 2 - PRODUCTS

2.01 GENERAL

A. The Contractor shall provide a field trailer with a 8' x 12' minimum, to be used by the Engineer as well as appropriate conference room with table and chairs.

B. Exterior and interior surfaces, other than factory-finished, shall be painted with two coats of an approved paint. No painting will be required on aluminum or stainless steel surfaces.

C. Interior walls, sub-floors, and ceilings should be insulated and shall be finished with plywood or gypsum wallboard or other suitable material.

D. Electrical service entrance shall be 220-volt, minimum 60-amp, to supply concurrent power demands for office services, appliances, mechanical equipment and utilities.

E. Lighting shall be provided to furnish a minimum of 100-foot candles at desk height uniformly in all areas.

F. Duplex electrical receptacles shall be provided around interior walls at approximately 6-foot spacing.

G. Office shall be provided with an automatically controlled heating and air conditioning system, capable of maintaining the temperature at 70 degrees F to 75 degrees F.

H. Office shall have the following equipment and facilities.
   1. Provide a Low Capacity Multifunctional Device (MFD); Copier, Scanner, Fax, and Printer meeting the requirements listed in PENNDOT Publication 408 Section 609.2.c.2
   2. Electric bottled water (5-gallon capacity) cooler shall have one hot tap and one cold tap.
   3. First aid kit with manual, suitable for ten (10) people, and shall be such as that as American White Cross No. K10 or approved equal.
   4. Coat rack and hooks.
   5. One (1) ten (10) cu. Ft. refrigerator.
   6. Restroom facility to include water closet, lavatory with hot and cold water, toilet tissue holder, paper towel dispenser, and mirror.
   7. Two (2) parking spaces for Engineer's use.
   8. One (1) plans table 3'-0" x 6'-0" x 3'-2" high.

I. Provide the following equipment and furniture in the Engineer's room.

   1. White marker board, including markers, 4 foot by 6-foot size, and one (1) board required.
   2. One (1) desk 30 inches by 60 inches with lockable drawers.
   3. One (1) desk chair with cushioned back and seat, five (5) support legs and castors, and pneumatic height adjustment.
   4. Two (2) guest chairs with cushioned back and seat, five (5) support legs and casters, and pneumatic height adjustment.
   5. One (1) four (4) drawer, fire-resistant (D-Label) metal file cabinet with lock.
   6. Provide Internet Service in accordance with PENNDOT Publication 408 Section 609.2.e or appropriate wifi hotspot in accordance with speed requirements in 609.2.e
   7. One (1) plan rack capable of supporting ten (10) sets of drawings.
   8. Coffee maker.

ARTICLE 3 - EXECUTION

3.01 GENERAL

A. Maintain and clean on a bimonthly basis. Provide and maintain bottled water and water cooler dispensing units (with paper cups) in constant supply.

B. Provide continuous maintenance during the construction period including, but not limited to, utilities, office equipment, mechanical heating, ventilation and air conditioning (HVAC) and electrical equipment.

C. Repair or replace defective furnishings and utilities immediately.

D. Provide janitorial service each workday. Service shall consist of furnishing paper towels, toilet tissue, sweeping, mopping, dusting, and disposing of trash.

E. Provide paper, toner, and other required supplies for copy machine. Contract with a maintenance service for the copy machine.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this Section shall be measured as a Lump Sum Unit, acceptably complete in place.

4.02 PAYMENT

A. The Work of this Section will be paid as part of the Lump Sum Unit Price paid for **Bid Item 01806 – Field Office** for which the Work in this Section pertains.

END OF SECTION

SECTION 01809

TEMPORARY FACILITIES

ARTICLE 1 - GENERAL

1.01 SUMMARY

A. The Work of this Section include:

1. Arrangements with the utility company to provide for temporary service prior to the execution of the Work.
2. Temporary electrical distribution from the utility source(s) to the Worksite for the execution of the Work and for lighting and power at the field office.
3. Equipment needed to distribute temporary electricity from the source(s) to the points of utilization required for the proper and timely execution of the Work.
4. Temporary power, temporary lighting, temporary telephone service, temporary internet, and associated electrical Work as required to complete the Work.

1.02 RELATED SECTIONS

A. Section 01806, - “Field Office”

B. Section 01855, - “Mobilization”

1.03 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA).

B. NFPA National Electrical Code, latest edition (NEC).

C. Uniform Construction Code (UCC).

D. International Building Code (IBC).

E. U.S. Architectural Transportation Barriers Compliance Board: Americans with Disabilities Act (ADA) Accessibility Guidelines for buildings and Facilities/Transportation Facilities.

F. Underwriters' Laboratories, Inc. (UL).

G. Occupational Safety and Health Administration (OSHA) Construction Industry Regulation (29CFR 1926).

H. National Electrical Manufacturers Association (NEMA).

I. Illumination Engineering Society (IES).

J. Other industry/municipal standards as relevant to the Work and per local jurisdiction.

K. Commonwealth of Pennsylvania Department of Transportation Specifications, Publication 408.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

A. Obtain and pay for permits, as required by governing authorities, and temporary

easements across property other than Authority's.

B. Comply with federal, state, and local codes and utility company regulations that are applicable.

ARTICLE 2 - PRODUCTS

2.01 TEMPORARY ELECTRICAL EQUIPMENT

A. Temporary equipment shall consist of transformers, panel boards, grounding, receptacle outlets, switches, wiring and other materials to ensure a complete, grounded operating system that is capable of continuous service, with adequate capacity for the intended purpose and conforming to NEC and referenced standards.

2.02 TEMPORARY POWER AND LIGHTING

A. Temporary power and lighting in accordance with NEC and referenced standards.

1. Temporary lighting fixtures in accordance with OSHA regulations and UL-listed. This includes provisions of shatterproof guards where required.

2.03 PORTABLE ELECTRICAL GENERATORS

A. Portable electrical generators shall be grounded in accordance with NEC.

2.04 EXTENSION CORDS AND ENCLOSURES

A. Extension cords shall be grounded type and UL-approved.

B. Enclosures shall be suitable for the application in accordance with NEMA and NEC.

2.05 TEMPORARY TELEPHONE & INTERNET EQUIPMENT

A. Equipment: Compatible with that of the telephone company. Enclosures for instruments and directories at exterior locations shall be weatherproof.

B. The Contractor shall provide a high-speed internet connection for the field office.

2.06 TEMPORARY SANITARY MATERIALS AND EQUIPMENT

A. Materials and equipment shall be adequate for purposes intended, and shall neither create unsanitary conditions nor violate requirements of codes applicable to temporary sanitary facilities.

B. Minimum quantity of toilet facilities shall be as followed:

1. For fewer than twenty (20) employees One (1) toilet.
2. For twenty (20) to one hundred ninety-nine employees: One (1) toilet and one (1) urinal per forty workers.

C. Potable water as required by Allegheny County Health Department.

D. Toilet facilities shall be portable type satisfying the requirement of Occupational Safety and Health Administration (OSHA) 1926.51, and shall be chemical, recirculating, or combustible toilets. Toilet tissue shall be provided and maintained on suitable dispenser.

E. Enclosures for toilets shall be weatherproof, sight-proof and sturdy type. Interior shall be lighted and ventilated. Privacy screens shall separate toilet fixtures that are in enclosures capable of accommodating more than two (2) persons at one time.

2.07 TEMPORARY ENCLOSURES AND FENCING

A. Construction: Portable commercial grade chain link fence.

B. Provide 6 feet high fence at locations indicated on drawings as staging areas; equip with access gates if required.

B. Exterior Enclosures:

1. Contractor shall provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

2. Contractor shall provide temporary roofing to maintain a weather tight enclosure when required.

ARTICLE 3 - EXECUTION

3.01 INSTALLATION

A. Locate facilities where they will not interfere with material-handling equipment, storage spaces, traffic and execution of the Work. Installed products shall present a neat and orderly appearance, be structurally sound, and be maintained in a manner that shall ensure continuous service and present no unsafe working conditions.

B. Temporary sanitary facilities shall be installed in a neat and orderly manner, made structurally and mechanically sound, and serviced, maintained, and cleaned to ensure sanitary conditions. Portable toilets shall be securely erected, and shall be anchored to prevent dislocation. Toilets shall be serviced as often as necessary to prevent accumulation of wastes and creation of unsanitary conditions. In no event shall toilets be serviced less frequently than once a week.

3.02 POLES

A. Do not use temporary poles to support wires for temporary electrical power.

3.03 DIRECTORIES

A. In addition, prepare and maintain an alphabetical telephone directory containing the parties and their telephone numbers set forth in the Terms and Conditions.

3.04 SECURITY

A. Provide security to protect the Work from unauthorized entry, vandalism, or theft until Final Inspection.

3.05 ACCESS ROADS AND STAGING AREA

A. Construct and maintain temporary roads accessing public thoroughfares to serve construction area.

B. Provide implementation measures including prewashing and sweeping to remove mud from vehicle wheels before vehicles enter busway and public street access and to remove mud from public streets.

C. Construct and maintain staging area(s) to service worksite. Submit working drawings of proposed locations for staging areas to the Engineer for approval.

3.06 PARKING

A. Contractor shall arrange for parking areas to accommodate construction staff.

B. Contractor shall provide additional off-site parking as required, at no additional cost to Authority.

3.07 FACILITY LOCATION

A. Locate temporary sanitary facilities, as approved by Engineer, within the Worksite, convenient to Work Stations, and relocate as may be required by Work progress. Seclude toilet facilities from public observation, insofar as it is practicable to do so.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this Section shall not be measured separately for payment.

4.02 PAYMENT

A. The Work of this Section will be paid for as part of the Lump Sum Unit Price paid for **Bid Item 01855 – Mobilization** for which the Work in this Section pertains.

END OF SECTION

SECTION 01850

MISCELLANEOUS UNFORESEEN CONDITIONS (AS DIRECTED)

ARTICLE 1 - GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, providing all labor, material, tools, equipment, and incidentals necessary for miscellaneous work as directed.

1.02 RELATED SECTIONS

A. As applicable.

1.03 REFERENCE STANDARDS

A. PENNDOT Publication 408

ARTICLE 2 - PRODUCTS

2.01 MATERIALS

A. Materials shall be provided in accordance with applicable related Sections of the Technical Provisions included in the Work.

ARTICLE 3 - EXECUTION

3.01 CONSTRUCTION

A. Perform as directed miscellaneous work in accordance with the related Sections of the Technical Provisions included in the Work.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. **Bid Item 01850 – Miscellaneous Unforeseen Conditions (As Directed)** shall be measured as directed by the Engineer.

4.02 PAYMENT

A. **Bid Item 01850 – Miscellaneous Unforeseen Conditions (As Directed)** will be paid for as part of a Predetermined Amount (PDA), as such work is directed, to be performed, by the Engineer. The value to be paid for the direct work of this Contract Item will be established, at the discretion of Authority, by one or more of the following methods

1. By a negotiated amount, subsequent to receipt of the Contractor's submission of a proposal, following the procedures for establishing a price for a negotiated Change Order in Section 00900, Article 1.7,
2. By force account, following the procedures for establishing the value of force account work as set forth in Section 01200, Article 4, and/or
3. By Authority on the basis of the Engineer's estimate of an equitable value for the Work to be performed. This would be a unilateral value as determined by the Authority.

END OF SECTION

SECTION 01855

MOBILIZATION

ARTICLE 1 - GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, furnishing all labor, material, tools and equipment for the assembling and setting up the Contractor's general plant for the Project, including offices, shops, plants, storage areas, sanitary and other facilities, as required by the Contract Documents. The determination of the adequacy of the Contractor's facilities, except as noted above shall be made by the Contractor. The cost of required insurance and bonds, other requirements of the Terms and Conditions not specifically included elsewhere, and other initial expenses required for the start of Work shall be included in this Section.

1.02 RELATED SECTIONS

A. Section 01806, “Field Office”.

B. Section 01809, “Temporary Facilities”.

ARTICLE 2 - PRODUCTS

2.01 MATERIALS AND FURNISHINGS

A. Material and furnishings required for the work of this Section shall be furnished by the Contractor. These materials and furnishings will not be considered as a part of the various items of the completed Contract.

ARTICLE 3 - EXECUTION

3.01 GENERAL

A. Contractor shall notify the Engineer at least three (3) working days prior to the start of mobilization, and de-mobilization.

B. Contractor must provide on-site sanitary facilities for contractor employees. Obtain location approval from engineer prior to installing these facilities.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Mobilization shall be measured as a Lump Sum Unit, acceptably complete in place.

4.02 PAYMENT

A. The Work of this Section will be paid for at the Lump Sum Unit Price paid for **Bid Item 01855 – Mobilization** for which the Work in this Section pertains.
B. The Authority will pay for Mobilization according to the following schedule:

1. First payment (30%) of the contract Lump Sum amount bid for Mobilization will be released after 20% of the original total contract amount, including payments for delivered materials but excluding mobilization, is earned.

2. Second payment (20%) of the contract Lump Sum amount bid for Mobilization will be released after 40% of the original total contract amount, including payments for delivered materials but excluding mobilization, is earned.

3. Third payment (20%) of the contract Lump Sum amount bid for Mobilization will be released after 60% of the original total contract amount, including payments for delivered materials but excluding mobilization, is earned.

4. Fourth payment (20%) of the contract Lump Sum amount bid for Mobilization will be released after 80% of the original total contract amount, including payments for delivered materials but excluding mobilization, is earned.

5. The final payment (10%) of the contract Lump Sum amount bid for Mobilization will be released when all physical work has been satisfactorily completed and all certificate and documents, as required, have been properly furnished.

END OF SECTION

SECTION 01910

MAINTENANCE AND PROTECTION OF TRAFFIC

ARTICLE 1 - GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, providing all labor, materials, tools, equipment, and incidentals necessary for furnishing and installing Maintenance and Protection of Traffic measures, coordinating with adjacent Property owners as indicated, as hereinafter specified, and/or as otherwise required for the proper and timely completion of this Contract.

B. Provide traffic protection for SR 0088 as required per the Contract Plans.

C. Provide Site Security fencing for project site.

D. Provide Pedestrian detours, protection and temporary walkways as required.

E. Provide temporary signage, pavement markings, etc. as shown on the Contract Drawings.

F. Coordinate with adjoining Property Owners and Bethel Park Borough related to work measures that may affect their properties or Right-of-Way.

G. Contractor shall not be permitted to direct any revenue service vehicle.

1.02 RELATED SECTIONS

A. Section 02761, “Pavement Markings”

B. Section 13572, “Grade Crossing Warning System”

1.03 REFERENCE STANDARDS

A. Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways 11th Edition.

B. PennDOT Publication 35, Bulletin 15.

C. PennDOT Publication 212.

D. PennDOT Publication 213.

E. PennDOT Publication 408.

1.04 TRAFFIC CONTROL PLANS

A. Performance Requirements.

1. Contractor shall obtain any required permits from PennDOT and PRT prior to implementing traffic controls on SR 0088.

2. Do not place any traffic control device or signing until required. When Work is complete, immediately remove Worksite traffic control devices.

3. Do not place any sign or traffic control device in a location which would block all or a portion of any sidewalks, pedestrian walkway, driveway, or entrance to any building or residence unless approved by the Engineer, and the appropriate governing agency or agencies.

4. Maintain vehicular and pedestrian traffic around the Work area in accordance with the Traffic Control Plan (TCP).

5. Do not impose traffic restrictions, other than those on the TCP, without the prior written approval of Engineer, in conjunction with the appropriate governing agencies.

6. Do not impose parking restrictions, other than those on the TCP, without the prior written approval of Engineer.

7. Contractor shall not be permitted to direct any revenue service vehicles.

1.05 SUBMITTALS

A. During the Pre-Construction Conference, the Contractor shall submit to the Engineer for approval their Traffic Control Plan for the maintenance and protection of traffic, personnel, contractor property, and adjoining properties during the life of this Contract. This plan, in the form of a working drawing, shall indicate the quantities, types, and locations of flashing warning lights, signs, traffic signals, barricades, concrete barriers, steel plates, dust control barrier, and other protective devices to be used, and the approximate dates of their installation and removal.

1. The plan shall be modified as required to obtain the approval of the Engineer.

2. If required at any other time, any part of the plan shall be revised and resubmitted as directed by the Engineer.

1.06 SITE RESTRICTIONS

A. Maintenance and Protection of Traffic for Contractor Access. Maintain, provide signs, and protect traffic at the access to the Worksite at the locations shown in the Contract Documents.

B. Pedestrian access must be maintained at all times. Maintain safe pedestrian walkways through the Worksite as indicated on the TCP, by detouring pedestrian traffic to unaffected walkways, or by other means approved by Engineer. Obtain Engineer's approval prior to implementing pedestrian traffic control measures. Devices used to establish pedestrian access will be inspected by the contractor daily to ensure they are properly placed.

ARTICLE 2 - PRODUCTS

2.01 MATERIALS

A. In accordance with PennDOT 408, Section 901.2.

B. Channelizing Devices – PennDOT Publication 213

C. Signs – MUTCD – Chapter 6F, PennDOT Publication 213, and Publication 111.

D. Waterborne Pavement Markings and Legends - PennDOT 408, Section 962.

E. Pavement Marking Removal - PennDOT 408, Section 963.

F. Lights – MUTCD Section 6L.07 – Section 6, PennDOT Publication 213.

ARTICLE 3 - EXECUTION

3.01 GENERAL REQUIREMENTS.

A. The Contractor will conduct their operations so as not to obstruct or prevent normal operations of the existing Authority facilities, unless as noted on plans.

B. Coordination between the Authority and the Contractor shall be done through the Engineer.

C. The Contractor shall provide temporary barricades, signs and lights.

D. Prior to beginning any Work or imposing any traffic restrictions, coordinate traffic restrictions/Work with Engineer.

E. The Contractor will provide adequate notice (at least a minimum of three working days) to adjoining property owners and Bethel Park Borough prior to commencing work that would affect their properties.

3.02 PEDESTRIAN SAFETY

A. When the Work area encroaches on a crosswalk, sidewalk or other pedestrian walkway not indicated on the TCP, submit a detailed plan for satisfactorily closing

the walkway to pedestrian traffic to the Engineer. Include the number and types of devices to be used in accordance with the appropriate figure from PennDOT Publication 213. Do not close any walkway without prior approval of the plan and at all times adhere to the submitted plan unless otherwise directed.

3.03 TRAFFIC CONTROL DEVICES, PERSONS, AND FACILITIES

A. General. The signs and traffic control devices, and persons listed or indicated on the TCP details represent the minimum requirements for this item, and as such, are for information only. Consider the number and types of traffic control signs and devices, and persons for Project to be a function of the number and location of Work locations, the extent of repairs, and the planned sequence of operations.

Provide additional traffic control signs required for Maintenance and Protection of Traffic as directed by the Engineer. Use minimum size sign for the required application as defined in PennDOT Publication 213, and Publication 236.
As applicable, remove or cover maintenance and protection of traffic signs during non-working hours so they are not readable to oncoming traffic.
At the completion of the Project, remove signs and devices from the Project site.
Do not change TCP or approved TCS without the approval of the Engineer, in coordination with the appropriate governing agency.

B. Existing Signs
   1. Cover existing warning, regulatory, guide, and directional signs as required to accommodate construction operations.
   2. When covering conflicting existing signs, do not place an adhesive on the sign face. Place adhesive on the back of the sign. Any reflective sheeting damaged by adhesive or cover will constitute damage to the sign. Replace the sign at no cost to Authority.
   3. Coordinate the placement of any sign or traffic control device with any existing signing already in place for concurrent construction projects.

C. Barricades
   1. Furnish and install barricades in accordance with PennDOT Publication 213, "Guidelines for Height and Lateral Placement for Work Zone Signs" and PennDOT Publication 111M, TC-8716.

3.04 INSPECTION

A. Perform the following inspection tasks to ensure the coordination, integrity, and functionality of the Work:

   1. Administer the implementation and maintenance of the traffic control

schemes, and placement and maintenance of traffic control signs and devices on the Project.

2. Conduct daily inspection reviews of and document the condition/operation of the traffic control signs and devices, flaggers, and temporary pavement markings.
3. Direct cleaning, repairing, replacing, and/or realigning of signs and devices when necessary.

3.05 SEQUENCE OF OPERATIONS AND TRAFFIC CONTROL

A. General. All traffic control to be in accordance with PennDOT Publication 213.

1. All sign dimensions to be as indicated in the TCP.

B. Construction Sequence

1. Refer to the proposed sequence of construction on the traffic control plans.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. **Item 01910 – Maintenance and Protection of Traffic** shall be measured lump sum, complete in place. This item includes additional signage beyond that specified in the plans, Type B Lights, channelizing devices, Type III barricades, and installation, inspection and maintenance costs of the required devices for the traffic control as specified in this plan.

4.02 PAYMENT

A. **Item 01910 - Maintenance and Protection of Traffic** will be paid at the unit price and shall include the cost of all related work specified in this Section.

END OF SECTION

SECTION 01915

MISCELLANEOUS UNFORESEEN MAINTENANCE AND PROTECTION OF TRAFFIC (AS DIRECTED)

ARTICLE 1 GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, providing all labor, material, tools, equipment, and incidentals necessary for unforeseen maintenance and protection of traffic work as directed.

1.02 RELATED SECTIONS

A. As applicable.

1.03 REFERENCE STANDARDS

A. Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways 11th Edition.

B. PennDOT Publication 35, Bulletin 15.

C. PennDOT Publication 212.

D. PennDOT Publication 213.

E. PennDOT Publication 408.

ARTICLE 2 PRODUCTS

2.01 MATERIALS

A. Materials shall be provided in accordance with applicable related Sections of the Technical Provisions included in the work.

ARTICLE 3 EXECUTION

3.01 CONSTRUCTION

A. Perform as directed by the Authority, unforeseen maintenance and protection of traffic work in accordance with the related Sections of the Technical Provisions included in the Work.

ARTICLE 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. **Bid Item 01915 – Miscellaneous Unforeseen Maintenance and Protection of Traffic (As Directed)**.

1. Shall be measured to the limits as directed by the Engineer for documentation of field records.

4.02 PAYMENT

A. **Bid Item 01915 – Miscellaneous Unforeseen Maintenance and Protection of Traffic (As Directed)** will be paid for as part of a Predetermined Amount (PDA), as such work is directed, to be performed, by the Engineer. The value to be paid for the direct work of this Contract Item will be established, at the discretion of Authority, by one or more of the following methods:

1. By a negotiated amount, subsequent to receipt of the Contractor's submission of a proposal, following the procedures for establishing a price for a negotiated Change Order in Section 00900, Article 1.7;

2. By force account, following the procedures for establishing the value of force account work as set forth in Section 01200, Article 4; and/or

3. By Authority on the basis of the Engineer's estimate of an equitable value for the Work to be performed. This would be a unilateral value as determined by the Authority.

END OF SECTION

SECTION 01920

CUTTING AND PATCHING

ARTICLE 1 - GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, furnishing all labor, materials, tools and equipment for cutting and patching as required to complete the Work as described in the Contract Documents.

1.02 RELATED SECTIONS

A. Section 01910, “Maintenance and Protection of Traffic”

1.03 DEFINITIONS

A. Cutting: Removal of existing concrete, bituminous and concrete pavement, and other material as necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.04 SUBMITTALS

A. Cutting and Patching Plan: Submit a plan describing procedures at least 10 days before the work for cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Products: List products to be used and firms or entities that will perform the work.
3. Dates: Indicate when cutting and patching will be performed.
4. Utilities: List utilities that cutting and patching procedures will disturb or affect.
5. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
6. Engineer’s Approval: Obtain approval of cutting and patching plan before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work at no additional cost to Authority.

1.05 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.

ARTICLE 2 - PRODUCTS

2.01 MATERIALS

A. Existing Materials: For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, submit materials that, when installed, will match the visual and functional performance of existing materials to Engineer for approval.

ARTICLE 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Temporary support: Provide temporary support of work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Services: Where existing fuel power and distribution services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services.

3.03 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Asphalt: Cut using a cutting machine, such as an abrasive saw or a diamond- core drill.
4. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls, partition, or slabs on grade to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in the Contract Documents.

1. Inspection: Test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Slab-on-Grade: Patch and repair slab-on-grade surfaces. Provide an even surface of uniform finish, color, texture, and appearance.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this Section shall not be measured separately for payment.

4.02 PAYMENT

A. No separate payment will be paid for the Work of this Section. Payment for the work of this Section shall be incidental to payment of Section 01930 – Selective Demolition.

END OF SECTION 01920

SECTION 01930

SELECTIVE DEMOLITION

ARTICLE 1 - GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, providing all labor, materials, tools, equipment, and incidentals necessary for the completion of the Work required by this Section. Work is to include:

1. Removal and disposal of existing masts shall be completed following operation and testing of new gate system.

2. Removal and disposal of existing shall be completed following installation of new signs.

3. Demolition, removal and disposal of existing materials, equipment or structures necessary to complete the Work. This shall include protection of adjacent surfaces and their repair at no additional cost to the Authority, if damaged during the course of the Work.

4. Demolition, modifications, and removals that may be specified under other Sections shall conform to the requirements of this Section.

5. Contractor shall remove and dispose of materials, equipment and associated piping and electrical connections in accordance with applicable regulatory and legal requirements.

6. Demolition Work is to be performed at locations throughout the Project as described in the Contract Documents.

1.02 RELATED SECTIONS

A. Section 01920, - “Cutting and Patching”.

B. Section 02090, - “Removal and Disposal of Regulated Fill”.

1.03 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to a location as directed by the Engineer.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated in Contract Documents.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.04 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be salvaged, reinstalled, or otherwise indicated to remain Authority's property, demolished materials shall become Contractor's property and shall be removed from Project site. Should "roll-off" dumpsters be utilized, dumpsters to be removed immediately when full, otherwise all material to be removed immediately.

1.05 SUBMITTALS

A. Schedule of Selective Demolition Activities. Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure and Authority on-site operations are uninterrupted.

B. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit on CD or DVD before work begins.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI A10.6 and NFPA 241.

C. Predemolition Conference: Conduct conference at Project site to review work of this Section. Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

1.07 PROJECT CONDITIONS

A. Authority will use portions of the site immediately adjacent to selective demolition area. Conduct selective demolition so Authority's operations will not be disrupted. Provide not

less than (1) one week's notice to Engineer of activities that will affect Authority's operations.

B. Authority assumes no responsibility for condition of areas to be selectively demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Authority as far as practical.

ARTICLE 2 - PRODUCTS

2.01 REPAIR MATERIALS

A. Use repair materials that match existing materials or approved equal.

1. If identical materials are unavailable or cannot be used, submit materials that when installed, will match the visual and functional performance of existing materials to Engineer for approval.
2. Use materials whose installed performance equal or surpass that of existing materials.

B. Comply with material and installation requirements specified in individual Technical Provision Sections.

ARTICLE 3 - EXECUTION

3.01 EXAMINATION

A. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required in the Contract Documents.

B. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written Request for Information (RFI) to Engineer.

3.02 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Engineer and authorities having jurisdiction.

Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

2. Erect temporary protection, such as walks, fences, railings, and covered passageways, where required by authorities having jurisdiction.
3. Protect existing site improvements, appurtenances, and landscaping to remain.
4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
5. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain in accordance with the drawing of the MPT.

3.03 POLLUTION CONTROLS

A. Dust Control: Use water mist, wet saws, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.04 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Dispose of demolished items and materials promptly.
8. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

B. Removed and Salvaged Items: Comply with the following:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Authority.
4. Transport items to location as designated by the Engineer.
5. Protect items from damage during transport and storage.

C. Removed and Disposed of Items: Comply with the following:
1. Proceed with removal systematically.
2. Do not use cutting torches until work area is cleared of flammable materials. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
3. Obtain any required permits and approvals and transport the materials to and dispose of at a licensed and permitted waste facility.

D. Existing Items to Remain: Protect existing items indicated to remain against damage and soiling during selective demolition.

E. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

3.05 REMOVAL ITEMS

A. Existing items to be removed include, but are not limited to: catenary poles, metal railings, trench drains, concrete barrier, concrete plinths and pavement as indicated on the Contract Drawings.
B. Contractor is responsible for maintaining any lighting cables currently supported by Catenary Poles to be removed.

3.06 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations at no additional cost to the Authority.

B. Patching: Comply with Section 01920, "Cutting and Patching."

C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this Section shall be measured as a Lump Sum Unit, acceptably complete in place.

4.02 PAYMENT

A. The Work of this Section will be paid as part of the Lump Sum Unit Price paid for **Bid Item 01930 – Selective Demolition** for which the Work in this Section pertains.

END OF SECTION 01930

SECTION 01940

CLEANING

ARTICLE 1 - GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, furnishing all labor, materials, tools and equipment to maintain clean, orderly, hazard-free conditions at the Worksite as described in the Contract Documents.

1.02 RELATED SECTIONS

A. Section 01920, - “Cutting and Patching”
B. Section 02350, - “Drilled Caisson Foundations”

1.03 SAFETY REQUIREMENTS

A. Worksite shall be maintained in accordance with governmental requirements applicable to Worksite cleanliness and in a neat, orderly and hazard-free condition until Final Inspection of the Work. Worksite, sidewalks and walkways, and public sidewalks, roadways, streets and walkways adjacent to the Worksite, shall be kept free from hazards caused by construction activities, and shall be regularly inspected for hazardous conditions caused by construction activities.

B. Hazards Control
   1. Volatile wastes shall be stored in covered metal containers, and shall be removed from the Worksite daily.
   2. Accumulations of wastes that create hazardous conditions shall be prevented.

C. Cleaning and disposal operations shall be conducted in accordance with anti-pollution laws and governmental requirements applicable to those operations. Rubbish, volatile wastes and other construction waste shall not be buried nor burned on the Worksite, and shall not be disposed of into storm drains, sanitary drains, streams and other waterways.

ARTICLE 2 - PRODUCTS

2.01 CLEANING MATERIALS

A. Cleaning materials shall be of the types recommended by the manufacturer of the surface to be cleaned.

ARTICLE 3 - EXECUTION

3.01 INTERIM CLEANING

A. Broom Cleaning shall be executed every workday during the Project. Structures, grounds and areas of the Worksite, and public and private properties immediately adjacent to the Worksite and temporary sanitary facilities, shall be maintained "Broom Clean" and free from accumulations of waste materials and rubbish that has been caused by construction operations. Waste materials and rubbish shall be placed in dump containers.

B. Loose material shall be either removed or secured either at the end of each workday or more often to maintain Worksite in hazard-free condition.

C. Dump containers shall be emptied promptly at least once a week. Contents shall be legally disposed of at either public or private dumping areas off Authority's property.

D. Waste materials, debris and rubbish shall be handled in a controlled manner, and shall not be dropped nor thrown from heights.

E. Spillage, of other than portable water, shall be immediately removed.

F. Dust from saw cutting shall be cleaned at the end of each work day.

G. Cleaning operations shall occur at times when dust and other contaminants will not fall on wet and newly painted surfaces.

H. Debris on the site, city streets, or sidewalks shall be removed immediately upon verbal or written notification from the Engineer.

3.02 FINAL CLEANING

A. Final cleaning shall occur before application to Authority for Final Inspection.

1. Inspection of surfaces that are exposed to view shall be conducted in preparation of the Final Inspection.

2. Any grease, dust, or foreign materials shall be removed from any exposed piping.

3. Paved surfaces shall be broom-cleaned, and other ground surfaces shall be rake-cleaned.

4. Any debris, waste materials, or materials left over from construction shall be removed from the job site.

5. Cleaning shall be maintained until the Final Inspection of the Work.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this Section shall not be measured separately for payment.

4.02 PAYMENT

A. The Work of the Section will be paid for as part of the work to which is applies. Payment for the work of this Section shall be incidental to payment of Section 01855 – Mobilization.

END OF SECTION

SECTION 02090

REMOVAL AND DISPOSAL OF REGULATED FILL

ARTICLE 1 - GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, removal and disposal of contaminated soils identified at the project site, as hereinafter specified, and/or as otherwise required for proper and timely completion of this Contract as follows:

1. Removal and disposal of contaminated soil, including all testing and procedures required by PA DEP and all other governing agencies and the sampling and testing required by the disposal site.

2. Provide an equal amount of satisfactory backfill (as required)

3. Compliance with all regulatory requirements.

4. Removal and disposal of regulated fill.

B. Stockpiling of contaminated soil is permitted on-site, with location limited to areas, which will not impact Authority operations. Approval from Engineer is required before stockpile operations begin. All control measures required by the applicable regulations related to contaminated material must be in place and maintained during the holding period. All stockpiled contaminated soil must be removed within 60 calendar days.

C. Prepare and implement a company health and safety plan, in accordance with the OSHA 1910.120 regulations, when conducting tank removal services and related activities under this contract. Provide a copy of the site-specific health & safety plan upon request by the Authority Representative.

1.02 RELATED WORK

A. Section 02100, - “Cutting and Patching
B. Section 02350, - Drilled Caisson Foundations

1.03 QUALITY ASSURANCE

A. Quality Assurance Program: Contractor shall have a quality assurance program which meets requirements of ANSI Z.1.8, and which satisfies safety- related quality requirements imposed by governmental agencies.

B. Disposal Site: Contractor shall dispose of removed materials only at disposal sites which are approved for such materials by authorities having jurisdiction. Contractor is to identify the proper disposal site for the material. Contractor shall furnish Engineer with certification that all soil removed from job site has been delivered to and disposed of at a licensed and

authorized disposal site in accordance with all applicable State and Federal regulations. Furnish all bills of lading or manifests associated with soil removal work.

C. Soils Testing: Contractor shall provide all sampling and testing as required by PA DEP, in accordance with PA DEP procedures.

D. Reference Standards: Contractor shall comply with all applicable provisions and standards of following governmental authorities.

1. EPA (Environmental Protection Agency), EPA/530/UST-88/008, Musts for USTs.
2. OSHA (Occupational Safety and Health Administration), 29 CFR 1926.652, Safety and Health Regulations for Construction.
3. Pennsylvania Department of Environmental Protection (PaDEP) Management of Fill Policy (see Attachment A), including (PaDEP) b.l annual reporting for transport of residual waste and Doc. 258-2182-773.
4. Pertinent local municipality ordinances.

1.04 SUBMITTALS

A. Work Plan: Prepare a plan of work to be performed. Preparation of reports shall be prepared by a qualified environmental professional. Specify the contaminated soil management approach and how performance criteria will be met. For, additional requirements refer to Terms and Conditions, Section 00700, Article 17 – Disposal of Material Outside the Worksite.

ARTICLE 2 - PRODUCTS (NOT USED)

ARTICLE 3 - EXECUTION

3.01 CLASSIFICATION

A. Contractor shall test and classify all materials, which are candidates for off-site disposal including soil stockpiles.

B. Contractor shall arrange for and carry out disposal of materials according to their classification.

3.02 MEASUREMENT OF SOLID WASTE QUANTITIES FOR BILLS OF LADING

A. Contractor shall provide for vehicle weighing both before and after disposal and shall provide copies of records of weights to Engineer within 48 hours after receipt of waste at off-site disposal facility.

B. Contractor shall ensure that measuring devices used off-site are certified by an appropriate State agency.

3.03 BILLS OF LADING

A. Contractor shall prepare and provide Engineer with copies of bills of lading for each

shipment of contaminated soils from site. Weight, and not volume, shall be used to measure solid waste quantities for trucking and disposal purposes.

B. Contractor shall provide Engineer with copies of completed shipping tickets indicating each shipment has been received at treatment facility(s) designated by Contractor. Copies shall be provided to Engineer within two (2) days of their return to Contractor.

C. Should any trucking ticket not be returned to Engineer within two (2) weeks of shipment, Contractor shall initiate follow-up and shall document its follow-up effort. A copy of any exception report prepared under this paragraph shall be furnished to Engineer.

3.04 SOLID DISPOSAL FACILITY

A. Contractor shall manage contaminated soil removed from site in a manner, which meets one of the following performance criteria. Contractor shall provide Engineer with documentation specifying which contaminated soil management approach will be used and how performance criteria will be met.

1. Dispose of all contaminated soil in one Pennsylvania permitted residual waste landfill.

B. Engineer reserves the right to contact the disposal facility designated by Contractor and appropriate regulatory agencies, if applicable, to verify information provided by Contractor.

3.05 DECONTAMINATION

A. Tools and equipment shall be steam-cleaned prior to initial use and prior to leaving site.

1. Cleaning shall be performed at a designated area of the work-site.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this Section shall be measured by the TON, acceptably performed.

4.02 PAYMENT

A. The Work of this Section will be paid for at the per ton Unit Price paid for **Bid Item 02090 – Removal and Disposal of Regulated Fill**, which includes the cost of all Work specified in this Section.

END OF SECTION

Attachment A

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Waste Management

DOCUMENT NUMBER: 258-2182-773

EFFECTIVE DATE: January 16, 2021

TITLE: Management of Fill Policy

AUTHORITY: This document is established in accordance with the Solid Waste Management Act, 35 P.S. §§ 6018.101 *et seq.* (SWMA); the Clean Streams Law, 35 P.S. §§ 691.1 *et seq.*; Section 1917-A of the Administrative Code, 71 P.S. § 510-17; and the Land Recycling and Environmental Remediation Standards Act, 35 P.S. §§ 6026.101 *et seq.*

POLICY: A person placing solid waste onto the ground is generally required to obtain a disposal permit from the Department of Environmental Protection (Department or DEP). A person is not required to obtain a permit under SWMA if the person can demonstrate that the material qualifies as clean fill in accordance with the municipal and residual waste regulations, 25 Pa. Code § 271.101(b)(3) and § 287.101(b)(6).

PURPOSE: This policy provides DEP's procedures for determining whether fill is "clean fill," as defined in the municipal and residual waste regulations at 25 Pa. Code § 271.1 and § 287.1, respectively, or "regulated fill," as defined in this policy. Regulated fill may not be used outside of a project area or right-of-way of a project unless a SWMA permit has been issued to the person using the regulated fill.

APPLICABILITY: This policy shall be used to evaluate whether a person is required to obtain a permit under the SWMA for the use of fill in accordance with the municipal and residual waste regulations, 25 Pa. Code § 271.101(b)(3) and § 287.101(b)(6). This policy describes the type of fill that qualifies as clean fill or regulated fill. This policy does not apply to mine land reclamation activities subject to a permit or fill used within the same project area or project right-of-way. Excavation, movement or reuse of fill within a project area or right-of-way of a project is not an activity that requires a SWMA permit. This policy does not apply to fill that has been determined to be clean or regulated fill prior to the effective date of this policy, unless the fill is moved to a new receiving site or off the project area or project right-of-way after the effective date of this policy. This policy does not apply to fill that has been determined to be clean or regulated fill prior to the implementation of revised clean fill concentration limits or regulated fill concentration limits, unless the fill is moved to a new receiving site or off the project area or project right-of-way after the effective date of the revised limits.

DISCLAIMER: The policies and procedures outlined in this guidance document are intended to supplement existing requirements. Nothing in the policies or

procedures shall affect regulatory requirements. The policies and procedures herein are not an adjudication or a regulation. There is no intent on the part of the DEP to give the rules in these policies that weight or deference. This document establishes the framework within which DEP will exercise its administrative discretion in the future. DEP reserves the discretion to deviate from this policy statement if circumstances warrant.

PAGE LENGTH: 26 pages

DEFINITIONS:

Acid-producing rock – Stone, rock or other mineral materials that, when exposed to air and water, cause a low pH discharge that adversely affects or endangers public health, safety, welfare, or the environment or causes a public nuisance.

Act 2 – The Land Recycling and Environmental Remediation Standards Act, 35 P.S. §§ 6026.101 *et seq.*

Act 2 site – A site as defined in Section 103 of Act 2, 35 P.S. § 6026.103, for which a notice of intent to remediate has been submitted to DEP.

Background – The concentration of a regulated substance that is present at a site but not related to the release of regulated substances from a specific point source or activity at the site.

Background reference area – The area identified for sampling that: will be used to establish background; is sampled and analyzed to determine the concentration of regulated substances found at or within a close proximity to the donor site, at a depth comparable to that of the area to be excavated at the donor site, in the same soil layer as the donor fill; is unaffected by a release of regulated substances from a specific point source or activity at the site; and meets one of the following criteria:

i. The concentration of regulated substances in the soil is attributable to the parent material from which the soil was derived and the natural processes which produce soil, or

ii. The concentrations of regulated substances in the soil resulted from an atmospheric deposition, including lead or polynuclear aromatic hydrocarbons, but are not attributable to a specific point source or release of a regulated substance. For the purposes of this definition, "atmospheric deposition" refers only to the ubiquitous, widespread deposition of regulated substances from the air that is incapable of being traced to a specific point source or multiple point sources. For example, chromium that has condensed on the ground outside an electroplater air vent would not be due to "atmospheric deposition" because the presence of the chromium is a result of a discharge from a specific point source, even though the chromium was released into the air before being deposited on the ground. However, the presence of lead or benzo-a-pyrene (BAP) in an urban or industrial area that can be traced to the operation of motor vehicles may be due to atmospheric deposition if the concentration levels are demonstrated to be pervasive over the greater urban or industrial area.

Clean fill – Uncontaminated, nonwater-soluble, nondecomposable, inert solid material used to level an area or bring an area to grade. The term does not include materials placed in or on the waters of the Commonwealth. Although the placement of clean fill in or on waters of the Commonwealth cannot be managed under this policy, placement of clean fill in or on waters of the Commonwealth may be approved under a separate DEP authorization. The term includes only those materials that are identified as "fill," as the term is defined in this policy. The term does not include fill that has been blended, mixed or treated with the purpose of meeting the definition of "clean fill" and that without being blended, mixed or treated would fail to meet the numeric limits identified in the definition of "uncontaminated material" contained in this policy.

Clean fill concentration limits (CFCLs) – With the exception of PCBs and chloride, the concentrations of regulated substances that do not exceed the numeric values specified in Table 3 [Medium-Specific Concentrations (MSCs) for Organic Regulated Substances in Soil] and Table 4 [Medium-Specific Concentrations (MSCs) for Inorganic Regulated Substances in Soil] of Appendix A in 25 Pa. Code

Chapter 250 (relating to administration of land recycling program). The applicable numeric limit is determined by comparison of the Generic Soil to Groundwater Value[1] with the Direct Contact Residential Value[2] and selection of the lower of the two values. For PCBs, the sum total of the concentration of all PCB aroclors (total PCB concentration) may not exceed 50 ppm. Fill containing a concentration of total PCBs greater than 2 ppm may be subject to regulation under the Toxic Substances Control Act (TSCA), 15 U.S.C. Section 2601 et seq., and 40 C.F.R. Part 761, which is administered and implemented by the U.S. Environmental Protection Agency (EPA). EPA's TSCA requirements are independent of any use of fill that is otherwise in accordance with the Department's policy and regulations. An applicant should be aware that its characterization and handling of any soils through the guidance of the Management of Fill policy does not necessarily satisfy a potential EPA TSCA inquiry, and that an applicant may need a separate approval from EPA should EPA require it. For all such material, DEP recommends that you contact the PCB Coordinator for EPA Region 3 by email at R3_PCB_Coor@epa.gov to determine whether PCB-containing fill may be used and to obtain information relating to the associated EPA procedures for collecting and analyzing samples. For chloride, the value obtained using the Synthetic Precipitation Leaching Procedure, (SPLP, SW-846, Method 1312) may not exceed the numeric value specified in Table 2 [MSCs for Inorganic Regulated Substances in Groundwater] of Appendix A in 25 Pa. Code, Chapter 250.

Composite sample – A sample collected across a spatial range that typically consists of a set of discrete samples that are combined or "composited." A composite sample should not be confused with a discrete sample that is created from multiple increments taken at a single location to obtain a sample of the desired size, shape and orientation.

Discrete sample – A sample that represents material from a single location. A discrete sample can be composed of more than one increment.

Donor site – The area from which fill originates that is separate from a receiving site. Multiple donor sites may be identified on a single project area.

Environmental due diligence – Investigative techniques used to determine whether fill from a donor site has been affected by a release of a regulated substance. Examples of investigative techniques included in this term are visual property inspections, electronic data base searches, review of ownership and historical use of a property, Sanborn maps, environmental questionnaires, transaction screens, analytical testing, environmental assessments, audits, or procedures outlined in ASTM standard E1527-13. A single investigative technique may not be used as the basis for environmental due diligence. Environmental due diligence includes visual property inspection and a review of ownership and historical property use, at a minimum, unless analytical sampling is performed in lieu of a review of ownership and historical property use.

Fill – The term is limited to clean, regulated and historic fill that is soil, rock, stone, gravel, used asphalt, brick, block or concrete from construction and demolition activities that is separate from other waste and recognizable as such, and "dredged material," as the term is defined by the municipal and residual waste regulations, 25 Pa. Code §§ 271.1 and 287.1, whichever is applicable. The term does not include reclaimed asphalt pavement, naturally occurring asbestos, mine spoils or acid-producing rock.

Grab sample – A discrete sample, consisting of one increment, collected specifically for Volatile Organic Compounds (VOC) analysis.

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[1] Numeric values based on generic leaching modeling for soils at residential properties overlying used aquifers with total dissolved solids at concentrations less than or equal to 2500 mg/L.

[2] Direct contact numeric values for soils at residential properties.

Historic fill – Material, excluding material disposed in landfills, waste piles and impoundments, used to bring an area to grade prior to 1988, and consisting of a conglomeration of soil and residuals, such as ashes from the residential burning of wood and coal, incinerator ash, coal ash, slag, dredged material and construction and demolition waste. The term does not include iron or steel slag that is separate from residuals if it is a coproduct, as the term is defined in 25 Pa. Code § 287.1 and satisfies the requirements of 25 Pa. Code § 287.8. The term does not include coal ash that is separate from residuals if it is beneficially used in accordance with 25 Pa. Code §§ 290.1 – 290.415.

Increment – Material collected in a single operation of the sampling device.

PCB – A chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees or a substance that contains that substance.

ppm – Parts per million.

Project area – The boundary within which earth disturbance activities occur, including areas in close proximity to the earthmoving activities that are necessary for the completion of a construction project, or other human activity which disturbs the surface of the land, including land clearing and grubbing; grading; excavations; embankments; land development; agricultural plowing or tilling; operation of animal heavy use areas; timber harvesting activities; road maintenance activities; linear projects such as utility line work; oil and gas activities; well drilling; mineral extraction; and the moving, depositing, stockpiling, or storing of soil, rock or earth materials. The term includes the boundary within which all earth disturbance activity, construction, materials storage, grading, landscaping and related activities occur.

Reclaimed asphalt pavement (RAP) – Small particles, typically less than one inch in size, of bitumen and inorganic materials produced by the mechanical grinding of bituminous pavement surfaces that have not been subject to a release of regulated substances or mixed with other solid waste. The term does not include "used asphalt," as the term is defined in this policy.

Receiving site – The area to which fill is proposed to be relocated. A receiving site is separate from a donor site and not part of a project area or right-of-way.

Regulated fill – "Fill," as the term is defined in this policy, that has been affected by release of a regulated substance and is not "uncontaminated material," as the term is defined in this policy. The term does not include fill that has been blended, mixed or treated with the purpose of meeting the definition of "regulated fill" and that without being blended, mixed or treated would fail to meet the regulated fill concentration limits, as the term is defined in this policy.

Regulated fill concentration limits (RFCLs) – With the exception of PCBs, the concentrations of regulated substances that do not exceed the numeric values specified in Table 3 [Medium-Specific Concentrations (MSCs) for Organic Regulated Substances in Soil] and Table 4 [Medium-Specific Concentrations (MSCs) for Inorganic Regulated Substances in Soil] of Appendix A in 25 Pa. Code Chapter 250 (relating to administration of land recycling program). The applicable numeric limit is determined by comparison of the Generic Soil to Groundwater Value[3] with the Direct Contact Non-Residential Value[4] and selection of the lower of the two values. For PCBs, the sum total of the

[3] Numeric values based on generic leaching modeling for soils at non-residential properties overlying used aquifers with total dissolved solids at concentrations less than or equal to 2500 mg/L.

[4] Direct contact numeric values for soils at non-residential properties.

concentration of all PCB aroclors (total PCB concentration) may not exceed 50 ppm. Fill containing a concentration of total PCBs greater than 2 ppm may be subject to regulation under the Toxic Substances Control Act (TSCA), 15 U.S.C. Section 2601 et seq., and 40 C.F.R. Part 761, which is administered and implemented by the EPA. EPA's TSCA requirements are independent of any use of fill that is otherwise in accordance with the Department's policy and regulations. An applicant should be aware that its characterization and handling of any soils through the guidance of the Management of Fill policy does not necessarily satisfy a potential EPA TSCA inquiry, and that an applicant may need a separate approval from EPA should EPA require it. For all such material, DEP recommends that you contact the PCB Coordinator for EPA Region 3 by email at R3_PCB_Coor@epa.gov to determine whether PCB-containing fill may be used and to obtain information relating to the associated EPA procedures for collecting and analyzing samples.

Regulated substance – The term includes hazardous substances and contaminants regulated under the Hazardous Sites Cleanup Act, 35 P.S. §§ 6020.101 *et seq.*; and substances regulated by the Clean Streams Law, 35 P.S. §§ 691.1 *et seq.*; the Air Pollution Control Act, 35 P.S. §§ 4001 *et seq.*; the Solid Waste Management Act, 35 P.S. §§ 6018.101 *et seq.*; the Infectious and Chemotherapeutic Waste Law, 35 P.S. §§ 6019.1 *et seq.*; and the Storage Tank and Spill Prevention Act, 35 P.S. §§ 6021.101 *et seq*.

Release – Spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing of a regulated substance into the environment in a manner not authorized by the Department. The term includes the abandonment or discarding of barrels, containers, vessels and other receptacles containing a regulated substance.

Uncontaminated or *Uncontaminated material* – The term means either of the following:

(1) Fill unaffected by a release of a regulated substance or,

(2) Fill affected by release of a regulated substance, if the concentrations of regulated substances in the fill do not exceed the clean fill concentration limits, as the term is defined in this policy. Analysis should be carried out for only those regulated substances that are suspected to be present due to a release.

The term does not include fill that has been blended, mixed or treated with the purpose of meeting the definition of "uncontaminated material."

Used asphalt – Pieces of bitumen and inorganic materials from the demolition of bituminous pavement. The term does not include "reclaimed asphalt pavement," as the term is defined by this policy.

REFERENCES:

25 Pa. Code Chapters 287 to 299 (residual waste regulations)
25 Pa. Code Chapters 271 to 285 (municipal waste regulations)
Solid Waste Management Act, 35 P.S. §§ 6018.101 *et seq.*
Land Recycling and Environmental Remediation Standards Act, 35 P.S. §§ 6026.101 *et seq.*
Section 1917-A of the Administrative Code, 71 P.S. § 510-17
The Clean Streams Law, 35 P.S. §§ 691.1 *et seq.*

TECHNICAL GUIDANCE:

A. Purpose and Applicability

Fill is used in construction or earthmoving projects across the Commonwealth to level an area or bring an area to grade. These projects may involve using fill as a subbase or to fill in low-lying areas. The manner in which fill may be used depends on whether the fill is clean fill or regulated fill. This policy provides procedures for determining whether fill is clean fill or regulated fill and describes how each category may be managed after a fill determination has been performed.

This policy does not apply to the following activities:

- Mine land reclamation activities subject to a permit.
- Management of waste from land clearing, grubbing and excavation, including trees, brush, stumps and vegetative material.[5]
- Movement or use of fill within a project area or right-of-way of a project.
- Use of reclaimed asphalt pavement in accordance with DEP's industry-wide coproduct determination.
- The use of clean fill or regulated fill prior to January 1, 2020, unless the fill is moved to another receiving site, project area or off the project right-of-way after January 1, 2020.

In general, fill that is demonstrated to be clean fill can be used in an unrestricted manner, provided it is not placed in waters of the Commonwealth; it is used in compliance with 25 Pa. Code, Chapters 102 and 105 (relating to erosion and sediment control; and dam safety and waterway management); and it is managed in accordance with Section D of this policy. Persons using fill must also comply with the fugitive emissions regulations under 25 Pa. Code, Chapter 123 (relating to standards for contaminants) issued under the Air Pollution Control Act, 35 P.S. § 4001, and shall comply with all the applicable provisions of 25 Pa. Code §§ 123.1 and 123.2 (relating to prohibition of certain fugitive emissions and fugitive particulate matter). Depending on the manner in which it is generated, clean fill may be a "waste," as that term is defined in the municipal or residual waste regulations, 25 Pa. Code § 271.1 and § 287.1, respectively, whichever is applicable.

This policy does not apply to fill that has been determined to be clean or regulated fill prior to the implementation of revised CFCLs or RFCLs, unless the fill is moved to a new receiving site or off the project area or project right-of-way after the effective date of the revised CFCLs or RFCLs.

Fill that is demonstrated to be regulated fill can be used by persons who have applied for and obtained coverage under the Department's General Permit No. WMGR096, Beneficial Use of

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[5] In accordance with 25 Pa. Code § 271.101(b)(4), a person managing waste from land clearing, grubbing and excavation, including trees, brush, stumps and vegetative material, shall implement best management practices developed by the Department. Refer to Document No. 254-5400-001 - *Best Management Practices for the Management of Waste From Land Clearing, Grubbing, and Excavation (LCGE)*.

Regulated Fill. Coverage under General Permit No. WMGR096 is not required in the following instances:

- Remediation activities undertaken entirely on an Act 2 site, pursuant to the requirements of § 902 of Act 2.

- When fill from an Act 2 site is used as construction material at a receiving site that is being remediated to attain an Act 2 standard, provided the procedural and substantive requirements of Act 2 and the conditions specified in Section C.2.a. and b. of this policy are satisfied.

- Use of the regulated fill is limited to the excavation, movement or use of the regulated fill within a project area or right-of-way of a project.

Regulated fill is a "waste," as that term is defined in the municipal or residual waste regulations, 25 Pa. Code § 271.1 and § 287.1, respectively.

B. Procedure for Performing a Fill Determination

Prior to the movement of fill to a receiving site, either the person proposing to provide the fill from a donor site or the person proposing to receive the fill determines whether the fill is clean fill or regulated fill pursuant to this policy. Use the following steps to make that determination:

1. Determine Eligibility: A material is eligible for management as clean or regulated fill under this policy if it satisfies the following criteria:

    a. The material is "fill," as the term is defined in this policy. If the fill under consideration contains acid-producing rock, it is specifically excluded from the definition of fill. Appendix B contains information relevant to identifying acid-producing rock.

    b. The fill does not contain regulated substances that were intentionally released.

    c. The fill has not been blended, mixed or treated with the purpose of meeting the definition, or applicable numeric limits, of "uncontaminated material," "clean fill" or "regulated fill."

    d. The fill does not exhibit a characteristic of toxicity, as determined by 40 CFR § 261.24 (relating to toxicity characteristic). The toxicity characteristic is of concern only when environmental due diligence indicates that the fill being considered for use may have been affected by a release of a regulated substance that is included in Table 1 in 40 CFR § 261.24. If the total concentration of the substance exceeds the limit for the substance in Table 1 of 40 CFR § 261.24 by a factor of 20 or more, the issue regarding potential toxicity should be addressed either by performing the Toxic Characteristic Leaching Procedure (TCLP), in accordance with Method 1311, found in the most recent version of EPA's publication, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, also known as SW–846, or providing additional description of the fill, indicating that the substance is bound in the matrix and not leaching.

e. PCB-containing Fill: If the environmental due diligence indicates that the fill may have been subject to a release of PCBs, test it for the presence of PCBs. Fill containing a concentration of total PCBs greater than 2 ppm may be subject to regulation under the Toxic Substances Control Act (TSCA), 15 U.S.C. §§ 2601 *et seq.*, and 40 CFR Part 761, which is administered and implemented by the EPA. EPA's TSCA requirements are independent of any use of fill that is otherwise in accordance with the Department's policy and regulations. An applicant should be aware that its characterization and handling of any soils through the guidance of the Management of Fill policy does not necessarily satisfy a potential EPA TSCA inquiry, and that an applicant may need a separate approval from EPA should EPA require it. For all such material, DEP recommends that you contact the PCB Coordinator for EPA Region 3 by email at R3_PCB_Coor@epa.gov to determine whether PCB-containing fill may be used and to obtain information relating to the associated EPA procedures for collecting and analyzing samples.

2. Perform Environmental Due Diligence: Once determined that the fill is eligible for use under this policy, evaluate the fill to determine whether it has been affected by a release of a regulated substance by performing "environmental due diligence," as the term is defined in this policy. Except for historic fill, analytical testing of the fill is not necessary unless environmental due diligence indicates that the fill may have been affected by a release of a regulated substance. However, a person performing a fill determination may choose to perform analytical testing in lieu of conducting a review of ownership and historic property use to satisfy the minimum condition for performing environmental due diligence.

The use of historic fill as clean fill under this policy is limited to historic fill that is a conglomeration of soil, residuals and fill. Historic fill that is comprised primarily of residuals does not represent a conglomeration of soil, residuals, and fill and therefore, cannot be used as clean fill. Pockets of residuals, such as ash or slag, should be removed and managed separately from other historic fill prior to making a determination that the historic fill can be used as clean fill. Perform analytical testing to demonstrate that the historic fill meets the definition of uncontaminated material. To qualify for use as clean fill, historic fill should be tested for the parameters included in Table 1, below, as well as any additional parameters that are suspected based on historic property use or review of records. The placement of historic fill as clean fill may not contaminate groundwater. For regulated substances detected in the historic fill, the value obtained using the Synthetic Precipitation Leaching Procedure, (SPLP, SW-846, Method 1312) may not exceed the numeric value as identified in Table 1 [MSCs for Organic Regulated Substances in Groundwater] and Table 2 [MSCs for Inorganic Regulated Substances in Groundwater] of Appendix A in 25 Pa. Code, Chapter 250.

a. If due diligence shows no evidence that the fill may have been affected by a release of a regulated substance, the fill may be managed as clean fill in accordance with the Section D of this policy (relating to management of clean fill) unless during movement, transport or placement there are observable indications (such as appearance or odors) which indicate evidence of a release of a regulated substance.

b. If due diligence shows evidence that the fill may have been affected by a release of a regulated substance, test the fill to determine if it is clean fill or regulated fill. Perform the testing in accordance with Appendix A of this policy. Analysis should be carried out for only those regulated substances that are suspected to be present due to a release or based upon historic use of the donor site.

i. Except as provided elsewhere in this policy, if testing reveals that the fill contains regulated substances at concentrations that are below the CFCLs, the fill may be managed as clean fill in accordance with Section D of this policy (relating to management of clean fill). A person may not blend, mix or treat fill that would otherwise fail to meet the CFCLs with the purpose of meeting the definition of uncontaminated material or clean fill. For the purposes of completing Form FP-001 for the certification of clean fill, the CFCLs in effect on the date of submission should be used to evaluate whether the fill qualifies for use as clean fill.

ii. Except as provided elsewhere in this policy, if testing reveals that the fill contains regulated substances at concentrations that exceed the CFCLs but are at or below the RFCLs, the fill may be managed as regulated fill only if coverage under General Permit No. WMGR096 is obtained. A person may not blend, mix or treat fill that would otherwise fail to meet the RFCLs with the purpose of meeting the definition of regulated fill. Manage regulated fill in accordance with the Section C of this policy (relating to management of regulated fill).

iii. Except as provided elsewhere in this policy, if testing reveals that the fill contains regulated substances at concentrations that exceed the RFCLs, the fill may not be managed as clean fill or regulated fill. Fill exceeding the RFCLs may require disposal in accordance with the hazardous, municipal or residual waste regulations, 25 Pa. Code, Articles VII, VIII or IX, respectively, whichever is applicable.

TABLE 1: Screening Parameters for Historic Fill

Regulated Substance	CASRN	Regulated Substance	CASRN	Regulated Substance	CASRN
Aldrin	309-00-2	PCB-1254 (Aroclor)	11097-69-1	Copper	7440-50-8
Anthracene	120-12-7	Phenanthrene	85-01-8	Iron	7439-89-6
Benzene	71-43-2	Pyrene	129-00-0	Lead	7439-92-1
Benzo(a)anthracene	56-55-3	Toluene	108-88-3	Manganese	7439-96-5
Benzo(a)pyrene	50-32-8	Trichloroethane, 1,1,1-	71-55-6	Mercury	7439-97-6
Benzo(b)fluoranthene	205-99-2	Trichloroethylene (TCE)	79-01-6	Molybdenum	7439-98-7
Benzo(ghi)perylene	191-24-2	Xylenes (Total)	1330-20-7	Nickel	7440-02-0
Chrysene	218-01-9	Aluminum	7429-90-5	Selenium	7782-49-2
Cumene (Isopropyl benzene)	98-82-8	Antimony	7440-36-0	Silver	7440-22-4
DDD, 4,4	72-54-8	Arsenic	7440-38-2	Thallium	7440-28-0
DDE, 4,4	72-55-9	Barium	7440-39-3	Vanadium	7440-62-2
DDT, 4,4	50-29-3	Beryllium	7440-41-7	Zinc	7440-66-6

TABLE 1: Screening Parameters for Historic Fill

Regulated Substance	CASRN	Regulated Substance	CASRN	Regulated Substance	CASRN
Dichloroethylene, cis-1,2-	156-59-2	Boron	7440-42-8	Ammonia	7664-41-7
Dieldrin	60-57-1	Cadmium	7440-43-9	Chloride	7647-14-5
Ethylbenzene	100-41-4	Chromium(III)	16065-83-1	Fluoride	7681-49-4
Fluorene	86-73-7	Chromium(VI)	18540-29-9	Sulfate	7757-82-6
Ideno(1,2,3-cd) pyrene	193-39-5	Chromium (total)	7440-47-3		
Napthalene	91-20-3	Cobalt	7440-48-4		

C. Management of Regulated Fill

Regulated fill must be managed in accordance with the Department's municipal or residual waste regulations, 25 Pa. Code § 271.2 and § 287.2, respectively, whichever is applicable, and may be beneficially used in accordance with General Permit No. WMGR096.

Coverage under General Permit No. WMGR096 is not required in the following instances:

1. Remediation activities undertaken entirely on an Act 2 site, pursuant to the requirements of Section 902 of Act 2.

2. When fill from an Act 2 site is used as construction material at a receiving site that is being remediated to attain an Act 2 standard, provided the procedural and substantive requirements of Act 2 and the following are satisfied:

    a. Regulated substances contained in the fill are incorporated into the notice of intent to remediate and the final report for the remediation taking place at the receiving site.

    b. Movement of fill between Act 2 sites is documented in the final reports for both the donor site and receiving site.

    c. Except as provided elsewhere in this policy, placement of the fill does not and will not cause the receiving site undergoing remediation to exceed the selected Act 2 standard.

3. Use of the regulated fill is limited to the excavation, movement or use of the regulated fill within a project area or right-of-way of a project.

A person or municipality interested in obtaining coverage under General Permit No. WMGR096 must apply to the Department in accordance with the application instructions provided in the permit. The terms and conditions of General Permit No. WMGR096 are available on the Department's website.

D. Management of Clean Fill

Pursuant to 25 Pa. Code § 271.101(b)(3) and § 287.101(b)(6), use of clean fill does not require a permit under the SWMA or the municipal or residual waste regulations. Clean fill may be used in accordance with all applicable requirements governing the placement or use of clean fill,

including 25 Pa. Code Chapter 102 (relating to erosion and sediment control) and 25 Pa. Code Chapter 105 (relating to dam safety and waterway management). Persons using fill must also comply with the fugitive emissions regulations under 25 Pa. Code, Chapter 123 (relating to standards for contaminants) issued under the Air Pollution Control Act, 35 P.S. § 4001, and shall comply with all the applicable provisions of 25 Pa. Code §§ 123.1 and 123.2 (relating to prohibition of certain fugitive emissions and fugitive particulate matter). The use of clean fill may be regulated under other environmental laws and regulations.

If the uncontaminated brick, block or concrete from a construction or demolition activity is intended for use as clean fill, best management practices (BMPs) should be followed prior to demolition activities to remove from a building or structure all materials that do not meet the definition of clean fill, such as materials or surfaces covered with lead-based paint, friable asbestos, and hazardous materials such as mercury switches, PCB ballasts, tritium-containing exit signs, and fluorescent light bulbs.

Clean fill may not contain any free liquids based on visual inspection and cannot create a public nuisance (such as an objectionable odor) to users of the receiving site or adjacent properties.

If any person wants to use clean fill under this policy, complete Form FP-001, Certification of Clean Fill, and submit it to DEP electronically on the DEP website at https://www.dep.pa.gov/Business/Land/Waste/SolidWaste/Residual/Pages/default.aspx. Complete and submit the FP-001 prior to movement of clean fill to the receiving site. Complete and submit FP-001 regardless of whether sampling and analysis are performed as part of environmental due diligence.

If the donor site has undergone or is undergoing cleanup or remediation under a local, state or federal regulatory program that requires site characterization, or if the fill proposed to be managed as clean fill has otherwise been subject to analytical testing or other procedures identified in the definition of "environmental due diligence," attach the following to Form FP-001:

- Copies of the sampling plan developed for the fill,
- All laboratory reports,
- Documentation and data associated with a background determination and equivalent site evaluation conducted as part of the fill determination, including the identification and location of point sources, the proximity of identified point sources to the background reference area, identification of areas of imported fill other than imported clean fill, etc.

If a person receives fill from multiple donor sites, a separate Form FP-001 is necessary for each donor site. DEP will accept the completed FP-001 electronically via a link on the DEP website.

If a background demonstration is made, as described in Appendix A of this policy, use the FP-001 to include documentation of the background demonstration along with documentation demonstrating that an equivalent site evaluation has been performed and the provisions of Appendix A have been satisfied.

Both the donor site and the receiving site are responsible for maintaining copies of the completed Form FP-001 for a period of five (5) years. Copies of the form and all supporting documentation, including analytical test reports, should be made available and provided to DEP upon request.

Appendix A
Sample Collection and Analytical Testing Protocol for Performing Environmental Due Diligence

Prior to movement of fill to a receiving site, use Sections B-D of the Management of Fill policy to make a fill determination. Analytical testing of the fill is not necessary unless environmental due diligence indicates a release of a regulated substance. This Appendix provides guidelines for using analytical testing as part of the environmental due diligence.

A. Sampling Plan Development

The first step in a chemical evaluation of fill is to develop a plan for sampling. To use analytical testing as part of the environmental due diligence, develop and implement a scientifically credible sampling plan in accordance with the most recent version of the EPA's publication, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* also known and hereinafter referred to as SW-846, and the *RCRA Waste Sampling Draft Technical Guidance, EPA530-D-02-002*. Chapter 9 of SW-846 describes procedures for developing a sampling plan and the statistical treatment of data. Where there is disagreement between the procedures outlined in this Appendix and the referenced EPA documents, follow the procedures contained in this Appendix.

Employ a systematic planning process, such as the Data Quality Objectives Process identified in the *RCRA Waste Sampling Draft Technical Guidance*, to set objectives for the type, quantity and quality of data needed to demonstrate with a known level of assurance that the applicable standards for clean fill or regulated fill are achieved. The level of complexity and detail needed in the sampling plan are directly related to the size, scope and level of complexity of the donor site.

The following are the minimum scientific objectives of a sampling plan developed under this policy:

- Identify and quantify known or suspected contaminants in the fill.
- Collect samples that will allow measurements of the chemical properties of the fill that are both accurate and precise.
- Collect representative samples, which for the purposes of implementing this policy are samples exhibiting typical properties of the whole volume of fill.
- Collect enough samples, and in no case less than eight discrete samples or two composite samples, to sufficiently represent the variability of the fill.
- Obtain a statistically valid and reliable estimate of the fill's chemical properties.

Characterize the fill both horizontally and vertically to represent the entire volume of fill to be transported off the donor site and used at a receiving site. A thorough characterization will provide the following information:

- Identity of regulated substances associated with a release that are present in the fill, the concentration of each identified regulated substance, and the spatial variation in concentration of each regulated substance both horizontally and vertically.

- The physical characteristics of the fill in which the regulated substances associated with a release are present. Examples of these include the fill type (such as soil, rock, dredge), texture, dry bulk density, permeability, organic carbon content, porosity, and moisture content. Include documentation of physical characteristics and any significant variability over the donor site.

In the sampling plan include a summary of existing information about the donor site, including any previously performed sampling or analysis information, preliminary estimates of summary statistics such as the mean and standard deviation, process descriptions and materials used, spatial boundaries of the donor site to be managed under this policy, information about what is known or suspected at the donor site, releases, and release mechanisms. Document this information by written descriptions of site conditions supported by maps, cross-sections, site diagrams, or other descriptive, graphical, or tabular illustrations necessary to characterize the site conditions.

Sampling units for fill managed under this policy should represent the total volume of fill being characterized pursuant to Sections B and C of this Appendix. Sampling plans may include a combination of probability sampling and authoritative sampling designs depending on conditions at the donor site. Probability sampling should be used to characterize the fill as a whole. Some sites may require additional, more focused sampling, such as authoritative sampling, to evaluate problem areas, such as localized areas that are suspected to contain the highest levels of regulated substances, or "hot spots," or areas that may require further evaluation. For example, areas that housed an underground storage tank or experienced a release of regulated substances should be sampled authoritatively and more frequently than other areas of the donor site. The remaining area of the donor site should be sampled using probability sampling, in which all parts of the fill being characterized have a known probability of being included in the characterization. Samples collected to delineate a "hot spot" are typically in addition to those collected for the overall site characterization.

B. Sampling Procedures for Fill Stored in Piles

There are several variables involved in the sampling of fill stored in piles, including the size and shape of the pile, compactness of the fill, and physical properties of the fill. The size and shape of the pile should be used to calculate volume and plan for the correct number of samples to be taken. Simple random sampling or stratified random sampling should be used to obtain representative samples from a fill pile, in accordance with SW-846 and Sections 5.2.1 – 5.2.2, and 5.3 of the *RCRA Waste Sampling Draft Technical Guidance, EPA530-D-02-002*. A method of random sampling, such as simple random or stratified random sampling should be used unless one of the following conditions exists:

- There are known distinct strata.

- An objective of the sampling is to prove or disprove that there are distinct strata.

- The number of samples is limited, and an objective of the sampling is to statistically minimize the size of a "hot spot" that might not get sampled.

Stratified random sampling can be employed only if all points within the pile can be accessed. In such cases, the pile should be divided into a three-dimensional grid system. The grid cubes should be numbered, and the grid cubes to be sampled should be chosen by random number tables or generators.

Generally, stainless-steel shovels, trowels, or scoops should be used to clear away surface material before samples are collected. Depth samples may be collected using a decontaminated auger. For a sample core, thin-wall tube samplers or grain samplers may be used. Near surfaces, samples can be collected with a clean, stainless-steel spoon or trowel. All samples collected, except those for VOCs analysis, should be placed into a Teflon-lined or stainless-steel pail and mixed thoroughly before transfer to the appropriate sample container. Since volatilization of VOCs can occur rapidly once the matrix is disturbed, grab samples are necessary for VOCs analysis. Grab samples should be handled as intact cores and transferred immediately to the container that will be used for analysis. Refer to SW-846, Method 5035, for container and preservation details specific to samples for VOCs analysis.

The sampling and subsequent analysis of fill stored in piles may be performed by collecting composite or discrete samples.

1. Procedure for Using Composite Samples:

    a. Do not use composite sampling if the integrity of the individual sample changes because of the physical mixing of discrete samples.

    b. For up to 125 cubic yards of fill, collect and handle eight discrete samples (plus two grab samples for VOCs) as follows:

        i. Prior to compositing, field screen the eight discrete samples to identify the two that are most likely to contain the highest concentrations of VOCs.

        ii. In accordance with SW-846, Method 5035, collect grab samples for VOC analysis from the two points identified by the field screening described above.

        iii. For all other substances, combine the eight discrete samples collected into two composite samples comprised of four discrete samples each. Perform the analysis on the two composite samples in accordance with SW-846.

c. For greater than 125 cubic yards and up to and including 3,000 cubic yards, collect and handle 12 discrete samples (plus three grab samples for VOCs) as follows:

i. Prior to compositing, field screen the 12 discrete samples to identify the three samples that are most likely to contain the highest concentrations of VOCs.

ii. In accordance with SW-846, Method 5035, collect grab samples for VOC analysis from the same sampling points as the three discrete samples identified by field screening.

iii. For all other substances, combine the 12 discrete samples collected into three composite samples comprised of four discrete samples each. Perform the analysis on the three composite samples in accordance with SW-846.

d. For each additional 1,000 cubic yards of fill or part thereof over the initial 3,000 cubic yards, collect four additional discrete samples (plus one grab sample for VOCs). Composite and analyze the four discrete samples in accordance with SW-846.

2. Procedure for Using Discrete Samples:

a. For up to 125 cubic yards of fill, collect and analyze a minimum of eight discrete samples (plus two grab samples for VOCs). For volumes of fill greater than 125 cubic yards and up to and including 3,000 cubic yards, collect and analyze a minimum of 12 discrete samples (plus three grab samples for VOCs). For each additional 1,000 cubic yards of fill or part thereof over the initial 3,000 cubic yards, collect and analyze a minimum of four additional discrete samples (plus one grab sample for VOCs).

b. For VOCs analysis, perform grab sampling as described in subsection B.1 of this Appendix.

C. Sampling Procedures for In-situ Fill

For the purposes of this policy, "in-situ fill" refers to fill that is undisturbed in its original location at the donor site or fill that has previously been used as clean or regulated fill and will be subsequently excavated and moved to a receiving site. If conducting sampling on in-situ fill to evaluate whether that fill can be managed as clean or regulated fill, characterize both the vertical and horizontal extent of the fill to be transported and used at a receiving site. Where multiple zones of contamination are possible due to site-specific conditions, including separate and discrete releases or the manner in which fill was originally placed, the characterization and demonstration that the fill meets the CFCLs or RFCLs apply individually to the separate zones.

For in-situ sampling where the purpose of the sampling is to characterize a specific release at the donor site, discrete samples collected using a focused sampling technique, such as authoritative sampling, must be used for analysis. These areas may be:

- Localized areas that are known to contain levels of regulated substances that exceed the CFCLs or RFCLs, whichever is applicable, based on analytical results, or

- Localized areas suspected to contain levels of regulated substances that exceed the CFCLs or RFCLs from a specific release, whichever is applicable, based on the historic use of the site.

Once the specific release at the donor site has been characterized, composite samples may be used to confirm that the remaining fill to be excavated and transported to a receiving site and used as clean or regulated fill meets the CFCLs or RFCLs, respectively.

To characterize the remaining area, the area should be sampled using a method of random sampling, such as simple random or stratified random sampling. Composite samples can then be used to verify that the fill intended for excavation and transportation meet the CFCLs or RFCLs, whichever is applicable. When composite samples are utilized for in-situ samples, the sampling plan must demonstrate that localized areas that are known to contain regulated substances exceeding the CFCLs or RFCLs, whichever is applicable, are not included in the portion of the site evaluated using composite samples.

Apart from known hot spots, which may require further sampling and analysis, as discussed above, the donor site should be divided into a three-dimensional grid. Where possible, each grid unit should be of similar size and shape and be comprised of equal volumes of fill. A method of random sampling, such as simple random or stratified random sampling, should be chosen based on knowledge of the donor site as set forth in SW-846 or the *RCRA Waste Sampling Draft Technical Guidance, EPA530-D-02-002.*

The number of sample points is determined by the volume of fill being characterized. Sampling frequency should account for the depth of donor fill to be removed. If an area of donor fill will be excavated to more than one depth (for example, three feet in one part and six feet in another part), then the samples should be distributed accordingly at multiple depths to be representative of the full depth of each cut. Determine the minimum number of samples using the procedure outlined in subsection B.2 of this Appendix. Additional sampling may be necessary based on site-specific conditions.

D. Evaluation of Data

Evaluate sample data generated in accordance with Sections B and C of this Appendix in accordance with the following:

1. For a composite sample collected in accordance with subsection B.1, the measured numeric value for a parameter may not exceed the CFCL for that parameter for the fill to be managed as clean fill, or the RFCL for that parameter for the fill to be managed as regulated fill.

2. For a grab sample collected for VOC analysis in accordance with the above sections, the measured numeric value for a parameter may not exceed the CFCL for that parameter for the fill to be managed as clean fill, or the RFCL for that parameter for the fill to be managed as regulated fill.

3. For discrete samples collected in accordance with subsection B.2, the measured numeric values for a substance in 75% of the discrete samples may not exceed the CFCL for that parameter for the fill to be managed as clean fill, or the RFCL for that parameter for the fill to be managed as regulated fill. For persons using the discrete sampling method, no single sample may show regulated substances at a concentration that is more than twice the CFCL or RFCL, whichever is applicable, for any parameter.

E. Alternate Evaluation of Data

In lieu of Section D of this Appendix, a person may use the 95% Upper Confidence Limit (UCL) of the arithmetic mean to determine whether the fill meets the CFCL or RFCL, whichever is appropriate, for a parameter. The calculated 95% UCL of the arithmetic mean should be below the appropriate CFCL or RFCL for that parameter. Persons intending to use this method for the treatment of data should determine a minimum number of samples in accordance with SW-846 and the *RCRA Waste Sampling Draft Technical Guidance, EPA530-D-02-002*. The application of the 95% UCL of the arithmetic mean should comply with the following performance standards:

1. The null hypotheses (Ho) is that the true arithmetic average concentration is at or above the CFCL or RFCL for that parameter, whichever is appropriate, and the alternative hypothesis (Ha) is that the true arithmetic average concentration is below the CFCL or RFCL for that parameter, whichever is appropriate.

2. Meet the underlying assumptions of the statistical method, such as data distribution.

3. Compositing cannot be used for VOCs.

4. The censoring level for each non-detect is the assigned value randomly generated that is between zero and the limit related to the practical quantitation limit (PQL).

5. Tests should account for spatial variability, unless otherwise approved by the Department.

6. Statistical testing should be done individually for each parameter for which a single sample result or multiple results exceed(s) a limit.

7. Where a fill has distinct physical, chemical or biological characteristics, or originates from different areas, do the statistical testing separately.

8. Document the following information:

   a. A description of the original areas of the fill and physical, chemical and biological characteristics of the fill.

b. A description of the underlying assumptions of the statistical method.

c. Documentation showing that the sample data set meets the underlying assumptions of the statistical method.

d. Documentation of input and output data for the statistical test, presented in tables or figures, or both, as appropriate.

e. An interpretation and conclusion of the statistical test.

F. Use of the Synthetic Precipitation Leaching Procedure (SPLP, SW-846 Method 1312) to Establish an Alternative Soil-to-Groundwater Value

Fill may be analyzed using SPLP to provide an alternative soil-to-groundwater value for use in making a fill determination. The value obtained using the SPLP represents a concentration of a regulated substance in the fill that does not produce leachate in which the concentration of the regulated substance exceeds the applicable groundwater MSC identified in Table 1 [MSCs for Organic Regulated Substances in Groundwater] or 2 [MSCs for Inorganic Regulated Substances in Groundwater] of Appendix A in 25 Pa. Code, Chapter 250. For both clean and regulated fill, the groundwater MSC for used aquifers with TDS <2,500 mg/L should be used to compare the SPLP result to Tables 1 or 2. For clean fill, use the groundwater MSC for residential use ("R") for comparison. For regulated fill, use the groundwater MSC for non-residential use ("NR") for comparison. If SPLP is used to identify an alternative soil-to-groundwater value, the alternative value is only applicable to the fill that was tested using SPLP.

Use the following procedure to determine an alternative soil-to-groundwater value based upon the SPLP:

1. During characterization of the donor site, obtain a minimum of ten samples from the proposed fill. For volumes of fill less than 125 cubic yards, collection of a minimum of eight samples is acceptable. Submit the four samples with the highest total concentration of the regulated substance for SPLP analysis. Samples obtained will be representative of the soil type and horizon impacted by the release of the regulated substance.

2. Determine the lowest total concentration (TC) that generates a failing SPLP result. The alternative soil-to-groundwater value will be the next lowest TC.

3. If all samples result in a passing SPLP level, the alternative soil-to-groundwater value will be the TC corresponding to the highest SPLP result. Additional samples may be collected.

4. If none of the samples generates a passing SPLP, additional samples may be collected and concurrent TC/SPLP analyses performed to satisfy the above conditions for establishing an alternative soil-to-groundwater value.

5. The alternative soil-to-groundwater value is then compared to the direct contact residential value for clean fill or the direct contact non-residential value for regulated fill

found in Chapter 250, Appendix A, Tables 3[6] or 4[7]. The lower of the compared values is the applicable numeric limit.

G. Performing a Background Demonstration and Equivalent Site Evaluation

A background demonstration may be utilized for both clean fill and regulated fill determinations. For clean fill determinations, use the CFCLs. For regulated fill, use the RFCLs. If fill from the donor site contains regulated substances at concentrations exceeding the CFCL or RFCL, whichever is appropriate, for that parameter, a demonstration may be made to show that the exceedance is due to background at the donor site. If a successful background demonstration is made, perform an equivalent site evaluation prior to movement of fill to a receiving site. The equivalent site evaluation ensures that no new regulated substance is placed on the receiving site other than a regulated substance already determined to be present and that the concentration(s) of regulated substance(s) in the donor fill has been compared to the concentration(s) of the same regulated substance(s) at the receiving site in accordance with subparagraphs G.3.b.i-ii. of this Appendix. Regulated substances detected in the donor fill that are below the CFCL or RFCL, whichever is appropriate, for that parameter, do not require a background demonstration or an equivalent site evaluation.

Generally, only naturally occurring metals, lead and some ubiquitous organics, such as polynuclear aromatic hydrocarbons (PAHs), from widespread atmospheric deposition, are eligible for a background demonstration. When data or other information indicates that a regulated substance has migrated onto the donor site from the release of a regulated substance at another site, the regulated substance is not due to background of that substance at the donor site. Pathways for the migration of a regulated substance due to an offsite release include surface runoff from specific sources (such as runoff from parking lots and storage facilities where spills have occurred); spills at railroad facilities and in railroad rights-of-way; and air deposition of regulated substances from specific sources.

Previously collected background data published by an accredited source with appropriate peer review may be considered, provided the information is sufficiently focused and contains the level of detail on the area used to determine background necessary to legitimately compare it to the donor site. The description of the sampling and analysis performed should be detailed enough to provide statistical validity.

Use the following guidelines when performing a background demonstration under this policy:

1. Select a Background Reference Area:

   The first step in making a demonstration that the presence of a regulated substance is due to background at the donor site and is not due to a release is to select a background reference area, as the term is defined in this policy, to collect samples for the purpose of establishing background at the donor site. Samples may be collected from the background reference area to demonstrate that an exceedance of a CFCL or RFCL, as appropriate, can be attributed to background, as the term is defined in this policy. Background reference areas should not include areas affected by a known or suspected

[6] Direct contact numeric values for soils at residential properties
[7] Direct contact numeric values for soils at non-residential properties

release of a regulated substance, including areas impacted by road runoff, areas near railroads affected by engine exhaust contaminants, and areas near buildings contaminated by paint chips. In urban areas, background reference areas may include areas where widespread, ubiquitous contamination is present that cannot be traced to a specific source.

Background reference areas should be as similar as possible to the donor site. Every attempt should be made to reduce the factors that are different between the background reference area and the donor site. This does not mean that a sample collected at a location that is a considerable distance from an area known or suspected to have been affected by a release of a regulated substance is unacceptable merely because the known or suspected regulated substance is detected in the sample. The presence of regulated substance outside of the area known or suspected to have been affected by a release may indicate that the presence of the regulated substance is truly ubiquitous, widespread and incapable of being traced to a specific source. In this case, the regulated substance may be part of the background at the donor site.

A background reference area, as the term is defined in this policy, should be selected for use in the background demonstration.

2. Sampling, Analysis and Evaluation of Data:

Establish background by a sampling methodology that is statistically valid and consistent with the methodology used to perform the fill determination. Use the same analysis methods for the background samples that were used for performing the fill determination.

Compare the analytical results of the background samples with the results obtained from the fill determination. Use the following statistical methods for the comparison:

a. Demonstrate that the highest measurement from the donor site is not greater than the highest measurement from the background reference area. The Department may accept insignificant variances in numbers. The minimum number of samples to be collected is 10 from the background reference area and 10 from each donor site. Analysis should be carried out on discrete samples.

b. The Department may accept another appropriate statistical method if it meets the conditions below.

   i. For nonparametric and parametric methods, the false-positive rate for a set of data applied to a statistical test may not be greater than 0.05. The minimum number of samples to be collected is 10 from the background reference area and 10 from each donor site.

   ii. For parametric methods, the censoring level for each non-detect (ND) should be the assigned value randomly generated that is between zero and the limit related to the PQL.

3. Equivalent Site Evaluation:

The equivalent site evaluation ensures that no new regulated substance is placed on the receiving site other than a regulated substance that is already determined to be present and that the concentration(s) of regulated substance(s) in the donor fill has been compared to the concentration(s) of the same regulated substance(s) at the receiving site in accordance with subparagraphs G.3.b.i-ii. of this Appendix. Regulated substances detected in the donor fill that are below the CFCLs or RFCLs, as appropriate do not need to be included in the equivalent site evaluation. Perform the equivalent site evaluation prior to the movement of fill to a receiving site. Include documentation in the FP-001 demonstrating that the equivalent site evaluation has been performed and is satisfied in accordance with this section.

a. Develop a Plan for Sampling the Receiving Site.

Make a background determination on the receiving site to determine whether the same regulated substances present in the donor fill due to background are also present at the receiving site, and if so, determine the concentrations of the identified regulated substances. Development of a sampling plan in accordance with Section A of this Appendix is necessary to characterize the receiving site.

In the sampling plan include a summary of existing information about the receiving site, including any previously performed sampling or analysis information, process descriptions and materials used, spatial boundaries of the receiving site, information about what is known or suspected at the receiving site, releases, and release mechanisms. Document this information by written descriptions of site conditions and supported by maps, cross-sections, site diagrams, or other descriptive, graphical, or tabular illustrations necessary to characterize the site conditions.

The receiving site should be sampled using probability sampling, in which all parts of the site being characterized have a known probability of being included in the characterization, except for areas of the receiving site that are known to be or suspected of being affected by a release of a regulated substance, including areas impacted by road runoff, areas near railroads affected by engine exhaust contaminants, and areas near buildings contaminated by paint chips, unless the entire receiving site is part of a larger urban area where ubiquitous, widespread contamination is present that is incapable of being traced to a specific source.

Select the area of the receiving site used for the equivalent site evaluation in accordance with the following:

i. The area sampled is unaffected by a release of a regulated substance.

ii. The area sampled should be at a depth comparable to the area where donor fill is to be placed on the receiving site.

iii. The concentration of regulated substances in the area sampled is attributable to the parent material from which the soil was derived and the

natural processes which produce soil; or the concentrations of regulated substances resulted from an atmospheric deposition, as the term is described in the definition of "background reference area," but are not attributable to a specific point source or release of a regulate substance.

b. Sampling, Analysis and Evaluation of Data.

Establish the background by a sampling methodology that is statistically valid and consistent with the methodology used to perform the fill determination. Use the same analysis methods for background samples that were used for performing the fill determination.

Compare the analytical results of background samples for the receiving site with the results obtained from the donor fill. Use one of the following statistical methods for comparison:

i. Demonstrate that the highest measurement from the donor site is not greater than the highest measurement from the receiving site. The Department may accept insignificant variances in numbers. The minimum number of samples to be collected is 10 from the receiving site and 10 from each donor site.

ii. The Department may accept another appropriate statistical method if it meets the conditions below.

(A) For nonparametric and parametric methods, the false-positive rate for a set of data applied to a statistical test may not be greater than 0.05. The minimum number of samples to be collected is 10 from the receiving site and 10 from each donor site.

(B) For parametric methods, the censoring level for each non-detect (ND) should be the assigned value randomly generated that is between zero and the limit related to the PQL.

Appendix B
Recognition and Identification of Acid-Producing Rock

Pennsylvania's municipal and residual waste regulations define clean fill, in part, as inert solid material. Acid-producing rock reacts when exposed to air or water and therefore does not meet the regulatory definition of clean fill. In addition to presenting abrupt and adverse environmental concerns, exposed acid-producing rock can also have long-term damaging effects on highways and highway structures, including corrosion of concrete and steel structures; destabilization of cut slopes and fill slopes; ground heaving of structures and pavements; toxicity to roadside vegetation and aquatic life; and degradation of drinking water supplies.

Determining whether or not fill contains acid-producing rock begins with determining the presence of or likelihood of encountering acid-bearing rock (ABR), which is widespread in Pennsylvania. The primary source of acidity in Pennsylvania sedimentary rocks is sulfide minerals. Although there are many minerals that contain sulfur, those containing pyrite, or ferrous disulfide, are the major contributors to the release of acid. While pyrite minerals are not always large enough to be visible to the unaided eye, larger crystals have a yellowish, metallic appearance. Deposits containing pyrite concentrations greater than 0.5% have the potential to be significant sources of acid. Various other forms of sulfide minerals are of lesser concern due to their chemical stability, and include chalcopyrite (CuFeS2), galena (PbS) and sphalerite (ZnS), but can be problematic when present with pyrite.

Although there are more than 200 common minerals that contain sulfur, only those classified as iron sulfide are of potential concern due to the ability of these elements to promote oxidation, hydration and the release of acid. In Pennsylvania, there are four potential sulfide deposit types, listed as follows in descending order of pyrite oxidation reactivity:

- Veined Rock Deposits;
- Sedimentary Rock Deposits;
- Mine Spoils; and
- Acid Sulfate Soil Deposits.

Typically, the upper 25- to 35-feet of bedrock does not contain pyrite because pyrite is not stable under atmospheric conditions and will weather away. Therefore, if excavations are shallower than 30 feet, the risk of acid release is generally minimal. This is particularly true if a site is located south of the glacial margin. Within the glaciated regions of Pennsylvania, weathered bedrock may have been removed by glaciers and pyrite may exist closer to the surface. Unconsolidated sediments, such as glacial till, sand, and gravel, are not acid-producing and can be excavated without risk of acidic drainage. With regard to characterization of fill excavated to depths greater than 25 feet, environmental due diligence should include details demonstrating that the fill does not contain acid-producing rock.

The following publicly available resources may also assist in assessing the likelihood of encountering ABR:

- The Pennsylvania Geological Survey's a map of potentially acid bearing rocks (OFMI Report 05-01.1);
- The Pennsylvania Department of Transportation's (PennDOT) Geotechnical Engineering Manual, Publication 293 (4/18) (PUB 293 (4/18)); and
- DEP's Fact Sheet titled, "How to Avoid and Handle Acid-Producing Rock Formations Encountered During Well Site Development" (PA DEP Link)

If ABR is anticipated in the fill based on published information or identified during due diligence, testing should be done to estimate the acid-producing potential. For more information on testing procedures and acid-base accounting procedures, please refer to PennDOT's "Geotechnical Engineering Manual, Publication 293 (4/18) (PUB 293 (4/18))," DEP's "Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania (Coal Mine Drainage Prediction and Pollution Prevention)" or DEP's "Evaluation of Acid-Base Accounting Using Computer Spreadsheets (Evaluation of Acid-Base Accounting)."

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WASTE MANAGEMENT

FORM FP-001 - CERTIFICATION OF CLEAN FILL

Prior to completing this form and signing this certification, please review the entire Management of Fill policy (#258-2182-773), including the certification requirements. Please note that historic fill, as defined in the Management of Fill policy, may meet the definition of clean fill if the material is limited to uncontaminated soil, rock, stone, dredged material, used asphalt, and brick, block or concrete from construction and demolition activities that is separate from other waste and recognizable as such.

Fill containing a concentration of total PCBs greater than 2 ppm may be subject to regulation under the Toxic Substances Control Act (TSCA), 15 U.S.C. Section 2601 *et seq.*, and 40 C.F.R. Part 761, which is administered and implemented by the USEPA. For all such material, contact the PCB Coordinator for EPA Region 3 by email at R3_PCB_Coor@epa.gov to determine the allowable PCB level for your site and situation prior to transporting the material off the site of origin or accepting the material for use.

Instructions: Sections 1 and 2 of this form must be completed by the person making the determination of clean fill at the site of origin. Section 3 must be completed by the person using the material as clean fill. Both the person determining clean fill and the user of the clean fill are responsible for maintaining copies of this completed form on site for a period of five (5) years for Department inspection.

Section 1: Person Determining Clean Fill

Name (Print): _____ Title: _____ Date: _____

Company Name: _____

Street Address: _____ City: _____ State: _____ Zip Code: _____

Telephone Number: _____ E-mail Address: _____

Clean Fill Material originated on the following property:

Site Name: _____

Street Address: _____ City: _____ State: _____ Zip Code: _____

Section 2: Site Characterization

Check the following that applies:

☐ **A. IF the site of origin for the fill material has undergone or is undergoing cleanup or remediation pursuant to a local state or federal regulatory program that requires site characterization, provide the following information along with a copy of the entire site characterization and laboratory analysis for the material to be used as clean fill.**

Name of local, state, or federal agency: _____

Identification number assigned to the project: _____

Name of the local, state, or federal contact person: _____

Telephone Number: _____ E-mail Address: _____

Name of the Laboratory that conducted the analysis: _____

Laboratory Accreditation Number: _____

☐ **B. IF the material proposed to be used as clean fill has otherwise been subject to analytical testing or other procedure identified in the definition of "environmental due diligence" contained in the Management of Fill policy, provide or attach the following:**

Copies of **ALL** lab analytical testing performed as part of environmental due diligence (see Management of Fill policy, #258-2182-773).

Name of the Laboratory that conducted the analysis: _____

Laboratory Accreditation Number: _____

☐ **C. IF the proposed material to be used as clean fill was subject to environmental due diligence procedures as defined in the Management of Fill policy other than those listed in A and B, describe those procedures.**

_____

_____

I, the undersigned, certify under penalty of law (18 Pa. C.S.A. §4904) that the information provided in Sections 1 and 2 of this form is true and correct to the best of my knowledge, information and belief.

Signature: _____

Section 3: Person Receiving or Placing Clean Fill

Name and address of person completing this form:

Name (Print): _____ Date: _____

Mailing Address: _____ City: _____ State: _____ Zip Code: _____

Telephone Number: _____ E-mail Address: _____

Fill material that has been determined to be clean fill will be placed on the following property solely for property improvement or construction purposes:

Property Address: _____ City: _____ State: _____ Zip Code: _____

Current Owner of Property: _____

Telephone Number: _____ E-mail Address: _____

The quantity of clean fill to be placed on the property is:

☐ <3,000 cubic yards ☐ 3,000 cubic yards to 20,000 cubic yards ☐ >20,000 cubic yards

I, the undersigned, certify under penalty of law (18 Pa. C.S.A. §4904) that the information provided is true and correct to the best of my knowledge, information and belief.

Signature: _____

* * * * *

Prior to placement of the clean fill, the owner of the property receiving fill material shall provide a copy of this completed form and attachments to the DEP Regional Office serving the county in which the receiving site is located. If a property receives fill from multiple sources, a separate Form FP-001 is required for each source.

Certification of Clean Fill

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

HELP (USER GUIDE)

This form will be unavailable for system maintenance and upgrade beginning 5 PM on June 11 until approximately 2 PM on June 12.

Prior to completing this form and signing this certification, please review the entire Management of Fill policy (#258-2182-773), including the certification requirements. Please note that historic fill, as defined in the Management of Fill policy, may meet the definition of clean fill if the material is limited to uncontaminated soil, rock, stone, dredged material, used asphalt, and brick, block or concrete from construction and demolition activities that is separate from other waste and recognizable as such.

Fill containing a concentration of total PCBs greater than 2 ppm may be subject to regulation under the Toxic Substances Control Act (TSCA), 15 U.S.C. Section 2601 et seq., and 40 C.F.R. Part 761, which is administered and implemented by the USEPA. For all such material, contact the PCB Coordinator for EPA Region 3 by email at R3_PCB_Coor@epa.gov to determine the allowable PCB level for your site and situation prior to transporting the material off the site of origin or accepting the material for use.

Instructions: Sections 1 and 2 of this form must be completed by the person making the determination of clean fill at the site of origin. Section 3 must be completed by the person using the material as clean fill. Both the person determining clean fill and the user of the clean fill are responsible for maintaining copies of this completed form on site for a period of five (5) years for Department inspection.

Reference Number
5573

Section 1: Person Determining Clean Fill

Name *

Title

Company Name

Street Address *

City *

State *

Zip Code *

Telephone Number *

E-mail Address *

Clean Fill Material originated on the following property:

Site Name

☐ Use same address as above

Street Address *

City *

State *

County *

Zip Code *

Municipality *

Region (based on County)

Section 2: Site Characterization (Check the following that applies – At least one option is required)

Section 2: Site Characterization (Check the following that applies - At least one option is required)

A.

☐ IF the site of origin for the fill material has undergone or is undergoing cleanup or remediation pursuant to a local state or federal regulatory program that requires site characterization, provide the following information along with a copy of the entire site characterization and laboratory analysis for the material to be used as clean fill.

B.

☐ IF the material proposed to be used as clean fill has otherwise been subject to analytical testing or other procedure identified in the definition of "environmental due diligence" contained in the Management of Fill policy, provide or attach the following:

Copies of ALL lab analytical testing performed as part of environmental due diligence (see Management of Fill policy, #258-2182-773)

C.

☐ Environmental due diligence - Investigative techniques used to determine whether fill from a donor site has been affected by a release of a regulated substance. Examples of investigative techniques included in this term are visual property inspections, electronic data base searches, review of ownership and historical use of a property, Sanborn maps, environmental questionnaires, transaction screens, analytical testing, environmental assessments, audits, or procedures outlined in ASTM standard E1527 13. A single investigative technique may not be used as the basis for environmental due diligence. Environmental due diligence includes visual property inspection and a review of ownership and historical property use, at a minimum.

Please fill in the description *

Section C Attachment (Please make sure you attach standard file formats like PDF, JPEG, TIFF, DOC, XLS, etc)

CCF Attachment C

Submitter's Signature

I, the undersigned, certify under penalty of law (18 Pa. C.S.A. §4904) that the information provided in Sections 1 and 2 of this form is true and correct to the best of my knowledge, information and belief. *

Click to Sign Document

Provide the information of the person receiving / placing Clean Fill

Name *

E-mail Address *

Prior to placement of the clean fill, the owner of the property receiving fill material shall provide a copy of this completed form and attachments to the DEP Regional Office serving the county in which the receiving site is located. If a property receives fill from multiple sources, a separate Form FP-001 is required for each source.

SECTION 02350

DRILLED CAISSON FOUNDATIONS

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section includes furnishing all labor, materials, tools and equipment required for the installation of all required drilled caisson foundations

B. Except as modified herein, the Work shall conform to the applicable portions of PennDOT Publication 408, Section 1006 and the Contract Drawings.

C. Reference the Grade Crossing Foundation Report for the SR 88 Grade Crossing Site Improvement Project dated August 4, 2023 for supporting information regarding subsurface conditions and foundation design.

1.02 REFERENCE STANDARDS

A. PENNDOT, Publication 408.

1.03 RELATED SECTIONS

A. Section 01570, “Site Survey”.

B. Section 03305, “Cast-in-Place Cement Concrete Structures”.

C. Section 13572, “Grade Crossing Warning System”

1.03 SUBMITTALS

A. See Article 3.01

ARTICLE 2 – PRODUCTS

2.01 MATERIALS

A. 24” Drilled Caissons . In accordance with PennDOT Publication 408 Section 1006.2

ARTICLE 3 – EXECUTION

3.01 QUALIFICATIONS & SUBMITTALS

A. Submit qualifications and required submittals in accordance with PennDOT pub 408 1006.3 (a)

B. Submittals shall also show locations of anchor bolts in accordance with Section 13572, as coordinated with manufacturer design recommendations. Drawings shall be sealed by

an engineer licensed in the Commonwealth of Pennsylvania.

3.03 PERFORMANCE REQUIREMENTS

A. General. Conduct caisson operations in accordance with PennDOT Publication 408 Section 1006.3 and as per contract documents and in accordance with equipment manufacturer requirements

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Item 02350 – Drilled Caisson Foundations shall be measured per Lump Sum for all required foundations, acceptably performed.

4.02 PAYMENT

A. Item 02350 – Drilled Caisson Foundations shall be paid at the Unit Price and shall include the cost of all the Work specified in this Section and Related Sections.

END OF SECTION

SECTION 02448

HORIZONTAL DIRECTIONAL DRILLING

ARTICLE 1 - GENERAL

1.01 SECTION INCLUDES

A. The Work specified in this section includes furnishing and installing high density polyethylene (HDPE) casing pipe using the horizontal directional drilling (HDD) method of installation as shown in the Contract Drawings. This Work shall include all services, equipment, materials, and labor for the complete and proper installation, testing, contractor designed temporary excavation support and protection system, excavation and backfill, restoration of underground utilities and environmental protection and restoration to install a 12” casing for PVC conduit under SR 88.

B. All materials and installation of the system shall be in accordance with the standards and specifications.

C. Contractor shall be responsible for the location and protection of all existing utilities

D. Contractor shall apply for and comply with stipulations of the PennDOT HOP Permit and PA code 67 Chapter 459.8 (a)

1.02 RELATED SECTIONS

A. Section 01800, “Erosion and Sediment Control”.

B. Section 01910, “Maintenance and Protection of Traffic”.

C. Section 02090, “Removal and Disposal of Regulated Material”.

D. Section 13570, “Signal System”.

E. Section 13571, “Logic and Signal Conduits”.

F. Section 13572, “Grade Crossing Warning System”.

G. Section 13574, “Signal Installation”.

H. Section 13575, “Wire and Cable”.

I. Section 13577, “Electrical and Electronic Components”.

J. Section 13578, “Housings and Housing Equipment”.

K. Section 13580, “Signal Power Distribution”.

L. Section 13581, “Signaling System Test and Inspection”.

1.03 QUALIFICATIONS

Directional drilling and pipe installation shall be done by an experienced Contractor specializing in directional drilling and whose key personnel have at least five (5) years of experience in this work. Furthermore, the Contractor must have installed directionally drilled pipe at least as large as 12-inches in diameter, having performed installations of at least 500 feet in length, and successfully installed at least 20,000 feet in total length.

1.04 SUBMITTALS

A. WORK PLAN: Prior to beginning work, the Contactor must submit to the Engineer a general work plan outlining the procedure and schedule to be used to execute the project. The plan should document the thoughtful planning required to successfully complete the project. The work plans should be complete in nature to satisfy the requirements of the PennDOT HOP process as well as addressing items such as Bore Profile and geometry, drilling fluid and mud management plan, inadvertent return/ frac out plans, tracking and guidance plan, settlement and surface monitoring, pipe pullback operations. The complete plan shall be submitted to PRT for approval prior to submittal to PennDOT for HOP approval.

B. EQUIPMENT: The Contractor must submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project.

C. LABOR: The Contractor must submit a detailed list of supervisory, technical and general personnel to be utilized during the project. Certifications and experience of all key personnel must be included.

D. MATERIALS: Specifications on all materials to be used shall be submitted to the Engineer for approval. Materials shall include the pipe, fittings and any other item which is to be an installed component of the project.

1.05 REFERENCE STANDARDS

A. ASTM D2239 – Standard Specification for Polyethylene Plastic Pipe Based on Controlled Inside Diameter.
B. ASTM D2737 – Standard Specification for Polyethylene Plastic Tubing.
C. ASTM D3035 – Polyethylene PE Pipes Dimensions.
D. ASTM F714 – Standard Specification for Polyethylene Plastic Pipe Based on Outside Diameter.

ARTICLE - 2 PRODUCTS

2.01 The material requirements for the pipe and fittings shall be SDR-9 with a 250 psi static pressure rating.

2.02 EQUIPEMENT

A. General: The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback of the pipe, a drilling fluid mixing &

delivery system of sufficient capacity to successfully complete the installation, a guidance system to accurately guide boring operations, and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

B. Drilling Rig: The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. The hydraulic system shall be free of leaks. The rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations.

C. Drill Head: The drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.

D. Mud Motors: Mud motors shall be of adequate power to turn the required drilling tools.

E. Drill Pipe: Shall be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tool joints should be hardened to 32-36 RC.

2.03 GUIDANCE SYSTEM

A. The guidance system shall be of a proven type and shall be setup and operated by personnel trained and experienced with this system. The Operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.

2.04 DRILLING FLUID (MUD) SYSTEM

A. Mixing System: A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid composed of bentonite clay, potable water and appropriate additives. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank shall be sized for adequate storage of the mud. Mixing system shall continually agitate the drilling fluid during drilling operations.

B. Drilling Fluids: Drilling fluid shall be composed of clean water and an appropriate additive. Water shall be from a clean source with a pH of 8.5 – 10 and/or as per mixing requirements of the manufacturer. Water of a lower pH or with excessive calcium shall be treated with the appropriate amount of sodium carbonate or equal. The water and additives shall be mixed thoroughly and be absent of any clumps or clods. No hazardous additives may be used. Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of the bore wall.

C. Delivery System: The mud pumping system shall have a minimum capacity to supply mud in an accordance with the drilling equipment pull-back rating at a constant required

pressure. The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe shall be relatively leak-free. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and properly disposed of. A berm, minimum of 12 inches (12”) high, shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps and/or vacuum truck(s) of enough size shall be in place to convey excess drilling fluid from containment areas to storage facilities.

2.05 OTHER EQUIPMENT

A. Pipe Rollers: Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations. Sufficient number of rollers shall be used to prevent excess sagging of pipe.

B. Pipe Rammers: Hydraulic or pneumatic pipe rammers may only be used if necessary and with the authorization of the Engineer.

C. Restrictions: Other devices or pipeline placement systems for providing horizontal thrust other than those previously defined in the preceding subsections shall not be used unless approved by the Engineer prior to the commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system will be evaluated prior to approval or rejection on its potential ability to complete the pipeline placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribe by the particular conditions of the project. Approval by the Engineer does not relieve the Contractor of its responsibilities.

ARTICLE - 3 EXECUTION

3.01 GENERAL

A. The Engineer must be notified 48 hours in advance of starting work. The directional bore shall not begin until the Engineer or his authorized representative is present at the job site and agrees that proper preparations and precautions for the operation have been made. The Engineer’s approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion to the work as authorized under the Contract.

3.02 PERSONNEL REQUIREMENTS

A. All personnel shall be fully trained in their respective duties as part of the directional crew and in safety.

3.03 DRILLING PROCEDURE

A. Site Preparation:

1. The work site as indicated on the Drawings, within the right-of-way, shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. The Contractor must confine all activities to the designated work areas.

B. Drill Path Survey: The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on the Drawings. If the contractor is using a magnetic guidance system, the drill path will be surveyed for any surface geomagnetic variations or anomalies.

C. Environmental Protection: The Contractor shall place silt socks between all drilling operations and any drainage, waterway or other area designated for such protection by the Contract Documents, state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. The Contractor shall adhere to all applicable environmental regulations. Fuel or oil may not be stored in bulk containers within two hundred feet (200') of any water-body.

D. Safety: The Contractor shall adhere to all applicable state, federal and local safety regulations and all operations shall be conducted in a safe manner. Safety meetings shall be conducted at least weekly with a written record of attendance and topic submitted to the Engineer.

E. Pipe: The pipe shall be welded/fused together in one length, is space permits. Pipe will be placed on pipe rollers before pulling into bore hole with rollers spaced close enough to prevent excessive sagging of pipe.

F. Pilot Hole:

1. Pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over the length of 100 feet. In the event that the pilot does deviate from the bore path more than 5% of depth in 100 feet, the Contractor must notify the Engineer and the Contractor may be required to pull-back and re-drill from the location along the bore path before the deviation.

2. In the event that a drilling fluid fracture, inadvertent returns or returns loss occurs during pilot hole drilling operations, the Contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and then wait another 30 minutes. If mud fracture or returns loss continues, the Contractor must cease operations and notify the Engineer. The Engineer and Contractor will discuss additional options and work then will proceed accordingly.

G. Reaming: Upon successful completion of the pilot hole, the Contractor will ream bore the hole to a minimum of 25% greater than outside diameter of the pipe using the appropriate tools. The Contractor shall not attempt to ream, at one time, more than the drilling equipment and mud system are designed to safely handle.

H. Pull-Back:

1. After successfully reaming the bore hole to the required diameter, the Contractor

will pull the pipe back through the bore hole. In front of the pipe will be a swivel to prevent torsional stresses occurring in the pipe. Once pull-back operations have commenced, operations must continue without interruption until the pipe is completely pulled into the bore hole. During pull-back operations the Contractor shall not apply more than the maximum safe pipe pull pressure at any time.

3.04 PIPE TESTING

A. The pipe shall be hydrostatically tested after joining into continuous lengths prior to installation and again after installation.

B. The testing procedure and pressures shall be in accordance ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.

C. At the completion of each successful test, erosion prevention and control measures will be used during removal and discharge of the water.

3.05 SITE RESTORATION

Following drilling operations and pipeline installation, the Contractor must de-mobilize equipment and restore the worksite to its original condition or as specified in the Contract Documents. All excavations must be backfilled and mechanically compacted to 95% of original density. All drilling mud shall be properly disposed of by the Contractor.

3.06 RECORD KEEPING

The Contractor shall maintain a daily project log of drilling operations and a guidance system log with a copy given to the Engineer at the completion of the project. As-Built drawings will be verified as to accuracy by the Engineer.

ARTICLE - 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for this section.

4.02 PAYMENT

A. No separate payment will be made for the work of this section. Payment for this work shall be incidental to the payment for Section 13572 – Grade Crossing Warning System.

END OF SECTION 02448

SECTION 02761

PAVEMENT MARKINGS

ARTICLE 1 - GENERAL

1.01 SUMMARY

The Work of this Section includes, but is not limited to, providing all labor, material, tools, equipment, and incidentals necessary for placement of pavement markings in accordance with the Contract Documents.

1.02 RELATED SECTIONS

A. Section 01910, “Maintenance and Protection of Traffic”

1.03 REFERENCE STANDARDS

A. PENNDOT, Publication 408.

B. PENNDOT, Publication 111.

D. PENNDOT, Publication 35 (Bulletin 15).

E. AASHTO.

F. MUTCD.

ARTICLE 2 - PRODUCTS

2.01 GENERAL

A. Pavement-Marking Epoxy Paint: In accordance with Pub 408 Section 964.2
   a. Color: Match existing or as indicated on the Contract Drawings.

ARTICLE 3 - EXECUTION

3.01 PAVEMENT MARKING

A. Do not apply pavement- marking paint until layout, colors, and placement have been verified with Engineer.

B. Allow paving to age for 2 days before starting final pavement marking.

C. Apply Pavement Markings in accordance with Pub. 408 Section 964.3

D. Sweep and clean surface to eliminate loose material and dust.

E. Remove any existing Pavement markings in accordance with Publication 408 Section 963.3. Removal of existing pavement markings will be considered incidental to application of new pavement markings.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this Section shall be measured as a Lump Sum Unit, acceptably complete in place.

4.02 PAYMENT

B. The Work of this Section will be paid for at the Lump Sum Price paid for **Bid Item 02761 – Pavement Markings**, which includes the cost of all Work specified in this Section.

END OF SECTION

SECTION 02891

SIGNING

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, providing all labor, material, tools, equipment, and incidentals necessary for the fabrication and placement of new signing and storage and resetting of existing signs, removal and disposal of existing signs, or setting of signs provided by the Authority in accordance with the Contract Documents and as directed by the Authority.

1.02 REFERENCE STANDARDS

A. PENNDOT, Publication 408.

B. PENNDOT, Publication 236.

C. PENNDOT, Publication 111.

D. PENNDOT, Publication 35 (Bulletin 15).

E. AASHTO.

F. MUTCD.

1.03 RELATED SECTIONS

A. NONE

ARTICLE 2 – PRODUCTS

2.01 MATERIALS

A. PENNDOT, Publication 408, Section 931.2

B. PENNDOT, Publication 408, Section 935.2.

C. PENNDOT, Publication 408, Section 936.2

D. PENNDOT, Publication 408, Section 944.2.

E. Steel Square Posts in accordance with PENNDOT, Publication 408, Section 1103.08.b

F. PENNDOT, Publication 408, Section 930.2.

ARTICLE 3 – EXECUTION

3.01 CONSTRUCTION

A. PENNDOT, Publication 408, Section 931.3 and as follows:

1. Provide installation of surface-mount post anchors meeting requirements of Section 931.3.

2. Anchor shall be installed flush with surface and post shall be installed in accordance with requirements of TC-8702B.

3. Installation of anchoring bolts shall be approved by the Inspector-In-Charge

B. PENNDOT, Publication 408, Section 935.3.

C. PENNDOT, Publication 408, Section 936.3

D. PENNDOT, Publication 408, Section 941.3.

E. PENNDOT, Publication 408, Section 930.3.

3.02 STORE AND RELOCATE EXISTING SIGNS

A. Remove, store, and reset existing site signage as shown in the Contract Drawings.

3.03 REMOVE EXISTING SIGNS

A. Remove and dispose of existing site signage where shown in the Contract Drawings.

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this Section shall be measured as a Lump Sum Unit, acceptably complete in place.

4.02 PAYMENT

B. The Work of this Section will be paid for at the Lump Sum Price paid for **Bid Item 02891 – Signing**, which includes the cost of all Work specified in this Section.

END OF SECTION

SECTION 03211
REINFORCEMENT BARS, EPOXY COATED

ARTICLE 1 GENERAL

1.01 SUMMARY

A. The Work of this Section shall include furnishing all labor, material, tools, equipment, and incidentals required for installing reinforcement bars for cement concrete construction.

1.02 RELATED SECTIONS

A. Section 02350, Drilled Caisson Foundations

B. Section 03305, Cast-in-Place Concrete and Cement Concrete Structures

C. Section 03300, Cement Concrete

1.03 REFERENCE STANDARDS

A. PennDOT Publication 408

B. PennDOT Publication 35, Bulletin 15

C. ASTM

ARTICLE 2 PRODUCT

A. PennDOT Publication 408 Section 1002.2

ARTICLE 3 EXECUTION

A. PennDOT Publication 408 Section 1002.3

ARTICLE 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the Work in this Section.

4.02 PAYMENT

A. No separate payment will be made for the Work of this Section. Payment for the work of this Section shall be incidental to payment of Section 02350 –Drilled Caisson Foundations.

END OF SECTION 03211

SECTION 03300

CAST-IN-PLACE CONCRETE

ARTICLE 1 - GENERAL

1.01 SUMMARY

A. The Work of this Section includes, but is not limited to, cast-in-place concrete, including reinforcement, concrete materials, mix design, placement procedures, and finishes for concrete around the islands, vertical curb and mountable curb.

1.02 RELATED SECTIONS

A. Section 02350, - “Drilled Caisson Foundations”

B. Section 05740, - “Bollards”

1.03 SUBMITTALS

A. Product Data: For each manufactured material and product indicated.

B. Design Mixes: For each concrete mix indicated.

C. Shop Drawings: Include details of steel reinforcement placement including material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports.

D. Material test reports.

E. Testing Agency.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

B. Comply with ACI 301, "Specification for Structural Concrete," including the following, unless modified by the requirements of the Contract Documents.

1. General requirements, including submittals, quality assurance, acceptance of structure, and protection of in-place concrete.
2. Formwork and form accessories.
3. Steel reinforcement and supports.
4. Concrete mixtures.
5. Handling, placing, and constructing concrete.

ARTICLE 2 - PRODUCTS

2.01 MATERIALS

A. Formwork: Furnish formwork and form accessories according to ACI 301.

B. Steel Reinforcement:

1. Epoxy Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
2. Plain-Steel Wire: ASTM A 82, as drawn.
3. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
4. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.

C. Concrete Materials:

1. Portland Cement: ASTM C 150, Type I.
2. Normal-Weight Aggregate: ASTM C 33, uniformly graded, not exceeding 3-inch nominal size.
3. Lightweight Aggregate: ASTM C 330.
4. Water: Complying with ASTM C 94.

D. Admixtures:

1. Air-Entraining Admixture: ASTM C 260.
2. Water-Reducing Admixture: ASTM C 494, Type A.
3. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
5. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

E. Vapor Retarder: Multi-ply reinforced polyethylene sheet, ASTM E 1745, Class C, not less than 7.8 mils thick.

1. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a No. 4 sieve and 10 to 30 percent passing a No. 100 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

F. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulose fiber.

G. Curing Materials:

1. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
2. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf.
3. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
4. Water: Potable.
5. Clear Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.02 CONCRETE MIXES

A. For Concrete Pavement or Curb Adjacent to HES Concrete Pavement Contractor shall defer to mix specified in Section 02751.

B. Comply with ACI 301 requirements for concrete mixtures. Concrete mix shall be early high strength mix with a 12-15-hour cure.

C. Prepare design mixes, proportioned according to ACI 301, for normal-weight concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Compressive Strength (28 Days): 4,000 psi.
2. Slump: 6 inches +/- 2 inches.

a. Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8 inches after adding admixture to plant- or site verified, 2- to 3-inch slump.

D. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 4.5 to 7.5 percent.

1. Air content of trowel-finished interior concrete floors shall not exceed 3.0 percent.

2.03 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with ASTM C 94.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.

C. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

ARTICLE 3 – EXECUTION

3.01 INSTALLATION, GENERAL

A. Formwork: Design, construct, erect, shore, brace, and maintain formwork according to ACI 301.
B. Vapor Retarder: Install, protect, and repair vapor-retarder sheets according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

C. Steel Reinforcement: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

D. Joints: Construct joints true to line with faces perpendicular to surface plane of concrete.

1. Construction Joints: Locate and install so as not to impair strength or appearance of concrete, at locations indicated or as approved by The Engineer.
2. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

a. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

a. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
b. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

E. Tolerances: Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

3.02 CONCRETE PLACEMENT

A. Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

B. Do not add water to concrete during delivery, at Project site, or during placement.

C. Consolidate concrete with mechanical vibrating equipment.

3.03 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Completely remove fins and other projections.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
2. Do not apply rubbed finish to smooth-formed finish.
3. Apply smooth-rubbed finish, defined in ACI 301, to smooth-formed finished concrete.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.04 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on the surface.

1. Do not further disturb surfaces before starting finishing operations.

C. Float Finish: Apply float finish to surfaces to receive trowel finish.

D. Trowel Finish: Apply a hard trowel finish to floor and slab surfaces exposed to view.

E. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

F. Tine Finish: Complete final texturing before the concrete has attained its initial set. Drag the carpet longitudinally along the pavement surface with the carpet contact surface area adjusted to provide a satisfactory coarsely textured surface. Prevent the carpet from getting plugged with grout. Do not perform carpet dragging operations while there is excessive bleed water. A metal-tine texture finish is required unless otherwise shown on the plans. Immediately following the carpet drag, apply a single coat of evaporation retardant at a rate recommended by the manufacturer. Provide the metal-tine finish immediately after the concrete surface has set enough for consistent

tining. Operate the metal-tine device to obtain grooves spaced at 1 in. approximately 3/16 in. deep, with a minimum depth of 1/8 in., and approximately 1/12 in. wide. Do not overlap a previously tined area. Use manual methods for achieving similar results on ramps and other irregular sections of pavements. Repair damage to the edge of the slab and joints immediately after texturing.

3.05 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions occur before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Cure formed and unformed concrete for at least 12 hours.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency (approved by Engineer) to sample materials, perform tests, and submit test reports during concrete placement. Tests will be performed according to ACI 301.

1. Testing Frequency: One composite set of samples for each day's pour of each concrete mix, but less than 25 cu. yd., plus one set for each additional 20 cu. yd. or fraction thereof.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this Section shall not be measured separately for payment.

4.02 Payment

A. No separate payment will be made for the Work in this Section. Payment for the work of this Section shall be incidental to payment of Section 02350 – Drilled Caisson Foundations and Section 05740 – Bollards.

END OF SECTION

SECTION 03305
CAST-IN-PLACE CONCRETE AND CEMENT CONCRETE STRUCTURES

ARTICLE 1 GENERAL

1.01 SUMMARY

A. The Work of this Section shall include furnishing all labor, material, tools, and equipment for cast-in-place concrete construction for various structures. Testing equipment, ACI Certified Concrete Technician and testing documentation are incidental to the work item.

1.02 RELATED SECTIONS

A. Section 02350, Drilled Caisson Foundations

B Section 03211, Reinforcement Bars, Epoxy Coated

F Section 03300, Cast in Place Concrete

G. Section 09894, Protective Coating for Concrete Surfaces

1.03 REFERENCE STANDARDS

A. PennDOT Publication 408

1.04 SUBMITTALS

A. Shop Drawings. Prepare and submit Shop Drawings stamped by a Professional Engineer registered in the Commonwealth of Pennsylvania to the Engineer for review and approval a minimum of 30 days prior to start-up of Work of this Section for reinforcement bars.

B. Concrete Mix Design. For all classes of concrete, submit a concrete mix design in accordance with the Contract Documents and PennDOT 408, Section 704.1(b) to the Engineer for review and approval.

ARTICLE 2 PRODUCTS

2.01 MANUFACTURERS

A. Construction Materials (Various): PennDOT Bulletin 15

B. Aggregate: PennDOT Bulletin 14

C. Ready-Mix Concrete: PennDOT Bulletin 42 and in accordance with Technical Provision 03300.

2.02 MATERIALS

A. Cement Concrete: Per Contract Documents and PennDOT 408, Section 704.1(a) and (b) and as follows:

B. Concrete Curing Material

1. Curing and Protective Covers: PennDOT 408, Section 711.1.
2. Curing Compounds: PennDOT 408, Section 711.2.

C. Forms

1. Temporary: PennDOT 408, Section 1001.2(h)1.

D. Protective Coating: Section 09894.

E. Other Material: PennDOT 408, Section 1001.2(I).

2.03 CONCRETE PLANT AND EQUIPMENT

A. Comply to requirements under PENNDOT 408, Section 704.2.

2.04 MIXES

A. Proportioning and Mixing of Concrete: PennDOT 408, Section 704.1.

2.05 SOURCE OF QUALITY CONTROL

A. Concrete Testing. Provide per Contract Documents and PennDOT 408, Section 704.1(d).

ARTICLE 3 EXECUTION

3.01 CAST-IN-PLACE CONCRETE

A. Construct per Section 03211 and PennDOT 408, Section 1001.3.

B. Application of Protective Coating. Apply protective coating, as applicable, per Section 09894 and PennDOT 408, Section 1019.3.

3.02 FIELD QUALITY CONTROL

A. Field test concrete in accordance with PennDOT 408, Section 704.1(d) and Contract Documents.

ARTICLE 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement will be made for the Work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the Work in this Section. Payment for the Work shall be included in the payment for related portions of the Work. Payment for the work of this Section shall be incidental to payment of Section 02350 –Drilled Caisson Foundations.

END OF SECTION 03305

SECTION 03800
CEMENT CONCRETE

ARTICLE 1 GENERAL

1.01 SUMMARY

A. The Work of this Section shall include furnishing all labor, material, tools, equipment, and incidentals required for placing Class AA and Class A cement concrete, as indicated on the Contract Drawings.

B. Except as noted herein, the Work shall conform to the applicable portions of Section 03305 Cast-in-Place Concrete and Cement Concrete Structures.

1.02 RELATED SECTIONS

A. Section 03211, Reinforcement Bars, Epoxy Coated

B Section 03305, Cast-in-Place Concrete and Cement Concrete Structures

C. Section 05740, Bollards

D. Section 09894, Protective Coating for Concrete Surfaces

1.03 REFERENCES

A. PennDOT Publication 408

ARTICLE 2 PRODUCTS

2.01 MATERIALS

A. Class AA (including Polymer Modified) or Class A.

B. Cement Concrete: Per Contract Documents and PennDOT 408, Section 704.1(a) and (b) and as follows:

ARTICLE 3 EXECUTION

3.01 CAST-IN-PLACE CONCRETE

A. Construct per Section 03211 and PennDOT 408, Section 1001.3.

B. Application of Protective Coating. Apply protective coating, as applicable, per Section 09894 and PennDOT 408, Section 1019.3, except as noted on the Contract Drawings.

ARTICLE 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the Work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the Work of this Section. Payment for the work of this Section shall be incidental to payment of Section 02350 –Drilled Caisson Foundations and Section 05740 - Bollards.

END OF SECTION

SECTION 05740

BOLLARDS

ARTICLE 1 - GENERAL

1.01 SUMMARY

A. The Work of this Section shall include construction of new bollards.

1.02 RELATED SECTIONS

A. Section 03300, - “Cast-in-Place Concrete”.

ARTICLE 2 - PRODUCTS

2.01 GENERAL

A. Fabricate metal bollards from Schedule 40 Steel Pipe.

B. Prime bollards with zinc-rich primer.

C. Coordinate placement of new bollards with the Engineer and as shown on the Contract Drawings.

ARTICLE 3 - EXECUTION

3.01 GENERAL

A. Anchor bollards in place with concrete footings and aggregate as shown on Contract Drawings. Center and align bollards in holes 6 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

B. Fill bollards solidly with concrete, in accordance with Section 03300, mounding the top surface to shed water.

C. Construct in accordance with contract details.

D. Paint steel pipe with safety yellow finish paint.

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this Section shall be measured per Each, acceptably complete in place.

4.02 PAYMENT

A. The Work of this Section will be paid for by the Each Unit Price paid for Bid Item 05740 - Bollards and shall include the cost for Work specified in this Section, related sections and as shown on the Contract Drawings

END OF SECTION 05740

SECTION 09894

PROTECTIVE COATING FOR CONCRETE SURFACES

ARTICLE 1 GENERAL

1.01 SUMMARY

A. The Work of this Section shall include furnishing all labor, materials, tools, and equipment for the application of a protective coating of the specified type on concrete surfaces.

1.02 RELATED SECTIONS

A Section 02350, Drilled Caisson Foundations

B Section 03211, Reinforcement Bars, Epoxy Coated

F Section 03800, Cement Concrete

1.03 REFERENCE STANDARDS

A. PennDOT Publication 408

B. PennDOT Publication 19

C. PennDOT Publication 35, Bulletin 15

1.04 SUBMITTALS

A. Submit materials safety data sheets, manufacturer's technical data, specifications and application instructions for review and approval by the Engineer.

ARTICLE 2 – PRODUCT

2.01 MATERIALS

A. Protective Coating: Clear penetrating, single component, VOC compliant, water-based silane concrete sealer, such as "Enviroseal 40" as manufactured by Harris Specialty Chemicals, Inc., 10245 Centurion Parkway North, Jacksonville, FL 32256, Telephone: 800-327-1570, or 904-996-6281, Mr. Israel Falcon or approved equal.

B. Performance Requirements
   1. Moisture Vapor Transmission Rate: OHD – L – 35.
   2. Water Absorption Test: ASTM C 642-82.
   3. Scaling Resistance Test: ASTM C 672-84.
   4. Percent Active Ingredients: 40% or greater.
   5. VOC content: EPA Method 24.
   6. Flash Point: ASTM D 3278-82.
   7. Water Repellency Test: Alberta Transportation and Utilities Procedure Type 1b; Water Repellent Performance (at 45% relative moisture).
   8. NCHRP 244, Series II – Cube Test: Weight Gain, Absorbed Chloride, Series IV – Southern Climate – Absorbed Chloride.
   9. Resistance to Chloride Ion Penetration: AASHTO T259 and T260.

ARTICLE 3 EXECUTION

3.01 APPLICATION

A. General

   1. Install caulking, patching, joint seals and joint sealants prior to application of sealer.
   2. Thoroughly cure new concrete before application of penetrating sealer; water cure or blanket cure concrete surfaces to receive penetrating sealer; use no curing compounds.
   3. Lightly etch hard steel troweled finished concrete prior to application of sealer.

B. Surface Preparation. Thoroughly dry and clean the surfaces of any dirt, debris, oil, grease, and foreign matter which would prevent protective coating penetration, adhesion, or drying.

C. Application. Apply penetrating sealer in a two coat application to indicated areas and in accordance with the manufacturer's specifications and printed application instructions. Apply to saturation with low pressure spray, or poured, followed by squeegee for even distribution. Apply at a rate of 125 sq. ft. to 200 sq. ft. per gallon.

D. Curing. Leave treated surface undisturbed for a minimum of four (4) hours. Do not allow traffic on surface until treated surface is dry.

E. Apply all exposed surfaces of the following construction or as otherwise indicated in the Contract Documents:

   - Caisson Foundations

ARTICLE 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the Work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the Work of this Section. Payment for the work of this Section shall be incidental to payment of Section 02350 –Drilled Caisson Foundations,

END OF SECTION 09894

SECTION 13570

SIGNAL SYSTEM

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section consists of designing, furnishing, installing, testing and commissioning a complete, safe, reliable, operable and maintainable portion of Authority's Signal System, as described in the Contract Documents and as specified herein.

B. The Work includes all signal and grade crossing warning system, engineering, material, equipment, hardware and software necessary to provide complete, working systems.

C. The Work includes all relay/instrument housings and site preparations, and the permits necessary to install signal and grade crossing warning equipment.

1.02 RELATED SECTIONS

A. Section 01910, "Maintenance and Protection of Traffic."

B. Section 02350, "Drilled Caisson Foundation."

C. Section 13571, "Logic and Signal Circuits."

D. Section 13572, "Grade Crossing Warning System"

E. Section 13574, "Signal Installation."

F. Section 13575, "Wire and Cable."

G. Section 13576, "Relays and Plugboards."

H. Section 13577, "Electrical and Electronic Components."

I. Section 13578, "Housings and Housing Equipment."

J. Section 13579, "Tags, Locks and Keys."

K. Section 13580, "Signal Power Distribution."

L. Section 13581, "Signaling System Test and Inspection."

1.03 REFERENCED STANDARDS

A. American Railway Engineering and Maintenance of Way Association (AREMA) Signal Manual of Recommended Practices.

1.04 GENERAL SYSTEM REQUIREMENTS

A. All equipment supplied shall be of the most modern design and meet the highest standards of industry and all applicable requirements of the AREMA Signal Manual of Recommended Practices.

B. Contractor shall supply all documentation, training, and spare parts, as indicated in the Contract Documents.

C. Signal Engineer: For the entire duration of installation work under this Contract, and for a period of 4 weeks after Final Inspection, the Contractor shall furnish the services of a signal engineer on an "on call" basis to make final adjustments and corrections as may be required during this period. The Contractor's signal engineer shall be approved by the Engineer.

D. Contractor shall support the phased installation and testing of the new systems.

E. Contractor shall become familiar with Authority’s existing LRT System.

F. Contractor is advised that all drawings and exhibits furnished as part of the Contract Documents are provided as illustrations for reference and to convey design concepts only, and are not to be utilized for manufacture of equipment or construction of the Signal System. Contractor shall be responsible for design of the Signal System. Signal system plans shall be sealed by an engineer licensed in the Commonwealth of Pennsylvania.

G. All equipment, materials and products provided under this Contract shall require approval of the Engineer.

H. Contractor shall review the Contract Documents in their entirety to determine their relationship.

I. Contractor shall bear total system responsibility for all Work and for specified additions and changes to Authority systems. Contractor has the responsibility to integrate all elements of the Work to meet overall specification goals.

J. All Contractor provided systems, equipment and services shall perform and be suitable for their intended purpose, be provided in accordance with best commercial practices, and be in compliance with all applicable specification requirements.

K. Contractor shall assume total responsibility for the configuration of equipment, parts, interconnecting wiring, software, and other materials and services furnished. Systems provided by Contractor that do not meet these Specifications shall be modified at Contractor’s expense. Any modifications to approved system designs shall be subject to prior approval by the Engineer.

L. Contractor shall assume total responsibility for the correction of any degradation in the performance of existing Authority systems or equipment, which results from any system or equipment interface installed by Contractor.

M. Although Engineer will review Contractor's system and component configuration and products selected, Contractor retains responsibility to comply with all Contract requirements.

N. During initial service, Contractor, through its Signal Engineer, shall provide technical assistance in troubleshooting, repair and maintenance. Contractor shall observe Authority's maintenance personnel and advise and assist them in providing high quality maintenance.

1.05 SUBMITTALS

A. Section 13571, "Logic and Signal Circuits."

1. Contractor shall submit a nomenclature list based on Contract Drawings to the Engineer for approval. Contractor shall then follow approved nomenclature in the design of logic and circuit drawings.
2. Contractor shall prepare and submit for approval complete circuit and detail drawings showing:
   a. New equipment details and circuit provided.
   b. Modifications to existing signal and crossing equipment and wiring.
3. Contractor shall prepare and submit "As In-service" circuit drawings and documentation that accurately depict actual circuit conditions placed in service.
4. Shop drawings shall be sealed by an engineer licensed in the Commonwealth of Pennsylvania.

B. Section 13572 "Grade Crossing Warning System."

1. Product Data, Shop Drawings, and specifications for all grade crossing equipment. Shop Drawings shall be coordinated with Section 02350 and show anchor bolt locations.
2. Installation and layout drawings for new and modified grade crossing equipment.
3. Shop drawings shall be sealed by an engineer licensed in the Commonwealth of Pennsylvania.

C. Section 13574, "Signal Installation."

1. Installation Plan.
2. Product Data and Specifications for Installation Materials.
3. Drawings showing location and installation details for conduits, cable trough, bonding, and cables.
4. Ground Resistance Measurement Method.
5. Installation Drawings and details for all equipment and materials.

6. Sag and Tension calculations for Aerial Cable.
7. Wire terminal samples.
8. Paint Specifications.

D. Section 13575, “Wire and Cable.”

1. Cable plan showing the locations and functions of all cables to be installed.
2. Results of cable testing.
3. Product Data, Shop Drawings and specifications showing details of fabrication and technical data for each type of cable to be furnished.
4. Shop drawings shall be sealed by an engineer licensed in the Commonwealth of Pennsylvania.

E. Section 13576, “Relays and Plugboards.”

1. Relay Product Data, Shop Drawings and specifications. Drawings shall show contact stacking arrangements and mounting and supporting arrangements for all relay types.
2. Applicable AREMA Office Records Test Form for each vital relay furnished. All information required shall be typed on the form and field verified.
3. Shop drawings shall be sealed by an engineer licensed in the Commonwealth of Pennsylvania.

F. Section 13577, “Electrical and Electronic Components.”

1. Product Data, Shop Drawings and specifications for:

    a. Transformers.
    b. Printed circuit cards.
    c. Printed circuit card connectors.
    d. Lightning arrestors and suppressors.

G. Section 13578, Housings and Housing Equipment.”

1. Product Data, Shop Drawings and specifications for all case, case equipment and components.

H. Section 13579, “Tags, Locks and Keys.”

1. Product Data, Shop Drawings and specifications for all tags, locks, and keys shall be submitted.
2. Contractor shall submit a sample of each type of tag, lock, and key for review and approval of the Engineer.
3. Contractor shall submit method of equipment identification coding.

I. Section 13580, “Signal Power Distribution.”

1. Calculations of the AC and DC power requirements for each signal

equipment location and grade crossing warning system location.
2. Product Data, Shop Drawings and specifications for all signal power components.

J. Section 13581, “Signaling System Test and Inspection.”

1. Inspection and Test Plan.
2. Factory Inspection and Test Procedures.
3. Field Inspection and Test Procedures.
4. Test Reports.

1.06 DESCRIPTION OF WORK

A. This Section presents an outline of the signaling work to be performed under this Contract. It does not supersede requirements detailed elsewhere.

B. AC power distribution changes:

1. Contractor shall provide power calculations analyzing the existing AC power feed to the existing crossing case.
2. If the existing AC power feed is not adequate for the new equipment, the contractor shall replace it with a new properly sized equipment and power feed.

C. Wayside equipment changes by Contractor:

1. Crossing equipment changes are outlined in the Contract drawings.

a. A new signal house shall be added for the new gate/flasher control equipment. It will be constructed along the inbound track as shown in the Contract Drawings.
b. Existing flashing light assemblies shall be removed.
c. Two road crossing gates with flashing light units shall be added as shown in the Contract Drawings.
d. Two pedestrian gates with flashing light units shall be added as shown in the Contract Drawings.
e. New cables to the gates and flasher units shall be provided by the contractor. These cables shall be installed in underground conduit provided and installed by the Contractor.
f. A gate control pushbutton box shall be provided to raise / lower the gates for testing or overriding failed approach circuits.
g. Two DO NO STOP ON TRACKS signs shall be added at the locations shown in the Contract Drawings.
h. A NO RIGHT TURN blankout sign shall be added at the location shown in the Contract Drawings.
i. Two Motorman’s Indicator lights (MMI) shall be added as the locations shown in the Contract Drawings.

2. Battery backup power for the Grade Crossing Warning System including new and existing AFO track circuits shall be provided.

D. Grade Crossing Warning Systems Equipment

1. Contractor shall install new and modify the existing Grade Crossing Warning System according to the layouts and equipment locations shown on the Contract Drawings and as specified in Section 13572, “Grade Crossing Warning System.”

E. After the changes have been put into service, the Contractor shall remove the crossing and signal equipment not required. This equipment shall be removed with care and delivered to Authority in as-found condition as directed by the Engineer.

1.07 EXISTING CONDITIONS

A. The information presented in this Section shall be used by Contractor to familiarize itself with the type of service that Authority currently provides and the type of service Authority anticipates providing in the future. Contractor shall verify this information as needed to accomplish its work.

B. The rails are continuous welded rail, with the occasional bolted joint found in or near special track work.

C. The light rail portion of Authority’s transit system is a 26.2 mile system operating in and around Pittsburgh, Pennsylvania. It operates through tunnels and at-grade and operates within dedicated right of ways with a dedicated signal system. It also operates on the street with automobile traffic with traffic signals directing movement.

D. The LRV fleet consists of eighty-three (83) LRVs: 28 built by CAF between 2001 and 2005; and 55 SD-400 LRVs built by Siemens and rebuilt by CAF with delivery in 2005 through 2008.

E. The LRVs are propelled by electric traction motors. Electric traction power is supplied to the LRV through the Overhead Contact System (OCS) at a nominal 650 V DC. A contact wire is installed over each running track, under which a pantograph collector on each LRV maintains contact. Both running rails of the track are used as negative return conductors, except at crossovers or other locations as noted within this Section.

ARTICLE 2 - PRODUCTS

2.01 GRADE CROSSING EQUIPMENT

A. Contractor shall provide grade crossing equipment as specified in Section 13572, “Grade Crossing Warning System.”

B. Contractor shall provide an additional Solid-State Crossing Controller and additional sets of cross arms as indicated in Section 13572 as a spare part. It

shall be new and packaged adequately for shipment and long term storage.

2.02 INSTALLATION MATERIAL

A. Contractor shall provide installation material as specified in Section 13574, “Signal Installation.”

2.03 WIRE AND CABLE

A. Contractor shall provide wire and cable as specified in Section 13575, “Wire and Cable.”

2.04 RELAY AND PLUGBOARDS

A. Contractor shall provide relays and plugboard as specified in Section 13576, “Relay and Plugboards.”

2.05 ELECTRICAL AND ELECTRONIC COMPONENTS

A. Contractor shall provide electrical and electronic components as specified in Section 13577, “Electrical and Electronic Components.”

2.06 HOUSINGS AND HOUSING EQUIPMENT

A. Contractor shall provide housing and housing equipment as specified in Section 13578, “Housing and Housing Equipment.”

2.07 TAGS, LOCKS, AND KEYS

A. Contractor shall provide tags, locks, and keys as specified in Section 13579, “Tags, Locks, and Keys.”

2.08 POWER SUPPLIES AND POWER DISTRIBUTION EQUIPMENT

A. Contractor shall provide power supplies and power distribution equipment as specified in Section 13580, “Signal Power Distribution.”

ARTICLE 3 - EXECUTION

3.01 DESIGN REQUIREMENTS

A. Contractor shall design new crossing / signal circuits and modify existing circuits as specified in Section 13571, “Logic and Signal Circuits.”

3.02 INSTALLATION

A. Contractor shall install crossing / signal equipment and material as specified in Section 13574, “Signal Installation.”

B. Contractor shall comply with the requirements of Section 01910, “Maintenance and Protection of Traffic” while installing the signal equipment and material.

C. Installation shall not inhibit or impact existing operations.

D. Contractor shall manage and coordinate its installation schedule to minimize delays to other Contractors. Any deviations shall promptly be brought to the attention of the Engineer.

E. Exterior Cable: Contractor shall furnish and install all cables and interconnect wiring. These requirements are detailed in Section 13575, “Wire and Cable.”

1. Cables to gates and flashers shall be underground as shown in the Contract Drawings with conduits under the roadway or tracks.
2. For other cables, Contractor may to use the existing messenger wire and hardware for aerial cable on the existing catenary poles. Contractor shall field verify the messenger and submit calculations to the Engineer confirming that the existing messenger is adequate. Otherwise, Contractor shall furnish and install new messenger.
3. Spare conductors shall be provided as specified in Section 13575, “Wire and Cable”.

F. Conduit: Contractor shall furnish and install conduits and associated hardware required for cable installation.

1. For the existing catenary poles, Contractor shall furnish and install conduits from the top of the catenary poles to ground equipment as required.
2. All conduits shall be furnished and installed by Contractor.

G. Contractor shall design, furnish, and install the connections between conduit, cable trough, and pullboxes/manholes that are required for signal cables. Contractor shall review the Reference Drawings to determine types and quantities. The requirements for these connections are detailed in Section 13574, “Signal Installation.”

3.03 TESTING AND INSPECTION

A. Contractor shall perform tests and inspections as specified Section 13581, “Signaling System Test and Inspection.”

B. Contractor shall test and inspect the grade crossing system as specified Section 13572, “Grade Crossing Warning System.”

ARTICLE 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for this section.

4.02 PAYMENT

A. No separate payment will be made for the work of this section. Payment for this work shall be incidental to the payment for Section 13572 – Grade Crossing Warning System.

END OF SECTION

SECTION 13571

LOGIC AND SIGNAL CIRCUITS

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section consists of designing the following train control logic and signal circuits and logic as described in the Contract Documents and as specified herein.

1. General requirements.
2. Signal clearing.
3. Signal lighting.
4. Traffic.
5. Line circuit logic.
6. Repeaters.
7. Grade crossing.
8. Other circuits.

1.02 RELATED SECTIONS

A. See Section 13570, “Signal System,” 1.02, “Related Section” for the list of other related specification sections.

1.03 REFERENCED STANDARDS

A. American Railway Engineering and Maintenance of Way Association (AREMA) Signal Manual of Recommended Practices.

1.04 SUBMITTALS

A. See Section 13570, “Signal System,” 1.05, “Submittals” for the list of submittals required for this Section.

ARTICLE 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Vital circuits shall be of fail-safe design, based on closed loop circuit principles, and meet AREMA requirements for use of vital relays.

B. Vital logic shall be implemented using vital plug-in relays.

C. Contractor shall provide Circuit Books as follows:

1. Draw conventional circuits and logic in accordance with samples in the Contract Drawings, with sufficient information to reflect the actual wiring of each circuit and location of each component.
2. Each wire connecting from point to point shall have a unique nomenclature. Nomenclature shall be assigned based on circuit function.
3. When the circuit is wired from point to point, the nomenclature shall remain the same if the function remains the same. Numerically stepped prefixes or suffixes shall not be used.
4. Each component or terminal shall have a unique location code.
5. The circuit book shall have drawings which contain a listing of the relays used, the sheet number where each relay is located, which contacts are used and which are spare for each relay, and the sheet number where each used contact is located.
6. The circuit book shall also have drawings which depict rack and sideboard layouts showing component arrangement and location, multiconductor connectors showing used and spare pin connectors with all used pin connectors marked with the page number of the drawing on which the pin connectors can be found.
7. Each relay and relay contact shall have a coordinate designation, which corresponds to its location on the rack or mounting bars.
8. Arrange drawings for easy reading – not crowded or cluttered. Show circuits with a minimum of crossed or offset lines.
9. Define nomenclature and symbols on a separate drawing or drawings. Use nomenclature and symbols as shown in Contract Drawings.

D. In addition to relays required for specific application by these Specifications, repeater relays and other necessary relays shall be supplied as needed to meet all system performance requirements.

E. All vital circuits that energize a relay located outside of a relay/instrument house or case and all circuits which energize a vital relay located inside a house or case but which contain contacts outside of the house or case, shall be two-wire double break circuits, energized from an ungrounded DC power supply.

1. Adjacent houses and/or cases interconnected by a vandal proof, weathertight enclosure above ground shall be considered as one house or case.
2. The cable way between these houses and/or cases shall be limited to 50 percent fill limit.
3. Vital circuits that do not go outside of the house or case may be positive energy, single-break circuits.

F. Failure Modes: The failure of any circuit element shall not cause unsafe conditions. Equipment and vital circuits shall not contain unmitigated hazards identifiable in a safety analysis per AREMA Part 17.3.3.

G. Circuits controlled by the prime relay and its repeaters shall be coordinated so that unsafe or undesirable conditions do not occur if any combination of repeater relays fails to energize.

H. Contractor shall provide surge suppressors, lightning arrestors for track circuits, power supplies, battery chargers, audio frequency transmitters and receivers and electronic circuit equipment to protect against damage caused by lightning and electrical transients.

1. Protection shall be provided on primary, secondary and tertiary levels.
2. Arrestors shall be series high voltage arrestors, shunt low voltage arrestors, and AC line arrestors or combination as required.
3. Arrestors used in vital circuits shall be self-clearing, except as otherwise specified.

2.02 LINE CIRCUIT LOGIC

A. Line circuit logic shall be provided to pass information from one location to the next. Line circuits may be dedicated, traffic reversed, or as necessary to provide complete information.

2.03 REPEATER CIRCUITS

A. Repeater circuits shall be series repeaters with the last repeater in the proper circuits to avoid unsafe conditions if a relay fails to energize. Use of larger vital relays to avoid repeater relays shall be permitted.

2.04 GRADE CROSSING WARNING ACTIVATION LOGIC

A. The typical logic required for grade crossings is shown on Contract Drawings. Contractor shall provide equipment and circuits for the control and shall finalize approach locations shown on the Control Line diagrams.

2.05 OTHER CIRCUITS

A. Other circuits shall be as shown on the Contract Drawings. Additional circuits necessary to meet system requirements and Contractor's specific design requirements shall be designed and implemented by Contractor as required.

ARTICLE 3 – EXECUTION

3.01 INSTALLATION

A. Contractor shall install all circuits in relay/instrument houses or cases. Similar and related circuits shall be grouped together.

3.02 TESTING

A. All circuits shall be tested as specified in Section 13581, “Signal System Test and Inspection.”

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the work of this Section. Payment for this work shall be incidental to the payment for Section 13572 – Grade Crossing Warning System.

END OF SECTION

SECTION 13572

GRADE CROSSING WARNING SYSTEM

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section consists of designing, furnishing, installing, testing and commissioning Grade Crossing Warning Systems at street intersections as described in the Contract Documents and as specified herein.

B. These systems shall include, but are not limited to, flashing lights, crossing gates, bells, motorman indicators, signs, approach track circuits, cabling, equipment cases, equipment foundations, crossing logic and associated materials, lightning/surge protection equipment, equipment appurtenances and subsystems as required for a complete installation.

C. The Work of this section also includes procurement and delivery of spare cross arms and a spare controller to PRT.

1.02 RELATED SECTIONS

A. See Section 13570, “Signal System,” 1.02, “Related Section” for the list of other related specification sections.

1.03 REFERENCED STANDARDS

A. American Railway Engineering and Maintenance of Way Association (AREMA) Signal Manual of Recommended Practices.

B. Manual on Uniform Traffic Control Devices (MUTCD) Standards.

1.04 FUNCTIONAL DESIGN REQUIREMENTS

A. Grade crossing warning equipment shall meet the requirements established by AREMA Part 3.1.15, “Recommended Functional/Operating Guidelines for Control of Automatic Highway-Rail Grade Crossing Warning Systems” and Part 3.3.1, “Recommended Instructions for the Maintenance and Test of Automatic Highway Rail Grade Crossing Warning Systems” except where these instructions and requisites conflict with the Contract Documents.

B. Grade crossing warning systems shall also be designed to meet the requirements of the Manual of Uniform Traffic Control Devices where applicable.

C. These systems shall also meet the same requirements and standards as other parts of the existing Signal System unless specified otherwise.

D. Contractor shall provide the equipment required to add crossing gates to the SR 88 grade crossing and modify the existing signal and grade crossing circuits and equipment for this addition.

E. Contractor shall modify the control of the existing crossing, replacing the existing control case. Contractor shall remove all existing equipment and cases not used for the modified crossing.

F. Approach circuits for grade crossing warning shall be designed as shown on the Contract Drawings. Contractor shall be responsible for incorporating necessary changes in the design to provide the warning times as specified.

G. The directional stick circuit shall not re-energize after any power off, or combination of power off situations occur, such as a power on at the crossing with a failure at the house containing the crossing logic.

H. The crossing start circuits shall allow for an added 10 second interval before the normal activation that shall prevent the crossing gates from partially raising and then lowing again. During this interval, the crossing will not activate, but if activated, it will remain activated.

I. A bell shall sound when lights begin flashing and continue to sound until the gate arm has descended to within ten degrees of horizontal position. Bells shall be silent when gates are rising.

J. The gates shall function as follows:

1. Gate arms shall begin to descend not less than 3 seconds or more than 5 seconds after signal lights begin to flash, and reach the horizontal position before the arrival of the train and remain in that position as long as a train occupies the crossing. Gate shall reach the horizontal position in not less than 10 seconds or more than 15 seconds after initial motion begins.
2. Gate arms shall begin to rise to their vertical position when the train has cleared the crossing with no other approaching train in the approach circuits, and reach the vertical position in not more than 8 seconds.

K. Approach locations for grade crossings are shown on the control line diagrams. Final locations shall be determined by Contractor based on Authority operating speeds and operating characteristics of proposed equipment. These locations shall be subject to approval by the Engineer.

1.05 SUBMITTALS

A. See Section 13570, “Signal System,” 1.05, “Submittals” for the list of submittals required for this Section.

ARTICLE 2 – PRODUCTS

2.01 GENERAL

A. Grade crossing equipment shall follow the recommendations of the AREMA Signal Manual, except as otherwise specified herein.

B. Contractor shall provide equipment housings as specified in Section 13578, "Housings and Housing Equipment." Housings for equipment at the crossings shall be equipped with a power off indication light unit protected by a plastic lens and wire cage, mounted on side of housing, observable by rail and road traffic and preferably above the pushbutton box.

C. All equipment for crossing warning devices (flashing light units, masts, bells, signs, bases, gate mechanisms) shall be of aluminum fabrication as specified herein, with stainless steel mounting hardware.

2.02 APPROACH TRACK CIRCUITS

A. Audio frequency track circuits shall be used for crossing approach circuits.

B. The contractor may relocate the existing AF track circuit equipment if contract and operational requirements are met.

C. Track circuits shall be designed to detect occupancy throughout the length of the circuit. Shunting sensitivity shall be 0.2-ohm impedance at the receiving end of the circuit with a rail-to-rail leakage impedance of 3 ohms minimum per 1000 feet of track at the operating frequency.

D. At West Library station on the inbound track, a short pre-shunt distance is required on the island track circuit to prevent crossing activation while an LRV is dwelling at the station while allowing an activation when the LRV moves forward but before the road crossing is fouled. Track circuits shall be modified or replaced to provide this operation.

2.03 GATES, FLASHING LIGHTS AND BELL

A. Contractor shall furnish mast mounted flashing light signals. The flashing light signal layout shall be equipped with standard railroad crossing signs as specified in Article 2.05 A and bells as specified in this Section.

1. Flashing light signals shall be in accordance with these Specifications and also conform to AREMA Signal Manual, Part 3.2.35.
2. Each signal unit shall be fabricated of cast aluminum. The unit shall be equipped with a door with front access, hinged at one side with a

weatherproof seal. A ventilator opening shall be provided at the bottom of the housing and covered with brass, or copper, wire screen. A sidelight shall be provided on both sides of the lamp housing complete with gasket, lens, and retainer.

B. Roundels shall be 12 inches diameter, high impact plastic material, weatherproof, resist cracking, shattering and vandalism.

C. Signals shall be equipped with an aluminum hood and a 24 inches aluminum background. Hood and background shall be finished with flat black enamel applied over suitable primer. Plastic hoods and backgrounds are not acceptable.

D. Flashing light signals shall consist of 12-inch LED light units. powered with 10 VDC.

E. Masts: The ground-mounted mast for supporting a gate mechanism shall be 5 inches in diameter, fabricated of aluminum, complete with a bell and cast aluminum split base junction box. Junction boxes shall be provided with AREMA terminals, gaskets, and provisions for padlocking. A minimum of 2 spare terminals shall be provided. Masts shall be anchored to Caisson foundations per Section 02350. Contractor shall coordinate submittals to include Anchor bolt locations.

F. Bells: Bells shall be solid state with adjustable impulse rate and volume in a weatherproof housing. The housing shall be fabricated of cast aluminum. Bell shall conform to AREMA Signal Manual, Part 3.2.60. Normal operating voltage shall be 10 volts DC. The bell shall be Western-Cullen-Hayes model 0777-CFR-S (Soft Tone 75 db Max) or approved equal. Contractor shall mount bell on top of mast as indicated in the Contract Drawing.

G. Crossarms: Crossarms for flashing light units shall be fabricated in accordance with AREMA Drawing, Part 3.2.50, as approved by the Engineer.

2.04 CROSSING GATES

A. Gates mechanisms shall be Ansaldo Model 95 or approved equal. It shall include mechanism, arms, counter-weights, lights, wiring and all accessories necessary for a complete system. Unless indicated otherwise, crossing gates shall be mounted on the same mast with flashing light signals.

1. Gate mechanism shall be of the powered-up type. Contractor shall include pivot clamps with hardware to allow gate mechanism to be turned so gate arm installation can be done off the roadway.
2. Gate mechanism shall be factory wired to include thermal protection in the motor control circuit.
3. Gate mechanism shall be powered by a DC motor.
4. Gate mechanism shall be weatherproof lightweight cast aluminum housing and cover.

5. Gates shall have a power down to 60 or 45 degree feature. Torque of the arm shall be designed so the arm will descend from vertical to the horizontal position by gravity in absence of power for motor drive down.

B. Gate arms shall be lightweight fiberglass with arm lamp units firmly attached. Wiring for lamp units shall be equipped with plug connector for coupling to its mate on the mechanism.

C. Grade crossing gate arms shall consist of telescoping sections and shall be adjustable to extend to within 12 inches of the centerline of the roadway or walkway.

D. Highway gate arm shall be equipped with 3 red light units arranged to shine in both directions along the highway. Lights shall operate at all times when gate is in position to obstruct highway traffic. The light nearest the tip end of the arm shall burn steadily. The other lights shall flash alternately in unison with the flashing light signals.

E. Gate arms shall be of the breakaway type equipped with shear pins. Striping shall be high intensity reflective red and white, and comply with AREMA Signal Manual, Part 3.2.25 and 3.2.26.

F. Gate arm brackets shall be provided for all crossing gate layouts. Brackets shall hold gate arms stationary when in the vertical position and provide a minimum clearance of 24 inches from overhead wire and cable.

G. Contractor shall provide PRT with 2 spare cross arms per gate. Spares shall be delivered to PRT at location directed by Way Department.

2.05 SIGNS

A. The following signs and mounting hardware shall be provided and installed by Contractor at each crossing location:

1. “Number of tracks” sign.
2. “Railroad crossing” crossbuck sign.
3. “Stop on red signal” sign.

B. Signs shall be of alloy aluminum fabrication with reflecting material attached permanently to the sign face to make the sign visible day or night. All signs shall have black images on white background except “stop on red signal” signs which shall be white images on black background.

C. Extension brackets shall be provided for mounting signs on gate masts.

2.06 MOTORMAN INDICATORS

A. The existing Motorman indicators will be replaced.

B. Contractor shall install new cables and circuits to provide the modified operation described below.

C. Indicator shall provide a positive check on actual status of the crossing gate mechanism with the following aspects:

1. Unlit (no light): No gate actuation.
2. Flashing white: Gate activated but not horizontal.
3. Solid white: Gate activated and horizontal (between 83 degrees to 90 degrees).

D. The indicator shall be located so the motorman is able to observe the white aspect a minimum of 500 feet before entering the crossing.

2.07 SOLID STATE CROSSING CONTROLLER

A. Control of the flashing light signals, bells and gates shall be performed by a solid state crossing controller capable of operating the number of flashing lights and gates as shown on the Contract Drawings.

B. The solid state crossing controller shall incorporate internal components to perform self-diagnostics and indicate system failures.

C. The solid state crossing controller shall be Siemens Solid-State Crossing Controller IIIA (SSCC IIIA) or approved equal.

D. The contractor shall provide to PRT a spare controller.

2.08 POWER SUPPLIES AND BATTERIES

A. The requirements for power supplies and batteries are detailed in Section 13580, “Signal Power Distribution”.

2.09 FOUNDATIONS

A. Foundations for flashing light signals, gate mechanisms, motorman indicators and equipment houses and cases shall be pre-cast concrete meeting the requirements of AREMA Signal Manual, Parts 14.4., where applicable or in accordance with Contract Drawings and Section 02350.

B. Foundations shall be modular assemblies equipped with anchor bolts sized per manufacturer recommendations and openings for cable passage where applicable.

C. Traffic signal support foundations for the motorman and blank-out sign locations to be in accordance with PennDOT Publication 408, Section 951 and PennDOT Publication 148 (Traffic Standard Drawings - Signals) TC-8801 Sheets 3-5 of 10 and TC-8804 Sheets 1-2 of 2.

2.10 PUSH BUTTON BOXES

A. Push button boxes shall be provided for each crossing with gates. Push button boxes shall be Siemens Model No. B092607 or approved equal. One lockable weatherproof box fastened to the exterior of the instrument housing for each crossing shall be installed. Each box shall contain 2 push buttons (RAISE and LOWER) for each track and a test switch. These controls shall be clearly labeled as to their functions. Boxes shall be cast iron or cast aluminum and not require any special tool to open. Contractor shall provide lockable hasp and lock for the box. Locks shall be keyed as specified in Section 13579, “Tags, Locks and Keys.” Push button circuitry shall be designed to raise and lower the gates in event of approach track circuit occupancy.

ARTICLE 3 – EXECUTION

3.01 GRADE CROSSING WARNING SYSTEM INSTALLATION

A. Installation shall follow AREMA Signal Manual recommendations and be in accordance with the requirements of the Manual of Uniform Traffic Control Devices and local authorities.

B. Contractor shall install Grade Crossing Warning Systems in such a manner that no part of the system projects into the vehicle clearance envelope, catenary structures or local utility equipment.

C. The pushbutton box described in Article 2.10 shall be located on the equipment housing facing the street at a height not exceeding 5 feet.

D. Cables under tracks or roadways shall be provided and installed by Contractor in conduits at the minimum depth as shown on Contract Drawings. Contractor shall provide the conduit required. Conduit shall meet the requirements of Section 13574, “Signal Installation.”

E. Contractor shall install flashing lights and gates at least 12 feet from the near rail, to the right of the highway on the approach to tracks unless otherwise marked on plans.

F. Contractor shall mount bell as indicated in the Contract Drawings.

G. Contractor shall provide and install additional flashing light units on gate or cantilever masts to provide warning to traffic coming from such roads toward the crossing. These locations are shown in the Contract Drawings. Requirements shall be in accordance with MUTCD and AREMA Standards.

H. Contractor shall restore street and sidewalk pavement and landscaping to original condition following installation of Grade Crossing Warning System equipment.

I. Existing grade crossings shall remain operational during installation or Contractor must arrange flag protection.

3.02 FIELD TEST AND INSPECTION

A. General:

The following shall be performed:

1. Verify function of all manual test switches, cutout pushbuttons, and starting pushbuttons.
2. Verify the instrument case, flasher, and gate equipment is properly installed, grounded, clean, and lubricated.
3. Wiring resistance between crossing gate mechanism and battery terminals shall not exceed 0.1 ohm or as approved by the Engineer.

B. Flashing Lights:

Tests and inspections shall be performed to verify:

1. Individual light units are arranged to shine in both directions along the highway, are mounted horizontally 30 inches on center, and centers of the lenses are not less than 100 inches above the surface of the highway.
2. Lamps flash alternately with a 50 percent duty cycles each, between 40 and 55 flashes per minute per lamp.
3. Lamp voltage is set in accordance with manufacturer's specifications.
4. With flashers operating, each flasher is aligned to provide unobstructed viewing with maximum visibility (focused) at a distance of 500 feet and adequate visibility up to a distance of 1000 feet.
5. Bell operates at the same time flashing lights are activated.

C. Crossing Gates:

Tests and inspections shall be performed to verify:

1. Each gate arm is equipped with 3 red light units arranged to shine in both directions along the highway.
2. Gate arm, when in vertical position does not obstruct highway traffic.
3. Gates start to descend in not less than 3 seconds or more than 5 seconds after flashing light signals are activated.
4. Gates reach horizontal position in not less than 10 seconds or more than 15 seconds after initial motion begins.
5. Maximum time to reach horizontal position does not exceed 20 seconds from the time flashing lights are first activated.
6. Gates reach vertical position in not more than 8 seconds.
7. Torque with gate in the horizontal position is not less than 50 foot-pounds. Torque with gate in the vertical position is not less than 175 foot-pounds for arm lengths up to 25 feet and increasing linearly to 360 foot-pounds for 38 feet arms.

8. There is no oil, grease or dirt on the armature or pole faces of the hold- clear magnet.
9. Circuit controller contacts are clean and properly adjusted.
10. Gate arms do not droop more than 25 mm (1 inch), or as approved by the Engineer, below horizontal when down, and gate arm and counterbalance do not strike any object during any portion of their travel or when in the vertical position.
11. Flashing lights are activated at all times except when gates are locked in the vertical position. Bell sounds when lights begin flashing and continues to sound until the gate arm has descended to within ten degrees of the horizontal position.
12. When the gate arm is physically prevented from moving while being raised or lowered or when in any fixed position, gate operating mechanism will stop without damage to the mechanism or motor.

D. Motorman Indicators:

Tests and inspections shall be performed to verify that:

1. Indicator is dark before the crossing is activated.
2. When the gate begins to move downward after the crossing warning system is activated, indicator starts flashing and continues flashing until the gate arm has reached the 5-degree from horizontal position.
3. When the gate arm reaches 5 degrees from horizontal position, the indicator stops flashing and displays a steady indication.
4. Indicator is dark when the crossing warning system is deactivated and gate arms begin to move upward to the vertical position.

3.03 OPERATIONAL TESTS

A. After Contractor has completed installation tests and verified system operation within the local limits of Work, the following tests shall be performed, at a minimum.

1. Verify proper operation of the Grade Crossing Warning System for trains operating in both normal and reverse directions:

a. Operate a test train through the crossing at maximum authorized speed.
b. Test the grade crossing and confirm that the crossing warning system functions as intended during the highway signal preemption time.
c. Inch forward a test train slowly, stop the train just as the crossing gate begins to rise, and note the rear axle position. The rearmost train axle shall not be more than 5 feet beyond the island track

circuit cable connections when the gates begin to clear. Repeat for both tracks in both directions.

d. Operate a test train through the crossing and stop the vehicle completely on the leaving approach track circuit. Crossing warning system shall reset to normal. Verify a following train entering or occupying the approach track circuit to the crossing, shall initiate flashing lights, bell and gate operation. Repeat for both tracks in both directions.

e. Verify proper train control protection is provided should a failed crossing approach track circuit cause the crossing protection system to be inoperative.

f. Verify proper train control protection is provided when crossing gate cutout and test switches are used.

g. Where extended approaches are provided, their proper operation shall be verified.

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. The Work of this section shall be measured as a lump sum unit, acceptably performed.

4.02 PAYMENT

A. Payment for the Work of this section shall be made in accordance with the lump sum price of Item 13572 – Grade Crossing Warning System.

END OF SECTION

SECTION 13574

SIGNAL INSTALLATION

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section consists of installing Signal System equipment and material as described in the Contract Documents and as specified herein.

1.02 RELATED SECTIONS

A. See Section 13570, “Signal System,” 1.02, “Related Section” for the list of other related specification sections.

1.03 REFERENCED STANDARDS

A. American Railway Engineering and Maintenance of Way Association (AREMA) Signal Manual, and the Engineering and Mechanical Division Electrical Manual of Recommended Practices.

B. American Society for Testing and Materials (ASTM) Standard A475.

C. Military Specification MIL 1-7798A.

D. National Electrical Manufacturers Association (NEMA) Standards TC2 and TC3.

E. Underwriters Laboratories (UL) Standard 514.

1.04 SUBMITTALS

A. See Section 13570, “Signal System,” 1.05, “Submittals” for the list of submittals required for this Section.

ARTICLE 2 – PRODUCTS

2.01 MESSENGER WIRE FOR AERIAL CABLE

A. Contractor shall provide messenger wire for installation of the aerial cable. It shall be zinc-coated wire conforming to American Society for Testing and Material (ASTM) Standard A475, Utilities grade strand, Class A coating.

B. Messenger wire shall be sized to support 125% of the calculated cable load.

2.02 CONDUIT

A. Contractor shall provide Schedule 80 PVC conduit for burial applications where its use is appropriate.

1. Conduit, couplings, elbows, bends, and nipples shall meet NEMA Standards TC2 and TC3 and be UL listed.
2. Conduit shall be suitable for direct burial, concrete encasement, use on pole riser or bridge applications.

2.03 LIQUID-TIGHT FLEXIBLE METALLIC-CONDUIT AND FITTINGS

A. Contractor shall furnish conduit consisting of a core of flexible galvanized steel with an extruded liquid-tight neoprene jacket overall. Use where applicable, such as switch machines to junction boxes.

B. Contractor shall furnish conduits of 1.25 inches diameter and smaller with a continuous copper bonding conductor spiral wound between the convolutions.

C. Contractor shall provide fittings that are cadmium or zinc-coated and meet the requirements of UL Standard 514.

2.04 TAPE

A. Rubber Tape

1. Field-applied rubber tape, furnished and applied by Contractor, shall be “Okonite” of Okonite Company manufacture, or approved equal.

B. Friction Tape

1. Field-applied friction tape, furnished and applied by Contractor, shall be 20 mm (0.75 inches) wide, shall meet Military Specification MIL 1-7798A, be overlapped at least 1/4 of its width, and be given a coating of insulating paint.

ARTICLE 3 – EXECUTION

3.01 GENERAL

A. Contractor shall cover all holes, trenches and excavations when they are not attended. Dimension lumber, planking and plywood shall be used for cover. Tape or other barrier shall not be acceptable for protection.

B. Contractor shall maintain clean ballast at all times. Contractor shall correct all ballast contamination due to its work as part of this Contract.

C. Contractor shall excavate for installation of foundations and conduit.

1. Use a protective covering over track ballast to prevent contamination during excavation and backfill operations. Remove any contaminated ballast and restore the ballast to original condition.
2. Excavate to an appropriate depth and prior to installation of the foundation, place a 6 inch minimum layer of 1.5 inches maximum washed

gravel in the bottom of the hole.

3. Remove soft or unsuitable material existing below the required subgrade and replace with compacted gravel. Remove rock or boulders below the subgrade to a minimum depth of 12 inches below bottom of the foundation.

D. All signal and power bonds necessary to meet all functional requirements of the Contract shall be provided and installed.

E. Where it is necessary to cut away portions of ties or timbers to accommodate signal equipment, Contractor shall thoroughly coat the cut surfaces with creosote.

F. Unless otherwise specified, all hangers, brackets, clamps, bolts, nuts, or washers shall be hot-dip galvanized. The zinc coating per ASTM A475 shall be of commercially pure zinc and shall be continuous and thorough with at least 2 ounces of zinc per 1 square foot of galvanized surface. Plating shall not scale, blister, or be removed by any process of handling during installation. All material shall be cut, formed, or drilled prior to plating.

G. Equipment shall not be mounted on station platforms unless otherwise specified or approved by the Engineer.

H. Final conduit locations shall be determined by Contractor for approval by the Engineer for all wayside track installations including impedance bonds, track circuit cables, track switch machines, power cables, and wayside signal control cables.

I. All painting shall be performed prior to installation. Any painted areas damaged during shipment or installation shall be repainted with matching colors.

J. Precast concrete foundations for wayside signal equipment shall be in accordance with AREMA Signal Manual, Part 14.4. In special situations proposed by Contractor and approved by the Engineer, cast-in-place foundations and reinforcement bars as specified in Sections 03211, “Reinforcement Bars,” and 03305, “Cast-in-Place Concrete and Cement Concrete Structures,” shall be provided.

K. Service loops shall be provided in all cable and wire terminations.

3.02 COORDINATION OF THE WORK WITH AUTHORITY OPERATIONS

A. Part of the Work under this Contract is to be performed on Authority’s operating LRT system. All Work in these areas shall be scheduled with the approval of the Engineer to minimize disruption of train traffic. Contractor may be required to attend the Operations Track Allocation Meetings.

B. Contractor shall be permitted access to operating portions of the system on a prearranged basis. Access requests shall be submitted in writing, with at least two weeks’ notice, to the Engineer.

C. Any installation or testing which affects existing train operations shall be done

during the hours specified by the Engineer and must be completed in sufficient time to allow for normal train service. It shall be Contractor's responsibility to supply sufficient competent employees and reserves to ensure restoration of scheduled service within the allotted time. Contractor shall furnish all equipment such as, but not limited to flags, safety vests, flares, phones, and radios.

D. Contractor shall submit an installation, testing and cutover sequence plan for all areas of new construction, which affect existing train operations. The plan shall be submitted at least 60 days prior to commencing any field installation work, and shall include, at a minimum, the following:

1. Narrative descriptions and schematics to maintain existing train operations.
2. Narrative descriptions and schematics for temporary or interim circuits and materials.
3. Narrative descriptions and schematics for final circuits and materials.
4. Description of the crew size and equipment to be used.
5. Descriptions for the implementation and sequencing of all required tests.

3.03 CONDUIT

A. Contractor shall provide and install any conduit required to route cables. Contractor shall repair any damage or disruption to existing subballast, geotextile material, or ballast caused by its installation of conduit, using the same type of materials as existing, or equal approved by Engineer.

B. Buried conduits shall be encased in sand. Backfill shall cover the sand and a geogrid fiber shall be placed between the backfill and subballast.

3.04 GROUNDING

A. General

1. Ground connection to the track rails or use of the neutral conductors of the local power utility company or AC signal supply system shall not be permitted.
2. Contractor shall submit the method of measuring ground resistance to the Engineer for review and approval.

B. Ground Rods

1. Where instrument cases and signal houses are located in an area where the track is on ballast, Contractor shall furnish and install 0.75 inch copper covered rods driven to a minimum depth of 8 feet.
2. The minimum number of rods shall be two, spaced at least 8 feet apart, and a maximum resistance of 15 ohms for equipment being installed between the rod and the surrounding earth shall be provided.
3. When the ohmic resistance between the equipment and earth exceeds 15 ohms, additional rods shall be installed in multiple with the first rod to lower the resistance to 15 ohms. No salts or other chemicals shall be used to achieve the resistance of 15 ohms.

4. A minimum No. 6 AWG stranded copper wire shall be furnished and exothermically welded to the ground rods 4 inches above grade in order to facilitate inspection. The other end of the ground wire shall be connected to the ground bus or ground stud at the case or house with the shortest and most direct route with no sharp bends.

C. Wayside Cases: Wayside cases shall be grounded with a separate ground rod, exothermically welded to the ground connection wire, which is connected to the minimum 0.375 inch stud bolt furnished with the box or case. Resistance between the junction box and ground and the cases and ground shall not exceed 15 ohms.

3.05 RELAYS AND PLUGBOARDS

A. Contractor shall ensure that relay-operating characteristics have not been altered during shipping or storage.

3.06 BONDS AND RAIL CONNECTIONS

A. General

1. All bonding wires or cables not installed in conduit, other than “C” type, shall be secured to the ties. All wires and cables installed between the rails shall be routed and secured in a manner that provides maximum protection from dragging equipment and track maintenance equipment.
2. All negative return cables shall be exothermically welded to the rails.
3. All terminals and electrical connection lugs on impedance bonds and negative-return cables shall be thoroughly cleaned immediately before being connected.

B. Rail to Bond Connections

1. Contractor shall install the electrical connections between all impedance bonds and the running rails.
2. At impedance bonds which are used to provide a connection between a substation negative propulsion return bus and the rails, two 1000 kcmil cables (or their equivalent) shall be used to connect each rail to the impedance bond track winding.
3. Unless otherwise specified, two 500 kcmil cables (or equivalent) shall be used to connect each rail to the impedance bond track winding at all other impedance bonds.

C. Qualifications:

1. Only properly qualified welders shall be employed by Contractor for the application of the bonds. Each welder shall first make complete connections to the rail for one impedance bond in the field. These connections shall be inspected, tested and certified by a representative of the manufacturer of the exothermic materials. The inspection shall include 3 blows to each connection with a 3 pound hammer; the

connections must not break. The welder may then proceed with further connections.

D. Welding

1. The bonds, except railhead bonds as indicated on Contract Drawings shall be applied to the rails at the neutral axis of the outside of the rail.
2. The surface of the rails that contact the weld metal shall be ground clean by use of a grinding wheel approved by the manufacturer of the exothermic weld equipment.
3. After grinding, the rails shall be cleaned with non-toxic solvent to remove all traces of grease.
4. The bonds shall then be welded by an exothermic process in accordance with the manufacturer recommendations.
5. All rail connections and bonds shall be at least 1 foot away from all rail welds.

E. Moisture: Welding shall not be done during any form of precipitation, unless the rail and welding materials are kept completely dry and clean. Any welds which fail shall be removed, the rail ground smooth, and the bonds replaced and rewelded.

F. Testing

1. Contractor shall be required to randomly test twenty percent of the bonded joints in the presence of the Engineer by measuring their resistance with a Kelvin double bridge and portable battery, or with other approved instrumentation.
2. Any completed joint whose resistance measures higher than the resistance of 3 feet of rail will not be accepted, except in the case of long special- work bonds, the calculated resistance of the bonding conductor may be added.
3. Any bonded joints having a resistance higher than that defined above shall have the bonding rewelded, or removed and replaced with new bonds.

3.07 SIGNAL CABLE INSTALLATION

A. All cable entrances to signal equipment and grade crossing warning system equipment housings shall be from the bottom with adequate space for the installation of cables. Cable entrances shall be sealed with an approved sealant.

B. General

1. Contractor shall furnish, install, and connect all wire and cable required for the signal, train control, and grade crossing warning systems.
2. Contractor shall furnish and install communication cables in accordance with these Contract Documents.
3. Cable shall be installed by trenching and installing in conduit or suspended from messenger wire as specified herein.

4. Direct burial of signal cable is not permitted unless approved by the Engineer.

C. Splicing

1. Taps and in-line splices shall not be permitted in any cable. Cables and wires shall be brought into the instrument cases, junction boxes or other housings and terminated.

D. Slack

1. Sufficient slack in wires and cables at signals and signal heads, instrument cases, junction boxes, housings, relay racks and other equipment shall be provided. A slack loop per Contract Drawing shall be provided underground where the cable enters an enclosure.

E. Sealing Ducts

1. Contractor shall furnish and place cable sealing compound to seal all cable openings in walls and floors and cable entrances to equipment housings, junction boxes, all duct or pipe openings, including spare openings, after cables have been installed.

F. Sealing Cable

1. Whenever it becomes necessary to cut any cable, the cut ends shall immediately be capped and sealed per manufacturer's instructions.

G. Protection of Cables

1. Care shall be taken in handling cables so as not to subject the jacket to undue abuse. Vehicular traffic shall not be allowed to pass over cable nor shall it be pulled over rocks, fences or other sharp objects. Cable reels shall be set up so the cable is pulled from the top of the reel. Abrasion at cable supports or other adjacent structures shall be avoided. At points where proper clearances cannot be maintained, place plastic guards over exposed area of cable. A standard line wire grip or come-along shall be used when pulling up and tensioning cable. The support wire insulation must be removed for this operation.

H. Continuity

1. Cables shall be installed in one continuous length between equipment enclosures or terminal boxes. It shall be Contractor's responsibility to measure each run before pulling and cutting cable lengths from the reels.

I. Cable Pulling

1. Cables shall be pulled into conduits and suspended from messenger

wire. The Engineer shall approve any deviations in cable routing.

2. Pulling sheaves shall allow for no less than 16 times cable outer diameter for cable pulling radius.
3. Contractor shall select cable pull and feed locations best suited to minimize overall cable pulling tension.
4. Cable pulling tensions shall be eased by the application of cable pulling lubricant as the cable is pulled into the duct.
5. Cable pulling lubricant shall not harm the cable jacket, and shall be a type approved by the cable manufacturer.
6. Installation of the cable shall follow the cable manufacturer's recommendation for the specific type being installed and shall not exceed any limits identified in the installation instructions.

J. Water in Ducts

1. Water may accumulate in ductlines and trenches. Any pumping necessary to keep trenches and ducts dry during Contractor's operations shall be performed by Contractor. Contractor shall swab out such ducts or conduits before pulling in cables.

K. Protection While Pulling

1. The method of pulling cables into ducts shall be approved by the Engineer. Cable-pulling tensions, speeds, lubricants, and other pertinent factors in connection with pulling and handling shall be in accordance with the cable manufacturer's recommendations.
2. A cable protector shall be fitted in the end of the duct during any pulling operation, to prevent injury to the cable.
3. While cables are being pulled into duct and conduit, they shall be protected by underground cable feeder straighteners and rollers.
4. Where more than a single cable is being pulled in, all cables together shall be pulled directly into the duct from the shipping coils or reels in which they were received.
5. Cable grips shall be designed for such purpose and shall not cut or otherwise damage the cable.
6. No cable shall be pulled with ends open. A rubber tape seal shall be maintained at all times.

L. Supporting Cable

1. Cable shall be racked, trained and supported in manholes and enclosures and shall be in accordance with the manufacturer's recommendations for the minimum bending radius.
2. The minimum bending radius of fiber optic cable shall be in conformance to the manufacturer's recommendations.
3. Cable racking shall be provided by Contractor for both train control and communications cable.

M. Slack at Ends

1. Sufficient slack in cables in equipment enclosures, junction boxes and

manholes shall be provided so that all connections, splices, and tests and adjustments can be easily made.

2. Whenever cables are cut, the ends shall be immediately capped and sealed to positively exclude moisture. The seals shall be carefully maintained until final connections are made.

N. Damaged Cable

1. Great care shall be exercised in handling the cable and, in pulling the cable in ducts and conduits, and in laying the cable in trenches to prevent damage to the insulation.
2. Any length of cable damaged shall be replaced at Contractor's expense with cable of the same size, make, type and quality.

O. Test Mandrel

1. Contractor's cable pulling shall be in accordance with accepted modern practices so as to prevent damage to the cable.
2. Before pulling cables into any conduit, Contractor shall swab out that conduit and pull a round test mandrel through the entire length of the duct which is to be occupied in order to assure that it is cleared of all obstructions.
3. The test mandrel shall be of a size especially designed for the duct being tested.
4. The mandrel shall be of a rigid type not less than 12 inches in length and shall have tool-steel cutting ends to remove obstructions.

3.08 AERIAL CABLE INSTALLATION

A. Contractor shall submit sag and tension calculations, hardware descriptions and installation drawings for approval by the Engineer and review by Contractor.

B. Contractor shall furnish and install all installation hardware for aerial cable on catenary poles. The hardware used and its installation shall be coordinated with the Contractor installing the catenary poles. This coordination shall be through the Engineer.

C. Contractor shall coordinate the installation of messenger wire and aerial cable with the Contractor. Any problems identified or deviations from the sag and tension calculations or installation drawings shall be immediately reviewed for effects on the catenary hardware and wire installation. This coordination shall be through the Engineer.

D. Installation Requirements:

1. When installing cables on the messenger wire, they shall first be tied to the messenger with temporary marline or rope ties placed sufficiently close together to hold the cable without undue sagging or slack, then permanently tied with cable straps placed on 15 inch centers.
2. At each line drop, the cable shall be securely tied to the messenger

with nylon cord ties approved by the Engineer.

3. Each cable strap shall be a complete unit consisting of pre-formed, ribbed 19 gauge bronze hook 0.625 inches wide; and a serrated extruded black polyethylene wire insulation with holes for the wire.
4. Where multiple cables are installed on one messenger, care shall be taken to prevent twisting of the cables.
5. Should it be necessary to add cable or cables to those previously installed on the messenger wire, they shall first be tied to the messenger with temporary ties spaced sufficiently close to prevent undue sagging between ties. The temporary ties shall support the existing cables and the new cables so that the old ties or straps may be removed. The entire group of cables shall then be retied to the messenger with new straps and ties. Re- use of straps or ties is not permitted.
6. Temporary wire or cable installed on messenger wire shall be fastened to the messenger by temporary marline or rope ties, and be placed to hold the cable without undue sagging.
7. Self-supporting aerial cable, which incorporates supporting messenger, may be provided when approved by the Engineer.

3.09 WIRING

A. Terminals: These requirements for electrical connections shall apply to field wiring. All wires which are terminated on AREMA binding posts shall be fitted with an approved insulated crimped type terminal as described in AREMA Signal Manual, Part 14.1.1 or equivalent. These terminals shall be placed on the wire by means of standard forming tools of the proper size, equipped with locks to assure that the proper pressure is applied before the tool is released. Care shall be taken to assure that the correct size of wire terminal is used and that the wire is thoroughly cleaned and centered properly in the wire terminal when using the forming tool.

B. Stripping of Wires: Wire terminals shall not be bent, nicked or otherwise damaged. An approved wire-stripping tool shall be carefully used to remove the insulation from No. 9 AWG and smaller wires. Scraping of these conductors with any sharp instruments shall not be permitted. For wires larger than No. 9 AWG, a knife may be used to remove the insulation, upon approval by the Engineer, extreme care being taken to prevent nicking the conductors. Contractor shall furnish the Engineer with Samples of the terminals proposed for use for connecting all wires to AREMA binding posts. The terminals shall be subject to approval by the Engineer.

C. Wire Connections: Connections to bases for plug-in relays and similar connections to lever and lamp contacts shall be crimped using an approved connector. Not more than two wires shall be terminated to a connector on relay bases.

D. Quality of Work: Should any evidence of improper or poor workmanship arise, Contractor shall, upon written request of the Engineer, remove the responsible parties from the Work, and re-do the faulty work without extra compensation.

E. A 6 inch minimum slack loop shall be provided for all wiring to vital relays.

F. No splices shall be made in any wire.

3.10 PAINTING

A. Requirement: All painting and other coating shall be furnished and applied as specified in this Article unless otherwise specified.

B. Standards: The painting and coating of materials and equipment furnished under these Specifications shall comply with the requirements of AREMA Signal Manual, Part 2.4.30, with the exception of galvanized and plated surfaces, aluminum, machined surfaces, wires and cable, bolts and nuts for field assembly and other similar surfaces and materials.

C. Brand: Paints for primer and finishing coats shall be subject to approval of the Engineer.

D. Application: No paint shall be applied on wet, damp, frosted or dirty surfaces, or when the temperature is below 12 degrees C (54 degrees F) or above the paint manufacturer's recommended maximum temperature, or when in the opinion of the Engineer, conditions are otherwise unsuitable for painting.

E. Primer: Galvanized surfaces to be painted under this Contract shall be field treated, prior to the application of any paint, with an approved primer or treatment.

F. Inaccessible Surfaces: Surfaces required to be painted that will be inaccessible after installation or erection shall be given two additional field coats of the specified paint before installation or erection.

G. Signal Heads: Hoods and faces of signal units shall be painted a flat black.

H. Damage: If any painted surface is damaged prior to the completion of the Work under this Contract, such damaged surface shall be cleaned, touched-up or completely repainted by Contractor without additional compensation.

I. Contractor shall furnish Authority 2 gallons of touch up paint for each finish color at the end of the work.

3.11 SIGNAL HOUSE AND INSTRUMENT CASES

A. Contractor shall install houses and cases level on precast concrete pier supports with the bottom of houses and cases at least 300 mm (12 inches) above the finished grade. Where cribbing is required, Contractor shall submit to the Engineer for approval a cribbing design for that location.

B. Unless otherwise specified, instrument cases shall be installed with their backs facing the tracks, and signal houses with their entrance doors perpendicular to the tracks.

C. Locate cases (or houses as required) at grade crossing warning locations. Instrument cases shall also be provided to house any equipment which cannot be housed in any of the above mentioned locations.

D. Contractor shall place stone or other material under houses and cases to prevent vegetation from growing.

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the work of this Section. Payment for this work shall be incidental to payment for Section 13572 – Grade Crossing Warning System.

END OF SECTION

SECTION 13575

WIRE AND CABLE

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The work of this Section includes, but is not limited to, providing all labor, materials, tools, equipment and incidentals necessary for wire and cable, in accordance with the Contract Documents.

B. The work of this Section includes, but is not limited to, the following activities:

1. Interior Wire and Cable
2. Exterior Cable

1.02 RELATED SECTIONS

A. See Section 13570, “Signal System,” 1.02, “Related Section” for the list of other related specification sections.

1.03 REFERENCE STANDARDS

A. AREMA Communications and Signals Manual of Recommended Practices.

B. ASTM Standards B-3, B-8, B-33, B-I05, B-173, B-189, 1248, D-3159, D-2802, and E-1354.

C. IEEE Standard 383.

D. ICEA Standard S-95-658.

E. NEC.

F. NEMA Standards HP-100, WC8, and WC26.

G. UL Standard 758.

H. NFPA Standard 130 (for all subway cables).

1.04 SUBMITTALS

A. See Section 13570, “Signal System,” 1.05, “Submittals” for the list of submittals required for this Section.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall have 15 years of documented experience in supplying cable to the railway or transit industry for use in installations similar to those required by this Contract. A certification letter shall

be submitted by the Contractor describing results of control testing.

B. Control Testing: The following control tests shall be performed during manufacture.

1. Voltage and insulation resistance tests on cables in accordance with ICEA S-95658, modified as follows:

a. Test potentials for both AC and DC as specified herein.
b. All immersion tests after 24 hours minimum immersion.
c. Individual conductors of multiple conductor cables tested before assembly as specified for single conductor cables.

2. Shield isolation test on all combinations of pairs and over-all shield. After one minute at 500 volts, minimum resistance shall be 0.1 megohms per 1 foot.
3. Conductor resistance test on all cables in accordance with ICEA S-95-658.
4. Physical characteristic tests on at least one sample from each type and size of cable in accordance with ICEA S-95-658.

C. AC voltage withstand test on each shipping reel of finished cable at the test insulation voltage for 1 minute prior to shipment.

1.06 DELIVERY, STORAGE AND HANDLING

A. Contractor shall pack and mark wire and cable in accordance with the AREMA Communications and Signals Manual of Recommended Practices, Part 10.3.17, except as otherwise specified.

B. Contractor shall ship, store, and handle material as specified in the AREMA Communications and Signals Manual of Recommended Practices, Part 10.4.1.

C. Cable ends shall be sealed to prevent entrance of moisture during storage and handling prior to final cable termination.

1.07 PACKAGING

A. Stranded wire and cables shall be wound on reels or spools. Each reel or spool shall have an appropriate diameter for the respective wire size. See NEMA WC26 for required reel diameter. The reels or spools shall be finished to prevent corrosion under typical storage and handling conditions. The method of attachment of the flanges to the barrels on metal reels or spools shall be structurally equivalent to a full crimp.

B. Wire shall be closely and tightly wound in layers. All cable ends must be securely fastened so they do not become loose in transit.

C. As appropriate, solid conductor wire shall be packaged on 16 inch spools or in barrel packs to reduce wire curl.

D. Contractor shall specify the requirements for acceptable minimum continuous wire lengths and the number of continuous wire lengths permitted per reel or spool.

E. Each reel or spool shall be marked with weather resistant tags, identifying the amount of wire per continuous length and the number of lengths. In addition, the following information shall be included on the tags:

1. Manufacturer's Part Number.
2. Wire size and stranding.
3. Date of manufacture.
4. Name of manufacturer.
5. Cable description, if applicable.

ARTICLE 2 – PRODUCTS

2.01 SIGNAL WIRE AND CABLE

A. General

1. Cable with insulating and jacketing materials capable of a 40-year average service life shall be provided.
2. Cable shall be suitable for installation at minus 5 degrees F.
3. Capacitance of cables shall be within the limits prescribed by the manufacturer of the equipment to which the cable is connected.
4. All interior and exterior cable and/or wire that is deployed in the tunnel, and cut and cover areas shall be provided with low smoke zero halogen jackets, and meet all of the Fire, Smoke and Smoke Toxicity requirements of this Section.

B. Minimum voltage rating for both AC and DC shall be as follows:

1. Track circuit cable: 2000 volts.
2. All snow melter control case, switch heater element and switch rod heater unit wiring and cables: 2000 volts.
3. All other cables shall be rated for 600 volts minimum.

C. Conductors shall be sized to ensure operation of the equipment based on the equipment loads and operating parameters for the systems in accordance with the NEC and as specified herein. Coated conductors of annealed copper wire shall be in accordance with ASTM B33. Class B and Class C stranded conductors shall conform to ASTM B8, Table 2, and Class G stranded conductors shall conform to ASTM B173 as follows:

1. Equipment module, signal, and instrumentation external wiring: No. 20 AWG minimum, Class B.
2. Rack to rack: No. 20 AWG minimum, Class B (multi-conductor cable).
3. Rack to rack: 14 AWG minimum, Class B (single conductor).
4. Track circuits: No.6 AWG minimum twisted, Class C.
5. Track switch machine, power: No.9 AWG minimum, Class C.
6. Track switch machine, control and indication: No. 14 AWG minimum, Class B.
7. Wayside signal lighting circuits: No.9 AWG minimum, Class C.
8. Power bonds: C type, 250 kcmil, Class G, bare.
9. Crossbonds and impedance bond connections: Class G.
10. Bond strand wire: No.6 AWG minimum, Class H.
11. Signal bonds: C type, cadmium bronze, ASTM B105, Alloy 80, bare stranded rope lay with one center rope of 19 wires surrounded by six ropes of 19 wires each, using wires of 0.0125 inches with nominal cable diameter of 0.1875 inches.
12. All other circuits: No. 14 AWG minimum, Class B.

D. Interior Cables

1. To be used only for wiring inside signal relay rooms.
2. Certified for continuous operation at 239 degrees F in wet or dry locations.
3. Conductors

    a. Stranded Conductors

        1) Conductors shall be tin plated, soft or annealed copper wire for electrical purposes, per the latest revision of ASTM B- 33 and B-3.
        2) Strands and rope members shall be concentrically stranded using uni-lay (UNI), concentric (CON), and bunch (BUN) construction as specified in Table 13575 below:

Table 13575·1, Construction of Bare Stranded Conductor, Relay Rooms

Conductor Size (AWG)	Stranding (NO/Size)	Strand (Type)	Conductor Nominal Diameter (mils)	Nominal DC Resistance @ 68°F (ohms/1000')
24	19/36	UNI	23.6	25.7
22	19/34	UNI	29.6	15.8
22	7/30	CON	30.9	16.9
20	19/32	UNI	37.8	9.63
18	19/30	UNI	46.7	6.15
16	19/29	UNI	53	4.77
14	19/27	UNI	66.2	3.04
14	37/30	CON *	71	3.05
12	37128	CON *	87.2	2.02
10	37/26	CON *	110	1.26
9	37/.019	CON *	129	0.83
9	19x7/.010	UNI/ROPE	148	0.88
8	19x7/29	UNI/ROPE	162	0.682
6	19x7/27	UNI/ROPE	203	0.433
4	19x7/25	UNI/ROPE	257	0.268
2	19x35/30	CON/ROPE	331	0.173
1	19x43/30	CON/ROPE	360	0.146
1/0	19x55/30	CON/ROPE	418	0.111
210	19x70/30	CON/ROPE	464	0.0872
310	37x45/30	CON/ROPE	531	0.0696
410	37x57/30	CON/ROPE	598	0.055
500 kcmil	7xl9x38/30	BUN/ROPE	988	0.022

*Double Pass Concentric

b. Solid Conductors

1) Solid conductors shall only be used for wire wrap applications.
2) Conductors shall be tin plated, soft or annealed copper wire for electrical purposes, per the latest revision of ASTM B- 33 and B-3.
3) Diameters shall be as specified below in Table 13575-2:

Table 13575·2, Solid Conductor Diameter, Relay Rooms

Conductor Size (AWG)	Conductor Nominal Diameter (mils)	Nominal DC Resistance @ 68°F (ohms/1000')
30	10.3	114
28	13	70.5
26	16.4	44.7
24	20.7	27.8
22	26.1	17.1
20	32.9	10.5

c. Insulation

1) The insulation material for stranded and solid conductor wires shall be modified ethylene tetrafluoroethylene (ETFE) per ASTM D3159-a, unless otherwise specified.

a) All insulation for AWG 12 through AWG 24 shall be Tefzel 200 or equivalent. Tefzel HT-2127 or equivalent may be substituted for Tefzel 200 for enhanced flexibility.

b) All insulation for AWG 10 through 500 kcmil shall be Tefzel 280 or equivalent.

c) All insulation for the solid conductor wire wrap wire shall be Tefzel 750 or equivalent per UL Subject 758, Style 10125 and will include wire sizes AWG 26-30.

d. Wire Constructions

1) The finished wire diameters, weights, and ampacity ratings are shown for 0-150 volt, 0-300 volt, or 0-600 volt, 0-1000 volt, and 0-2000 volt rated stranded wires in Table 13575-3 below. All conductors shall meet the requirements in item 3.a above.

2) The finished wire diameters and weights for 0-300 volt solid conductor wire are also shown below. All conductors shall meet the requirements in item 3.b above.

Table 13575·3, Wire Construction with Insulation, Relay Rooms

Stranded Wires Rated 0-150V

Conductor Size (AWG)	Thickness (mils)	Nominal Wire OD (mils)	Nominal Weight (Lbs./M ft.)	Ampacity
24	10	43.6	2.3	1.5
22	10	49.6	3.2	4.0
22 (7/30)	10	49.8	3.2	4.0
20	10	57.8	4.8	6.5
18	10	66.7	7.1	19.0
16	10	73.0	8.8	24.0

Stranded Wires Rated 0-300V

Conductor Size (AWG)	Thickness (mils)	Nominal Wire OD (mils)	Nominal Weight (Lbs./M ft.)	Ampacity
24	12	47.6	2.5	1.5
22	12	53.6	3.5	4.0
22 (7/30)	12	53.8	3.5	4.0
20	12	61.8	5.1	6.5
18	12	70.7	7.4	19.0
16	12	77.0	9.1	24.0
14 (UNI)	12	90.2	13.9	34.0
14 (CON)	12	95.0	14.6	34.0

Stranded Wires Rated 0-600V

Conductor Size (AWG)	Thickness (mils)	Nominal Wire OD (mils)	Nominal Weight (Lbs./M ft.)	Ampacity
24	15	53.6	2.8	1.5
22	15	59.6	3.9	4.0
22 (7/30)	15	59.8	3.9	4.0
20	15	67.8	5.6	6.5
18	15	76.7	7.9	19.0
16	15	83	9.7	24.0
14 (UNI)	15	96.2	14.6	34.0
14 (CON)	15	101	15.3	34.0
12	15	117.2	21.7	43.0
10	17	144.0	33.7	55.0
9 (371.019)	17	163.0	47.1	-
9 (19x7/.01	17	182.0	47.5	-
8	17	196.0	59.3	76.0
6	20	243.0	93.4	96.0
4	24	305.0	146.0	143.0
2	26	383.0	226.0	160.0
1	28	416.0	127.0	186.0
1/0	30	478.0	358.0	215.0
2/0	39	542.0	457.0	251.0
3/0	50	631.0	598.0	288.0
4/0	50	698.0	737.0	332.0
500 kcmil	50	1088.0	1770.0	580.0

Stranded Wires Rated 0-1000V

Conductor Size (AWG)	Thickness (mils)	Nominal Wire OD (mils)	Nominal Weightr (lbs/M ft)	Ampacity
18	18	82.7	8.5	19
16	18	89.0	10.3	24
14 (UNI)	18	102.2	15.3	34
14 (CON)	18	107.0	16.0	34
12	18	123.2	22.5	43
10	20	150.0	34.7	55
9 (371.019)	20	169.0	48.3	-
9 (19x7/.01	20	188.0	48.6	-
8	22	206.0	61.5	76
6	22	247.0	93.7	96
4	24	305.0	146.0	143
2	26	383.0	226.0	160
1	28	416.0	271.0	186
1/0	30	478.0	358.0	215
2/0	39	542.0	457.0	251
3/0	50	631.0	598.0	288
4/0	50	698.0	737.0	332
500 kcmil	50	1088.0	1770.0	580

Stranded Wires Rated 0-2000V

Conductor Size (AWG)	Thickness (mils)	Nominal Wire OD (mils)	Nominal Weightr (lbs/M ft)	Ampacity
16	20	93.0	10.8	24
14 (UNI)	20	106.2	15.8	34
14 (CON)	20	110.0	16.6	34
12	20	127.2	23.2	43
10	24	158.0	36.2	55
9 (371.019)	24	177.0	50.0	-
9 (19x7/.01	24	196.0	50.5	-
8	24	210.0	62.5	76
6	26	255.0	96.1	96
4	26	309.0	147.7	143
2	28	387.0	227.7	160
1	28	421.0	271.0	186
1/0	30	478.0	358.0	215
2/0	39	542.0	457.0	251
3/0	50	631.0	598.0	288
4/0	50	698.0	737.0	332
500 kcmil	50	1088.0	1770.0	580

Solid Conductor Wire Wrap Rated 0-300V

Conductor Size (AWG)	Thickness (mils)	Nominal Wire OD (mils)	Nominal Weightr (lbs/M ft)	Ampacity*
30	6	22.3	0.54	-
28	6	25.0	0.76	-
26	6	28.4	1.1	-
24	6	32.7	1.6	-
22	6	37.8	2.4	-
20	6	44.9	3.7	-

* Ampacity rating not available for these low amperage circuits.

e. Insulation thickness: Stranded and Solid Wires

1) The nominal or average thickness of the insulation shall be as specified above. The minimum thickness at any point shall not be less than 90 percent per NEMA HP-100-1991, Section 3.2.

f. Identification

1) Repeated at intervals no greater than 24 inches:

a) Manufacturer's name.
b) Year manufactured.
c) Insulation material (ETFE).
d) Conductor size.
e) Voltage rating.

2) The identifying marking shall be easily readable and shall withstand 125 cycles (250 strokes) using a scrape abrasion tester with a 250 gm weight, a wire mandrel with a diameter of 25 plus or minus 2 mils (0.635 plus or minus 0.051 mm), a stroke length of 0.375 inch and a frequency of 60 cycles/minute.

3) Each solid wire surface shall be printed with the UL Style Number, the manufacturer and the conductor gauge. This information shall be repeated at intervals no greater than 24 inches. The identifying marking shall be easily readable and meet the requirements specified above in 2).

g. Wire performance requirements

1) Insulation shall be applied directly to the surface of the specified conductors and adhere tightly to the surface, but must be free stripping, leaving the conductor clean and bare.

2) The following "Routine Tests" shall be performed for each production run.

a) Impulse dielectric or direct current spark test 100 percent of the wire per the following requirements:

Table 13575·4

	Impulse Dielectric Test Voltage KVAC (Peak) KVDC	DC Spark Test Voltage
Wire rated 0-150V	1.5	3.0
Wire rated 0-300V	5.0	7.0
Wire rated 0-600V	6.5	12.0
Wire rated 0-1000V	8.0	16.0
Wire rated 0-2000V	10.0	20.0

b) Wire performance requirements

i Apparatus: Use a tension testing apparatus equipped to operate in a tensile mode in conjunction with a fixture attached to one jaw of the tensile testing machine. The fixture is a metal plate approximately 0.2 inch thick with a hole 5 percent to 10 percent larger than the

conductor diameter.

ii Test specimen: The test specimens shall be approximately 5 inches long. Test a minimum of three specimens.

iii Test procedure: Allow the specimen to completely stabilize at room temperature. Prepare the specimen for testing by carefully removing the insulation from both ends with the exception of a 1.0 in section of undisturbed insulation located in the middle of the test specimen. Remove the insulation so that the exposed insulation ends are square with respect to the conductor. Insert one end of the exposed conductor through the fixture hole and clamp this end to the traveling section of the tensile tester. Do this without applying any force to the insulation test specimen and leave approximately 0.5 in of slack between the fixture hole contact point and the insulation piece. Using the tensile tester, pull the conductor approximately 1.0 in through the insulation at a rate of 2.0 in/min. and record the maximum force indicated. Do not displace the insulation over the end of the conductor.

iv Requirement: For stranded conductors, the force required to remove the insulation shall be a minimum of two pounds and a maximum of nine pounds. For solid conductors, the force required to remove the insulation shall be a minimum of 0.5 pounds and a maximum of 5 pounds.

c) Insulation Shrinkage

i The Shrinkage Test measures the ability of an insulation to be exposed to an elevated temperature without changing its length at the termination of the wire. It is important to maintain complete coverage of the conductor at the termination to insure the electrical barrier is intact.

ii Procedure: 1.0 inch of insulation shall be stripped from each end of a 14 inch specimen of finished wire using a razor blade, or equivalent instrument, held perpendicular to the axis of the wire for the insulation removal operation. The length of exposed conductor at each end of the specimen shall be determined to the

nearest
0.01 inch. The specimen shall be exposed to 356 degrees F for 6 hours in an air oven. At the end of 6 hours, the specimen shall be removed from the oven and allow to return to room temperature. The shrinkage of the insulation shall then be measured as the greatest additional distance which any layer of the insulation has receded from either end of the conductor. The measurement obtained at either end showing the greatest shrinkage shall be considered the shrinkage of the specimen. Three specimens shall be tested.

iii Requirement: The maximum allowable shrinkage for wire sizes AWG 30 - 16 is 3.175 mm (0.125 inches), for wire sizes AWG 14 - 6 is 6.35 mm (0.250 inches) and for wire sizes AWG 4 - 500 kcmil is 9.525 mm (0.375 inches).

d) The insulation must meet the tensile strength, elongation at rupture, heat shock, and cold bend requirements of NEMA HPI00.2-1991, Table 2-1.

i The insulation must meet the aging requirements, heat distortion, insulation resistance, and dielectric constant (SIC) requirements of NEMA HPI00.2-1991, Table 2-1 and the additional tests specified herein. These tests are considered "Material Tests" and must be performed every five years.

e) Fire, smoke and smoke toxicity test

i Flammability and Smoke Evolution Test: The Flammability and Smoke Evolution Test employs modem test methods, which measure the fire properties most important to controlling fire and smoke hazards. Used in conjunction with the Smoke Toxicity Test, they constitute a fair evaluation of tradeoffs - very good properties in one area can often offset marginal properties in other areas.

ii The Flammability test is ASTM E-1354, Standard Test Method for Heat and Visible Smoke Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter.

a Procedure: Specimens shall be 4 inch in length and placed side by side in a single layer to cover the entire surface of the specimen holder.

b The apparatus shall be operated at a heat flux of 35 kW/sq.m in the horizontal orientation.

c The following information shall be reported: Specimen thickness, or diameter of cable in mm (d). Time to sustain flaming in seconds tig. Average heat release rate for the period beginning when 10 percent of the ultimate specimen mass loss has occurred and ending at a time when

90 percent of the ultimate sample mass loss has occurred, in kW/sq. m (q"). Average mass loss per unit area for the same period as above, in g/s sq. m. (m"). Average specific smoke extinction area in sq. m/g (o).

d Requirements

- Smoke evolution rate: The product of the average mass loss rate, m", and the specific smoke extinction area, o, shall be equal to or less than (16/d) sq. mis, where "d" is the cable diameter.
- Heat release rate: The average release rate, q", shall be equal to or less than (1400/d) kW/sq. m, where dis the cable diameter.
- Tenable smoke density: The product of the smoke toxic potency, LC(50), the smoke specific extinction area, o, and the percent of sample vaporized, f, shall be equal to or greater than 0.2.

iii Smoke Toxicity: The Smoke Toxicity Test specified here is one of the modem test methods that measure the properties most important to controlling fire and smoke hazards. Used in conjunction with the flammability and smoke evolution, they constitute a pair evaluation of tradeoffs - very good properties in one area can often offset marginal properties

in other areas.
Procedure: The smoke toxicity test is the University of Pittsburgh Smoke Toxicity Test Protocol as described in the New York State Flammability Regulations.

a The test shall be carried out according to the published procedure. The following information shall be reported:

- LC(50), the toxic potency in grams.
- The percent residue, p.
- Fraction of sample vaporized, f=(100-p)/100.

b Requirement

- Toxic gas production: The toxic gas parameter, T, shall be less than or equal to 2100/d T= (m")x(450-t (tig)) / ((f)x(LC(50))
- Where mn is the average mass loss rate, f is the fraction of smoke vaporized and LC(50) is the toxic potency
- These tests and requirements replace the IEEE 383 flame propagation tests included in the NEMA HP100-1991 and NEMA HP100.2-1991standard.
- Qualification of these requirements shall be with 12 and 20 AWG conductors rated at 2000 and 600V respectively.

f) Corrosivity

i The copper mirror corrosion test detects corrosive materials that may be driven off the insulation material at elevated temperatures and have the potential for conductor corrosion.

ii Procedure:

a Cut a piece of insulation into small pieces and place 0.4 grams of the insulation into each of two test tubes. Use a third test tube as a control.

b Suspend a copper glass mirror about 0.25 inches wide by 1.0 inch in each of the test tubes. Suspend a thermometer, 6-7 inches above the bottom of one of the test tube. Fine copper wires attached to a cork may be used to suspend these items. Seal the test tubes with the cork wrapped in aluminum foil.

c The mirror shall be vacuum deposited copper with a thickness equal to 10 plus or minus 5 percent transmission of normal incident light at 5000A. Use the mirror only if no oxide film is present and the copper is not visibly damaged.

d Immerse the bottom two inches of the three test tubes in an oil bath at 347 degrees F for 16 hours. Keep the portion of the test tubes containing the mirror at a temperature below 140 degrees F.

e After cooling, examine the mirrors by placing them against a white background in good light. Any removal of copper from the mirrors will be a sign of corrosion. Disregard and removal of copper from the bottom 0.06 inches of the mirror, as drippings can cause this condition. Do not consider discoloration of the copper film or reduction of its thickness as corrosion. Consider the removal of copper so as to be transparent as the corrosion and estimate the area of copper removal.

f Examine the control mirror for corrosive damage and compare with the exposed mirrors.

iii Requirement: When compared to the control mirrors, the removal of 5 percent or more of the area of either of the test mirrors shall be considered as failure.

h. Color Coding of Wires

1) Stranded Wires

a) Cables with unpaired wires shall be solid colored in the color sequence shown in Table 13575-5 below. The second color is achieved by using a stripe that is clearly identifiable and permanent.

Table 13575.5, Color Code of Individual Wires of Multi-Conductor Cables

1.	Black	26.	Black/ Violet
2.	Brown	27.	Black/ Gray
3.	Red	28.	Black/ White
4.	Orange	29.	Brown/ Black
5.	Yellow	30.	Brown/ Red
6.	Green	31.	Brown/ Orange
7.	Blue	32.	Brown/ Yellow
8.	Violet	33.	Brown/ Green
9.	Gray	34.	Brown/ Blue
10.	White	35.	Brown/ Violet
11.	White/ Black	36.	Brown/ Gray
12.	White/ Brown	37.	Brown/ White
13.	White/ Red	38.	Red/ Black
14.	White/ Orange	39.	Red/ Brown
15.	White/ Yellow	40.	Red/ Orange
16.	White/ Green	41.	Red/ Yellow
17.	White/ Blue	42.	Red/ Green
18.	White/ Violet	43.	Red/ Blue
19.	White/ Gray	44.	Red/ Violet
20.	Black/ Brown	45.	Red/ Gray
21.	Black/ Red	46.	Red/ White
22.	Black/ Orange	47.	Orange/ Black
23.	Black/ Yellow	48.	Orange/ Brown
24.	Black/ Green	49.	Orange/ Red
25.	Black/ Blue	50.	Orange/ Yellow

2) In paired cables, one wire of each pair shall be white and the other wire shall be coded in accordance with the sequence of the first 21 wires given in table above, omitting the solid white. This color sequence shall be repeated as required for identification of all pairs.

3) Solid Conductor Wire - Wire Wrap: Solid color as specified by the Purchaser shall be used for these wires.

i. Jacket

1) Jacket of extruded block low density, high molecular weight polyethylene material shall be provided for:

a) Single conductor cables.
b) Outer jacket of multiple conductor cables.
c) Average jacket thickness on single conductor cables shall be 15 mils minimum.
d) Average jacket thickness for outer or overall jacket on multiple conductor cables shall be 45 mils minimum.
e) The minimum jacket thickness at any point shall not be less than 90 percent of that specified.

E. Assembly of Multiple Conductor Cables

1. The number of spare conductors for all local multiple conductor cables shall be at least 10 percent, but not less than 1 spare conductor.
2. Signal express cables shall be sized as indicated on the Contract Drawings.
3. Interior multiple conductor cables assembled in accordance with the AREMA Communications and Signals Manual of Recommended Practices, Part 10.3.15, Paragraph 9, except jacket as specified herein and fillers of flame resistant, non-wicking material.

F. Exterior Cables

1. Except where interior type cable is specifically permitted, use exterior cable for all circuits operating at or above 120 VAC/VDC and for all power, signal, control, and instrumentation circuits installed along the wayside.
2. Exterior cable shall be suitable for direct burial unless otherwise approved by Engineer.
3. Certified for continuous operation at 194 degrees F.
4. Insulation

a. Single conductor cables and individual conductors of multiple conductor cables insulated with a tight-fitting, clean stripping,ozone resistant ethylene propylene rubber or synthetic rubber vulcanized elastomer.
b. Average thickness of insulation not less than that specified below. Minimum thickness at any point not less than 90 percent of that specified.

1) Insulation thickness and test voltages of single conductor cable prior to jacket application for circuits rated up to 2000 volts is shown in Table 13575-6 below:

Table 13575·6, Construction of Single Conductor Exterior Cables

Conductor Size	Insulation Thickness In Mils	Test Voltage in kV AC	DC
14 to 9 AWG	78	10	30
8 to 2 AWG	94	11	33
1 to 4/0 AWG	94	11	33
250 to 500 kcmil	105	12.5	37.5
750 to 1000 kcmil	105	12.5	37.5

2) Insulation thickness and test voltages for individual conductors of multiple conductor cables on circuits rated up to 2000 volts is shown in Table 13575-7 below:

Table 13575·7, Construction of Multiple Conductor Exterior Cables

Conductor Size	Insulation Thickness In Mils	Test Voltage in kV AC	DC
20 to 18AWG	45	5.5	16.5
16AWG	65	8.0	24.0
14 to 9 AWG	78	10	30
8 to 2 AWG	94	11	33
1 to 4/0 AWG	105	12.5	37.5

c. Physical and electrical characteristics conforming to Table I when tested in accordance with ICEA S-95-658, as modified herein.

5. Outer Jackets

a. Low smoke, halogen free polymeric cable outer jackets shall be provided for all external signal cable jackets in accordance with the requirements of the AREMA Communications and Signals Manual of Recommended Practices, Part 10.3.13.

G. Exterior multiple conductor cables

1. Assembled in accordance with the AREMA Communications and Signals Manual of Recommended Practices Part 10.3.17, paragraph 9, except jacket as specified herein and fillers of flame-resistant, non-wicking material.
2. Cables shall also have over the assembled conductors and fillers a shock absorbing layer of moisture resistant extruded elastomeric material. The thickness shall be as follows:

Core Diameter	Ave. Cushion Layer Thickness
Less than 1.5 inches	47 mils
1.501 inches and larger	62 mils

3. A pull cord shall be included beneath the cushion layer to provide for removal of the layer for terminating.
4. Exterior type cables including single pair twisted cable provided with a 10 mil minimum bronze tape beneath outer jacket for rodent and other environmental protection.
5. Additional shielding with metal tape or metal braid appropriate for installation and service conditions, and in accordance with ICEA S-95-658, as required.
6. Two conductor twisted pair cable and multiple twisted pair cables shall be assembled as specified above for multiple conductor cables.
7. Conductor Identification

    a. For twisted pair, the insulation shall be identified as white on one conductor and black on the other.
    b. Except as otherwise specified, each insulated conductor in other multiple conductor cables shall be identified with a specific number or shall have a different color or tracer color combination.
    c. Except as otherwise specified in referenced REA specifications, insulated conductors in other multiple conductor cables shall be black with one red conductor in each layer.

8. Identify cables as to manufacturer, year of manufacture, insulation type, conductor size, and voltage rating in accordance with manufacturer's standard method and subject to approval of the Engineer.

H. Power Cable

1. Power cables shall be sized to carry the design loads and fault currents without exceeding the allowable cable temperatures.
2. Cables shall be stranded copper conductors of minimum size #6 AWG (minimum 3 conductors #6) and shall be ethylene-propylene-rubber insulated in accordance with ICEA S-95-658, NEMA WC8 and ASTM D-2802-78.
3. The insulation level shall be consistent with the system nominal voltage.
4. Cables shall be furnished with heavy duty hypalon jacket and with galvanized steel interlocked armor tape listed by Underwriters Laboratories and in accordance with ICEA S-95-658.
5. Jacket thickness shall be as specified above.
6. All power cables shall include a ground wire.
7. Power cable conductors shall be color coded per ICEA S-95-658.

ARTICLE 3 EXECUTION

3.01 CABLE PLAN

A. The Cable plan shall show all new cable runs between locations and junction boxes where cables are terminated and dropped to serve equipment locations.

B. Nomenclature, type, number, and gauge of conductors shall be shown for each cable run.

3.02 INSTALLATION

A. All wire and cable shall be installed in accordance with manufacturer's recommendation and applicable codes and standards.

B. Contractor shall not exceed minimum bending radius recommended by cable manufacturer.

C. Engineer shall be notified 24 hours prior to cable installation.

D. Cables for Signal System shall be installed at least 36 inches away from any high voltage cable such as substation cables to feed the catenary, local commercial power cables, or any cable required to carry current at 600 volts or more.

E. Contractor shall verify raceway conduit is free of obstructions by pulling a suitable wire brush, swab, and mandrel through raceway conduit to remove extraneous matter.

F. Contractor shall ensure raceway conduit is dry before installation of cable and use lubricant approved by cable manufacturer to facilitate pulling cable.

G. Maximum cable lengths and pulling tensions shall be determined to avoid excessive pulling tensions or more bends than manufacturer's recommendations.

H. Exposed cable will not be permitted along the wayside.

I. Wires shall not be allowed to cross one another when pulled into a conduit. Kinking shall be prevented in conduit fittings or boxes. All cables and wires to be installed in a conduit shall be installed at the same time.

J. All exposed wires and cables entering or leaving signal equipment housings, junction boxes, relay rooms and cable transition points shall be protected from abrasion. Chase nipples shall be provided in drilled or punched openings in housings and junction boxes. Openings in equipment enclosures and junction boxes shall have split ring plastic grommets.

K. All openings in equipment enclosures. relay rooms, and junction boxes where exposed cables enter the enclosure or box shall be sealed. A resilient sealing compound made expressly for the purpose shall be installed after the cables are in place.

L. Open wiring between individual equipment shall be neatly arranged, bundled, and tied approximately every 3 inches with nylon straps.

M. Cable installed in conduit, regardless of length, shall not exceed the maximum fill

recommendations of the manufacturer and the requirements of the NEC and local codes. Where the aforementioned codes do not apply, the maximum fill shall not exceed 60 percent.

3.03 SPLICES AND TERMINATIONS

A. Wires and cables shall be continuous between relay rooms and the intended termination point at the wayside or junction box and between other termination points. Splices shall not be permitted. All terminations shall be made in accordance with the cable manufacturer's recommendations. Termination hardware shall require Engineer approval.

B. If terminations are not made immediately after installation, ends of cable shall be sealed as recommended by the manufacturer to prevent entrance of moisture.

C. Testing:

1. All completed cable installation shall be tested as specified in Section 13581, "Signal System Test and Inspection."

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the work of this Section. Payment for this work shall be incidental to payment for Section 13572 – Grade Crossing Warning System.

END OF SECTION

SECTION 13576

RELAYS AND PLUGBOARDS

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section consists of designing, furnishing, installing, testing and commissioning Signal System relays and plugboards as described in the Contract Documents and as specified herein.

1.02 RELATED SECTIONS

A. Section 13570, “Signal System.”

1.03 REFERENCED STANDARDS

A. American Railway Engineering and Maintenance of Way Association (AREMA) Signal Manual of Recommended Practices.

1.04 SUBMITTALS

A. See Section 13570, “Signal System,” 1.05, “Submittals” for the list of submittals required for this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall ensure that relay operating characteristics have not been altered due to damage during shipping or storage. Relays shall be shipped separately from wired racks in which they are to be installed. They shall be packaged individually, each in a sturdy cardboard carton with the drawing number of the relay printed on the outside of the carton. Relays shall be stored in a protected area until installed.

ARTICLE 2 – PRODUCTS

2.01 RELAYS

A. General

1. All relays shall be plug-in type.
2. Relays shall be identified with manufacturer’s name, model number, contact identification, and serial number.
3. Relays shall be interchangeable with relays of the same type used elsewhere.

4. Plug-in type relays shall be equipped with a handgrip or other method for easy removal or insertion into plugboards.
5. Plug-in type relays shall be equipped with a latching mechanism or other type of fastening arrangement to provide firm attachment in the plugboards.
6. All vital relays shall be equipped with a minimum of one spare front-back dependent contact for each relay function.
7. The condition (either energized or de-energized) of all relays shall be easily viewed from the front.

B. Vital DC Relays

1. AREMA Signal Manual, Part 6.2.1 except as otherwise specified or as approved by the Engineer shall be followed.

    a. Operable on a nominal voltage in the range of 12 to 28 VDC and capable of continuous operation.
    b. Moisture resistant transparent dust cover of non-flammable composition.
    c. Arc suppression for vital coils shall be built into the relay or attached to plugboard.

2. Biased Neutral Relays

    a. A minimum of six contacts, configured as required.
    b. AREMA Signal Manual, Part 6.1.5 except as otherwise specified.
    c. Biased neutral relays shall be Ansaldo PN-150B or PN-250B relays appropriate for the intended use or an equal approved by the Engineer.

3. Switch Control Relays

    a. A biased-neutral controller or relay shall be provided that will provide control and overload functions for the operation of the switch.
    b. Each contact capable of interrupting the normal switch and lock movement current 10,000 times without its resistance exceeding
    1.0 ohm measured at five amps.
    c. A biased-neutral relay with heavy-duty contacts equipped with magnetic blowout feature to effectively interrupt high currents.
    d. All switch operating relays shall be identical. One normal and one reverse switch operating relay shall be provided for each switch machine.

4. Overload Stick Relays

    a. DC neutral relays equipped with two coils, one to be placed in series with the switch machine to detect overload and the other to be used in the stick circuit. One overload relay shall be

provided for each switch machine.

b. Equipped with sufficient number of contacts to perform the required functions.

c. Solid State device or function may be submitted for approval as an alternative.

5. Timer Relays

a. Vital timer relays shall be microprocessor based, vital time element, plug-in relays which utilize quartz timing components. Timing accuracy shall be 0.1 percent or better, under all operating conditions at any time setting.

b. Vital timer relays shall be field adjustable from 0 seconds to 3599 seconds in 0.1-second increments with safeguards to prevent tampering or accidental manipulation of timer setting.

c. Timer relays shall contain a display to indicate operational status including: de-energized, time running, energized, error codes and time setting.

d. Timer relays shall be equipped with 3F-1B silver impregnated carbon contacts rated at 4 amps at 30 VDC or 175 VAC.

e. Timer relays shall operate on voltage between 9 and 24 VDC with input protected against reverse polarity.

f. Vital timer relays shall be Union Switch and Signal model PN-150EVT, Microchron relay model A62-627 furnished by Alstom, or an approved equal, complete with plugboard and a filter unit for operation from an unfiltered full wave AC rectifier.

6. Flasher relays

a. Solid State devices shall be submitted. Electro-mechanical flasher relays are not permitted.

b. AREMA flashing rates shall be used.

1) Grade crossing: 30 to 50 per minute (adjustable).
2) Signals: 40 per minute, fixed.

c. Current rating of contacts controlling lamps shall exceed the connected lamp load by fifty percent minimum.

d. Built-in arc suppression and surge protection.

e. AREMA Signal Manual, Part 6.1.45 except as otherwise specified.

C. Vital AC Track Relays

1. Capable of operating continuously and successfully without resultant damage with a minimum voltage range of 100 volts to 135 volts inclusive applied to local winding, and with a minimum voltage range of 0.75 volts to 5 volts inclusive applied to the control winding.
2. A minimum of two dependent front-back contacts.
3. Plug-in, two-element, 60Hz, vane type induction relays.

4. AREMA Signal Manual, Part 6.1.35 except as otherwise specified.
5. Moisture resistance transparent dust cover of non-flammable composition.
6. AC track relays shall be Ansaldo PV-250B relays appropriate for the intended use or an equal approved by the Engineer.

D. Non-vital DC Relays

1. General

a. Solid-state devices shall be used where possible. Non-vital relays use shall be minimized.
b. Non-vital logic relays shall be mounted in racks and shall be furnished with transparent dust-proof covers that will not support combustion.
c. Non-vital relays shall be mechanically secured to the relay base.
d. Non-vital relays shall have one spare front-back dependent contact.
e. Non-vital relays shall be rated for continuous power on with a minimum duty cycle of ten million operations.

2. Logic Relays

a. Operating voltage: as for vital relays.
b. Response of less than 100 milliseconds when energized with 75 percent nominal voltage.
c. Response of less than 50 milliseconds when de-energized from nominal voltage.
d. Arc suppression built into the relay or attached to plugboard.
e. A minimum of six front-back dependent contacts capable of carrying one amp continuously without contact resistance exceeding five ohms.
f. Front or back contacts capable of breaking a load consisting of three vital or non-vital relays connected in parallel at least 10 million times without contact resistance exceeding five ohms measured at 10 milliamps.
g. Constructed to assure that contacts break before make.
h. AREMA Signal Manual, Part 6.3.5 except as otherwise approved by the Engineer.

3. Non-vital Heavy Duty Relays: Meeting the same requirements as non-vital logic relays except as follows:

a. Equipped with a minimum of two front-back contacts capable of carrying and breaking a resistive or inductive load, which does not exceed the following characteristics, one million times without the contact resistance, measured at five amps, exceeding one ohm.

1) Maximum continuous volt-amp load: 200 VA.
2) Maximum volt-amp load while relay contact is opening (transient due to inductive surge): 350 VA.
3) Maximum instantaneous load current: 5 amps.

4) Maximum continuous load current: 5 amps.
5) Maximum instantaneous switched voltage: 100 VDC.

b. Each contact shall also be capable of carrying and breaking a resistive or inductive load, which does not exceed the following characteristics, five million times without the contact resistance, when measured at 0.5 amps, exceeding 1 ohm.

1) Maximum continuous volt-amp load: 50 VA.
2) Maximum volt-amp load while relay contact is opening (transient due to inductive surge): 90VA.
3) Maximum instantaneous load current: 1.25 amps.
4) Maximum continuous load current: 1.25 amps.
5) Maximum instantaneous switched voltage: 100 VDC.

E. Non-vital Timers

1. 120 VAC at 60 Hz operating voltage, or 12 to 28 VDC operating voltage.
2. Timing range from 1 second to 200 seconds with adjustment in one- second intervals or fractional parts thereof.
3. Resetting time less than one second.
4. Repeat accuracy plus or minus 0.25 second.
5. Automatic reset.
6. Operating Life: one million operations minimum.

2.02 RELAY PLUG BOARDS

A. A plastic type plugboard for each plug-in relay shall be furnished.

B. Vital relay plugboards shall be equipped with a registration to prevent relays of the wrong style, contact arrangement, or operating characteristics from being inserted.

C. Each plugboard shall have a tag, or other approved means of identification, to indicate the nomenclature of the relay for which it is wired.

D. Plugboards for existing locations or cases shall be Ansaldo old style plugboards.

1. Contractor shall determine the quantity and types of plugboards required.
2. Contractor shall provide the relays.

ARTICLE 3 EXECUTION

3.01 RELAYS

A. In the field, relays shall be installed on racks in relay/instrument houses, or on standard spaced relay support bars in signal equipment cases. Backboards are not permitted.

B. Relay racks shall be located in the relay/instrument houses.

C. No relay shall be mounted on the first row above the finished floor. However, this space may be used in determining spare space requirements for the relay rack.

D. No more than two wires shall be attached to a relay connector.

3.02 PLUGBOARDS

A. Relay plugboards that are factory mounted and wired shall be provided.

B. Noncorrosive fasteners shall be used to mount plugboards on relay rack.

C. All wires terminating at a relay shall have sufficient length to connect to any terminals on the relay.

D. The wire on each contact shall carry an approved tag as specified in Section 13579, “Tags, Locks and Keys.”

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the work of this Section. Payment for this work shall be incidental to the payment for Section 13572– Grade Crossing Warning System.

END OF SECTION

SECTION 13577

ELECTRICAL AND ELECTRONIC COMPONENTS

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section consists of designing, furnishing, installing, testing and commissioning signal system electrical and electronic components as described in the Contract Documents and as specified herein.

1.02 RELATED SECTIONS

A. Section 13570, “Signal System.”

1.03 REFERENCED STANDARDS

A. American Railway Engineering and Maintenance of Way Association (AREMA) Signal Manual of Recommended Practices.

B. Military Standard MIL-STD-202G, Test Method Standard Electronic and Electrical Component Parts.

C. National Electrical Manufacturers Association (NEMA) Standards.

1.04 SUBMITTALS

A. See Section 13570, “Signal System,” 1.05, “Submittals” for the list of submittals required for this Section.

ARTICLE 2 – PRODUCTS

2.01 GENERAL

A. General: Solid-state equipment, including vital and non-vital microprocessor-based equipment shall be provided by Contractor. Such equipment shall be of the most modern design and meet the highest standards of industry and all applicable requirements of the AREMA Signal Manual of Recommended Practices.

B. Isolation and Regulation: Equipment shall be provided complete with the necessary isolation and power regulation devices to assure its performance and reliability under service conditions.

C. Modularity: Equipment shall be modular. Plug-in type printed circuit boards shall be used wherever possible, and be designed so that a board cannot be installed improperly.

D. Lightning Protection: Lightning protection devices shall be provided according to the manufacturer's standard. Protection against lightning, surges, spikes, and over-voltage shall be provided. The manufacturer shall protect all input and output lines and any auxiliary equipment as necessary.

2.02 ALL ELECTRICAL AND ELECTRONIC COMPONENTS

A. Components shall be applied and operated within the published specifications for that component

B. Components shall be readily available in the USA from more than one manufacturer unless otherwise approved by the Engineer.

C. Components shall not be damaged by normal variation in operating conditions including changes in load, low/high supply voltage, low/high ambient temperature, etc.

D. Surge protection devices shall be properly matched to and coordinated with the components they are intended to protect.

2.03 DEVICES AND COMPONENTS

A. Resistors

1. Resistors used in electronic modules shall have a maximum tolerance of +/-5%.
2. Resistors not used in electronic modules shall meet the requirements of the AAR Signal Manual, Part 14.2.15.
3. All resistors shall be rated to dissipate a minimum of 1.5 times the maximum power they will be required to dissipate in operation.

B. Capacitors

1. Capacitors 10 microfarads or less in value used in electronic modules shall have a maximum tolerance of plus or minus 10 percent and be rated for at least 1.5 times the maximum operating peak voltage.
2. All other capacitors shall have a maximum tolerance of plus 75 percent to minus 50 percent and be rated for at least 1.5 times the maximum peak operating voltage.

C. Inductors

1. Inductors used in electronic modules shall be rated to withstand a minimum of twice the maximum peak-to-peak voltage to which they will be subjected to in operation.
2. Inductors used in electronic modules shall have impregnated windings unless otherwise approved by the Engineer.
3. Inductors other than those used in electronic modules shall conform to all applicable recommendations of Part 14.2.20 Recommended Design Criteria for Air-Cooled Reactor), and be subject to the approval of the Engineer.

D. Transformers

1. All transformers in electronic modules shall have impregnated windings unless otherwise approved by the Engineer.
2. Transformers used in electronic modules shall not emit audible noise in excess of 40 dB referenced to 0.0002 dynes per sq. cm. at a distance of 2 feet while operating at rated voltage and load.

2.04 FUSES

A. Fuses shall meet the following requirements:

1. Fuses shall be UL-listed, non-renewable, time-lag Fusetron type unless otherwise approved by the Engineer.
2. Fuse interrupting rating shall be sufficient to interrupt the maximum short-circuit current of the power source to which it is connected.
3. Fuses on equipment racks and all fuses associated with power supplies shall be of the indicating type. This does not apply to AC track circuit fuses.
4. Fuses shall be rated for a minimum of 125 percent of the maximum connected load and derated for an ambient operating temperature of 120 degrees F.

2.05 CIRCUIT BREAKERS

A. Circuit breakers shall meet the following requirements:

1. Breaker interrupting rating shall be sufficient to interrupt the maximum short-circuit current of the power source to which it is connected.
2. Breakers shall have a nominal trip current rating of not less than 125 percent of the maximum steady current required by its load, derated for an ambient operating temperature of 120 degrees F., and in no case less than two times the current rating of the largest connected branch circuit current limiting device.
3. When the breaker is utilized to supply power to loads with inrush current ratings higher than their steady current ratings, the selected breaker shall have a time-delay characteristic curve suitable for that load, according to the breaker manufacturer's recommendations.
4. The voltage rating of the breaker shall not be less than the nominal voltage applied to the breaker.
5. The breaker shall have endurance ratings equal to or greater than 5000 operations at rated voltage and current.
6. Where equipped with a trip-indicating device, the voltage, current and current inrush ratings of the auxiliary trip-indicating contact of breakers shall be adequate.
7. The breaker shall have mechanical characteristic ratings adequate for the service to which it is assigned.
8. Circuit breakers shall be UL-listed unless otherwise approved by the Engineer.

2.06 ELECTRICAL CONNECTORS

A. A minimum of electrical connectors, and as few different sizes and types as practicable, shall be provided in all equipment. All connections shall be made using lugs, crimp, cage clamp, or bolted connectors, as applicable.

1. Fatigue. Electrical connectors shall not be subject to contact fatigue, development of high contact resistance, and failure in normal operational use or maintenance.
2. Removal. Quick-disconnect, hand-operated electrical connectors shall be provided unless otherwise approved by the Engineer.
3. Identification. All electrical connectors shall be color coded or numbered. In locations where mis-mating of electrical connectors might occur if connectors are identical, connectors shall be dissimilar or mechanically keyed.
4. Pins and Cables. Connectors shall have recessed pins wherever possible. Connectors not having recessed pins shall be made rigid. Wherever possible, connections shall be designed in a manner which will result in no voltage on exposed pins when connectors are disconnected. Connector cables shall be provided with enough slack to permit withdrawal of assemblies for test.

2.07 PRINTED CIRCUIT CARDS

A. Printed circuit cards shall meet the following requirements:

1. Printed circuit cards shall be of glass epoxy construction meeting the requirements of NEMA Type FR-4, grade G-10.
2. Printed circuit cards shall have thickness sufficient to permit easy insertion and removal without buckling or breaking. Large cards shall be provided with lever or cam locking devices.
3. Conductor material shall be etched copper. Width and thickness of this copper shall be in accordance with MIL-STD-275 or IPC-D-275.
4. Printed circuit cards shall be coated with conformal coating in accordance with (PC Guidelines (IPC-CM-770).
5. Component mounting and lead solder connections shall be in accordance with (PC Guidelines (IPC-CM-770).
6. Printed circuit cards shall be marked with the identification of each component adjacent to the place where it is installed. Provide diagrams illustrating the layout and identification of each component on the card for approval by the Engineer.

B. Printed circuit card connectors and associated terminals shall be:

1. Etched on both sides of printed circuit card connections.
2. Gold plated 0.00127 mm (0.00005-inch) thick minimum, unless otherwise approved by the Engineer.
3. Insulation resistance greater than 1000 Megohms at 500 VDC.
4. Temperature rating of 0 to 105 degrees C (32 to 220 degrees F).
5. Connector shall withstand card removal/insertion for regular testing and

maintenance.

6. Keyed to accept only those cards intended for that particular position, except where electrical keying is employed.

2.08 LIGHTNING ARRESTORS AND SURGE PROTECTION

A. Lightning arrestors shall be provided on incoming and outgoing conductors to protect equipment inside an equipment housing from surges caused by lightning. Surge protectors shall be applied in coordination with lightning arrestors.

B. Signal arrestors shall be specifically designed for railway signaling use. Signal arrestors shall be designed to minimize the risk of end-of-life failure in a shorted or low resistance condition.

C. Surge protection arrangements shall be properly coordinated to maximize protection of equipment and longevity of the surge protection devices.

D. Arrestor Types

1. Arrestors, line-to-ground

   a. The arrestor shall pass negligible current at rated circuit voltage.
   b. The arrestor failure mode shall be to open rather than short circuit or partial short circuit.
   c. The arrestor shall be suitable for use on circuits of 0 to 35 VDC without impedance restrictions.
   d. The arrestors shall have an average DC breakdown voltage of 1000 VDC or less.
   e. Arrestors shall have a maximum impulse spark-over voltage not exceeding 2000 volts peak for an impulse with a 10 kV/microsecond rise time. The arrestor shall be heavy duty Clearview as manufactured by Siemens (Safetran) or approved equal.

2. Arrestors, line-to-line type

   a. Arrestors shall pass negligible current at rated circuit voltage.
   b. Arrestors shall be suitable for use on circuits of 0 to 20 volts without circuit impedance restrictions.
   c. Arrestors may be used on circuits having voltages higher than 20 volts when the circuit has sufficient impedance to limit the follow-through current after a surge to a value that can be interrupted by the arrestor.
   d. Arrestors shall have an average breakdown voltage of 200 volts or lower.
   e. Arrestors shall have a maximum impulse spark-over voltage not exceeding 500 volts peak for an impulse with a 10 kV/microsecond rise time.

2.09 SURGE PROTECTION

A. Surge Protection: Surge protection shall be a shunting device, which triggers at a specified voltage to protect solid state equipment and other types of signaling and track circuit equipment from surges of AC or DC power.

B. Application: Surge protection shall be provided on all equipment for protection against AC or DC power line surges. Surge protection shall be similar to those manufactured by Siemens (Safetran), Alstom (GRS, GETS, Harmon), Ansaldo (US&S), or approved equal.

ARTICLE 3 – EXECUTION (Not Used)

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the work of this Section. Payment for this work shall be incidental to the payment for Section 13572 – Grade Crossing Warning System.

END OF SECTION

SECTION 13578

HOUSINGS AND HOUSING EQUIPMENT

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section consists of designing, furnishing, installing, testing and commissioning signal system Relay/Instrument Houses and Cases as described in the Contract Documents and as specified herein.

B. The Work shall include associated equipment such as environmental control equipment, racks, grounding systems, housing lights, outlets, alarms, and cable trays.

1.02 RELATED SECTIONS

A. Section 13570, “Signal System.”

1.03 REFERENCED STANDARDS

A. American National Standards Institute (ANSI) Standard Z55.1.

B. American Railway Engineering and Maintenance of Way Association (AREMA) Signal Manual of Recommended Practices.

C. National Electrical Code (NEC) Article 318.

D. National Electrical Manufacturers Association (NEMA) Standard VE1.

1.04 SUBMITTALS

A. See Section 13570, “Signal System,” 1.05, “Submittals” for the list of submittals required for this Section.

1.05 DELIVERY, STORAGE AND HANDLING

A. Relay/Instrument Houses and Cases shall be factory wired.

B. Plug-in relays and other equipment subject to damage shall be dismounted, placed in shipping cartons, secured and shipped in the house or case.

C. Houses and cases shall be shipped with all entrances plugged, locked, and sealed.

ARTICLE 2 – PRODUCTS

2.01 GENERAL

A. All housing equipment shall be designed to operate correctly and without damage over a temperature range of -40 to 71 degrees C (-40 to 160 degrees

F). Where AREMA requirements for specific equipment exceed the limits of this temperature range, equipment shall be designed to conform to requirements set forth by the AREMA.

B. An embossed metal nameplate on the outside shall identify each house or case. Information on the nameplate, in 130 mm (5 inch) high black letters on a white background, shall give the name of each interlocking or grade crossing.

C. Finishes: Unless specified otherwise, the following requirements shall apply to all housings and housing equipment:

1. Exterior metal surfaces, excluding the floor bottom, shall be painted with one coat of rust inhibiting vinyl primer and at least two finished coats of high solids vinyl. The coating shall be graffiti resistant. Minimum dry film thickness shall be 6 mils. Finish color shall be as specified by Authority.
2. Apply coal tar enamel coating to exterior floor bottom and base framing.
3. Interior metal surfaces, excluding the floor: Apply one coat of rust inhibiting vinyl primer and at least one finish coat of high solids vinyl. Minimum dry film thickness shall be 2 mils. Color shall be manufacturer's standard for the service specified.
4. Interior floors: Apply one coat of alkyd primer and at least two coats of alkyd resin industrial enamel for a dry film thickness of 6 mils. Color shall be medium light gray No. 49 in accordance with ANSI Z55.1.
5. If any painted surface is damaged prior to the completion of the Work, such damaged surface shall be cleaned, touched-up or completely repainted by Contractor without additional compensation.

2.02 RELAY/INSTRUMENT CASES

A. Cases shall be constructed of 12 gauge Cor-Ten steel or aluminum. Interior of cases shall be lined with 1 inch Thermax insulation.

B. Maximum dimensions: 7 feet high, 10 feet wide, 28 inches deep. If equipment at a location requires more than one case, a house shall be used instead.

C. Doors on cases shall be as described for the houses. Doors shall be provided for each compartment, both front and rear, on all cases.

D. All instrument cases shall include platform supports and platforms.

E. A minimum of 10 percent spare usable space shall be provided in each case compartment, both front and back. The 10 percent spare space shall, in no instance, be less than space required for one vital relay row.

2.03 ENVIRONMENTAL CONTROL EQUIPMENT

A. Relay/Instrument Cases

1. All case equipment shall operate correctly and without damage over a temperature range of –40 degrees C to 71 degrees C (-40 degrees F to

160 degrees F). Where AREMA requirements for specific equipment exceed the limits of this temperature range, such equipment shall conform to requirements set forth by the AREMA.

2. If the existing power feed is insufficient the new case shall be furnished complete with utility connection, meter, circuit protective devices, and all appurtenances necessary to supply to AC power required at the site.
3. Instrument cases shall be complete with relay mounting bars and shall be of sufficient size to provide space for the proposed equipment and wiring, plus 10 percent spare relay space. A non-corrosive stud bolt for externally grounding the case shall be included. Cable entrance shall be in the bottom of the case with provisions for sealing the entrance, and supports for securing the cables and wiring.
4. Cases shall be factory wired and tested in accordance with approved circuit and wiring diagrams. Wire, cable, wire and cable termination, cable entrances, and tagging shall be provided in accordance with the Contract Documents. All bundled wire shall be tied approximately every 75 mm (3 inches) with nylon straps in accordance with AREMA recommendations.
5. Provide passive ventilation as required to maintain the operating environment necessary for signal equipment housed within cases. Fans are not permitted.
6. Provide a minimum of two ventilating openings in each door, covered with fine aluminum wire mesh screens and protected by hoods to prevent entrance of precipitation.
7. A 500 watt heater unit similar to Berko / Marley Electric Heating unit SRA1012DSF shall be provided in the case containing the batteries as shown in the Pleasant St Highway Crossing Case Typical location drawings.

2.04 RACKS

A. Racks shall meet the following requirement:

1. Open frame welded construction.
2. Frame: Minimum 14 gauge cold rolled steel.
3. Base: Minimum 12 gauge cold rolled steel with a nominal height of 3.5 inches.
4. Chassis supports or guides: Minimum 11 gauge cold rolled steel.
5. Maximum height of rack shall be 7 feet, with 31 inch maximum width and 24 inch maximum depth.
6. Racks shall not be of the swing-out type unless approved by the Engineer.
7. Racks shall have a minimum clearance at front and back of 920 mm (3 feet) from all other equipment and walls.

2.05 GROUNDING

A. Contractor shall provide a grounding system at each house or case as specified in Article 3.03.

B. Contractor shall provide a hard drawn pure copper ground bus plate of 8

inches square minimum and 0.375 inch thick minimum, for each house and case.

C. Ground cable from houses and cases to ground rods shall be hidden as much as possible to prevent being vandalized.

2.06 LIGHTING AND OUTLETS

A. For each wayside case, an LED light with pull chain socket shall be provided, inside and above each door.

B. One convenience outlet with GFI shall be provided in each new case. Outlets shall be circuit breaker protected. Wire shall be run in conduit.

2.07 CABLE TRAYS

A. Cable trays and accessories required for equipment in the house shall be provided.

B. Ladder type cable trays with 230 mm (9 inch) rung spacing.

C. Steel, 76 mm (3 inch) deep minimum, zinc coated in accordance with NEMA VE1.

D. Design for NEMA Class II load capacity of 22.7 kg per 305 mm (50 pounds per linear foot) and test in accordance with NEMA load test VE1-3.01.

E. Radius of Bends: 610 mm (24 inches).

2.08 CABLE TRAY CHANNEL SUPPORTS

A. Fabricate from minimum 12 gauge steel channel, 38 mm by 38 mm (1.5 inches by 1.5 inches) with a continuous 23 mm (0.875 inch) wide slot. Zinc coated.

B. Hardware, Fittings, and Brackets: Zinc coated.

C. Assembled supports, fittings, brackets, and hardware shall be designed to carry the load with a safety factor of safety of three or greater.

2.09 POWER OFF INDICATOR LAMP

A. An POWER ON indicator LED shall be mounted on case containing batteries or power supplies.

B. The indicator shall be mounted where it is visible to passing LRV operator and from vehicles on Potomac Ave.

C. The indicator will be dark when AC power is removed from the battery charger.

ARTICLE 3 – EXECUTION

3.01 RELAY/INSTRUMENT HOUSES AND CASES

A. Contractor shall provide enough level walking space 610 mm (2 feet) minimum around the house and case (with doors open) for maintenance.

B. In each case, main terminal boards shall be mounted facing the front.

C. Cases shall be installed as specified in Section 13585, “Signal Installation.”

3.02 RACKS

A. Contractor shall install groups of racks and equipment so that similar types of equipment or functions of a similar nature are together. Relay rack configuration shall be consistent at all locations.

B. Rack clearance shall be a minimum of 3 feet to provide access to the front, back and around the ends of the rack.

C. Racks shall be shock-mounted.

D. Rack terminals shall be located on upper portion of racks.

E. A unique white identification number shall be stenciled on each rack top, front, and back.

F. A minimum of 20 percent spare space shall be provided on each equipment rack for future equipment. The 20 percent shall be equal to or greater than one vital relay row.

3.03 GROUNDING

A. The ground bus plates in the houses shall be connected to earth ground using a minimum No.6 AWG stranded copper wire.

B. Ground wire for any equipment connected to ground plate shall be at minimum a No. 6 stranded, copper wire.

C. In the field, earth grounds shall be supplied as specified in Section 13574, “Signal Installation.”

D. Grounding of Equipment inside the Housings: The following equipment shall be grounded in the manner specified:

1. The grounding of entrance racks and instrument racks located in the houses and cases shall be accomplished using the ground bus as specified herein. All racks shall be electrically connected to the ground bus by means of a minimum No. 6 AWG stranded wire. Means shall be provided at each rack to isolate the rack from ground for test purposes. Cable trays shall be isolated from the racks and grounded separately.
2. All other individual apparatus not located on racks or herein specified to be grounded shall have individual insulated minimum No. 6 AWG extra

flexible ground connections to the ground bus. These connections shall be designed to be of the shortest possible distance.

3. Any special grounding work or material required for the equipment furnished under this Contract, shall be provided at no additional cost to Authority.

3.04 CABLE TRAYS

A. Cable trays shall be installed in accordance with NEC, Article 318.

B. Trays shall be supported so maximum deflection after cable installation is 6.4 mm (0.25 inch). Maximum spacing of supports shall be 2439 mm (8 feet).

C. Supports shall be anchored with 13 mm (0.50 inch) minimum bolts.

D. Tray shall be supported adjacent to and on each side of joints and fittings.

E. Trays shall be mechanically anchored to supports.

F. Trays shall be bonded and grounded to the bus plate. Trays shall be isolated from racks to prevent ground loops.

G. Cable support shall be provided between conduit stub-ups or raceways and the cable trays.

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the work of this Section. Payment for this work shall be incidental to the payment for Section 13572 – Grade Crossing Warning System.

END OF SECTION

SECTION 13579

TAGS, LOCKS AND KEYS

ARTICLE 1 GENERAL

1.01 SUMMARY

A. The Work of this Section consists of designing, furnishing and installing tags, locks, and keys as described in the Contract Documents and as specified herein.

1.02 RELATED SECTIONS

A. Section 13570, “Signal System.”

1.03 SUBMITTALS

A. See Section 13570, “Signal System,” 1.05, “Submittals” for the list of submittals required for this Section.

ARTICLE 2 – PRODUCTS

2.01 TAGS

A. Tags shall meet the following requirements:

1. Stencils: White enamel paint.
2. Flat Tags
    a. Laminated phenolic or vinyl plastic, white with black lettering.
    b. Minimum two holes for screw mounting.
    c. Minimum thickness 0.050 inch.
3. Wire Tags
    a. White vinyl plastic with black lettering, protect with a 0.005 inch clear over laminate.
    b. Minimum 0.020 inch thick.
    c. All corners rounded to approximately 3.2 mm (0.125 inch) radius.
    d. Lettering minimum 3.2 mm (0.125 inch) high with minimum 2.4 mm (0.094 inch) spacing between lines.
4. Cable Tags: Same as wire tags except attached to the cable with pre-tied nylon cord loops.
5. Sleeve Tags
    a. White vinyl plastic with black lettering.
    b. 0.125 inch lettering.

c. Lengths as required, minimum length 0.75 inch.
d. Diameter shall be selected for a snug fit on wire.

6. Cast Metal Tags

a. Malleable cast metal.
b. Painted white.
c. Minimum height 3 inches.
d. Minimum thickness 1.6 mm (0.0625 inch).

7. Brass Tags

a. 0.25 inch letters and numbers stamped into tag.
b. Sufficient size to contain required information, “Danger 650 Volts,” without crowding.
c. Minimum thickness 0.8 mm (0.03125 inch).

2.02 LOCKS AND KEYS

A. Locks and keys shall meet the following requirements:

1. Padlocks

a. Same as now in service on existing Authority LRT manufactured by American Lock.
b. All by the same manufacturer.
c. Solid block of extruded brass.
d. Shackle of heavy wrought brass or stainless steel.
e. Six-pin cylinder type.
f. Suitable for outdoor use.

2. Keys

a. Brass.
b. Not commercially duplicable.
c. Two keys per lock.
d. Coding unique to Authority LRT system.

1) For all cases, cabinets and switch machines – American Lock key # 54832.
2) For all grade crossing cases – American Lock key # 44368.
3) For Local Control Panels (LCP) as specified in 15381.

3. Keying Arrangement

a. The keying arrangement shall be the same as that used on the existing Authority system.

ARTICLE 3 – EXECUTION

3.01 TAGGING

A. A unique equipment identification code shall be provided and installed for each type of fixed equipment and replaceable element. The identification code shall be up to 10 digits in length and the method of coding shall be submitted for review and approval of the Engineer prior to submittal of wiring diagrams/Shop Drawings.

B. Sleeve tags shall be installed on each end of all wires showing the origin and destination. Tags shall not obscure connecting links used between terminal binding posts. Tags shall be installed so that they can be read with a minimum of disturbance to the tags and wiring.

C. Stencil

1. Field cases and junction boxes using 1.5 inch lettering to identify location.
2. Relay and equipment racks and cabinets, using 0.75 inch lettering to identify racks and cabinets.

D. Install flat tags on:

1. Relay plugboards to show relay designation.
2. Equipment to show equipment designation.
3. Main terminal board to identify cables.

E. Wire tags with circuit nomenclature, location, and destination shall be installed:

1. On terminal ends of all wires and cable conductors installed.
2. Adjacent to terminals or binding posts.
3. Tags shall not slide off the wire when wire is disconnected from its termination point.
4. Tag shall be applied to cable conductors as conductors are verified during testing. Nomenclature shall be verified at both ends.

F. Cable tags shall be installed, showing cable identification, with pre-tied nylon cord loops on the cable sheath near the pothead.

G. Sleeve tags shall be installed on all wires connected to plugboard contacts.

H. Brass Tags

1. Use stamped brass tags attached to adjacent ties to identify impedance bonds with 0.25 inch lettering.

3.02 PADLOCKS

A. Contractor shall install padlocks on:

1. Wayside field cases and junction boxes.
2. Terminal cases.

3. Signal heads.
4. Signal instrument housings, all doors.
5. Grade crossing warning system equipment housings, all doors.
6. Grade crossings equipment.
7. Other equipment provided under this contract, as appropriate.

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the work of this Section. Payment for this work shall be incidental to the payment for Section 13572 – Grade Crossing Warning System.

END OF SECTION

SECTION 13580

SIGNAL POWER DISTRIBUTION

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section consists of designing, furnishing, installing, testing and commissioning the signal power distribution system as described in the Contract Documents and as specified herein.

B. The Work shall include feeders, buses, transformers, ground detectors, and associated auxiliary materials and equipment.

1.02 RELATED SECTIONS

A. Section 13570, “Signal System.”

1.03 REFERENCED STANDARDS

A. American National Standards Institute (ANSI) Standard C2.

B. National Fire Protection Association (NFPA) Standard 70.

1.04 SUBMITTALS

A. See Section 13570, “Signal System,” 1.05, “Submittals” for the list of submittals required for this Section.

1.05 DESIGN CRITERIA

A. General

1. Power for signal equipment locations and grade crossing warning system equipment locations shall be 120 VAC, 60 Hz, single phase.
2. Power for the signal system and grade crossing warning system shall be applied to AC buses through transformers as required for the various loads to be fed from these buses.
3. Power of 120 VAC, 60 Hz will be used for all signal DC power supplies (signal logic circuits, power switches); signal equipment housing lights, fans, air conditioning, outlets, alarms.
4. At grade crossing warning system locations, power for DC power supplies (gates, crossing logic circuits); equipment housing lights, fans, outlets, alarms; flashing lights; and crossing warning indicators shall be 120 VAC 60 Hz single phase.

B. Power Calculations

1. Contractor shall compute the size of the power distribution system required to feed equipment and design the complete power layout of feeders, transformers, fuses, and buses, based on the locations and sizes of individual signal and grade crossing warning system loads. Design shall be subject to approval of the Engineer.
2. Size all feeders to carry the rated load with a voltage drop of not more than 5 percent, except no feeder shall be smaller than No. 6 AWG. Size of feeders shall be able to carry a continuous load equal to 125 percent of the total continuous load that is required by the portion of the system to be fed.

ARTICLE 2 – PRODUCTS

2.01 POWER SUPPLIES

A. General: All DC power supplies furnished under this Contract shall meet the following basic requirements:

1. Internal Transformers: Transformers used in DC power supplies shall not emit audible noise in excess of 50 dB (referenced to 0.0002 dynes/sq. cm.) at a distance of 910 mm (3 feet) when operated anywhere within the range of input and output voltages and currents specified.
2. Electrical Insulation: The power supplies shall be insulated to withstand, for one minute, 600 VAC, 60 Hz applied between the input leads (connected together) and the output leads (connected together).
3. Cooling

    a. The power supplies shall be designed for natural convection cooling. Supplementary fans or other cooling devices are not permitted.
    b. Contractor's design shall allow for a power supply to be mounted on a rack with other power supplies and ensure the convection area and other components are sized and have dissipation ratings for such installations.

4. Duty Cycle: The power supplies shall be designed for a continuous duty cycle.
5. Failure Alarm

    a. Each DC power supply shall be equipped with a failure alarm device, which shall detect any internal failure that would prevent the power supply from delivering its full rated load.

b. This device shall be normally energized by a small percentage of the rated load current and cause two separately wired internal contacts to open when a failure is detected.
c. One of these contacts shall be independently wired to binding posts for an external alarm indication circuit. The second contact shall be used to light an indication lamp or LED indicator mounted on the power supply. This circuit shall function even if the output voltage is maintained by a tandem power supply.
d. The power supply shall be so designed that the internal failure indication lamp or LED can be replaced without removing the power supply or any adjacent equipment from the rack.

6. Input Voltage: The power supplies shall not be damaged by a sustained input voltage varying from 0 to 150 percent of the rated input voltage.
7. Current Rating: The power supplies shall be sized in such a manner that no individual power supply operates at less than 20 percent of its rated current output during normal operation of the power bus fed therefrom.
8. Output Current:

a. The power supplies shall self-limit their output current to no more than 200 percent of their rated load unless otherwise specified herein.
b. Reverse output current protection shall be provided to prevent shorting or sagging of tandem supplies in the event of filter capacitor failure.

9. Identification: Each power supply shall be clearly and permanently labeled with the following:

a. Manufacturer's name.
b. Part or model number.
c. Serial number.
d. Input rating.
e. Output rating (continuous or intermittent).

10. Components and Wiring

a. Electrical and electronic components used in DC power supplies shall be as specified in Section 13577, “Electrical and Electronic Components.”
b. Power supplies, which are designed to be repaired in the rack, shall have all components in modular assemblies, which do not require soldering to replace.

B. Batteries and Chargers: Storage batteries and chargers shall be supplied in each grade crossing house or case.

1. Each battery shall consist of maintenance free storage cells, and shall be sized so that operating voltages and currents are maintained throughout the crossing warning system cycle.
2. The chargers for these batteries shall be regulated and filtered.

a. Output shall be adjustable up to 19 VDC and current to 40 amperes.
b. Ripple shall not exceed one volt peak-to-peak at 40 amperes output.

C. DC Filtered Power Supplies and Rectifiers

1. Rectifiers for supplying power for the operation of DC equipment in the relay/instrument houses and cases shall be an Engineer-approved silicon rectifier type designed to operate from the local 60 Hz 120 VAC power source circuit.
2. Rectifiers shall be capable of supplying the entire connected load plus 50 percent for an indefinite period without overheating or damage.
3. Each rectifier output shall be filtered and regulated such that the supply voltage remains stable.

a. The voltage regulation under these conditions shall be sufficient to ensure continuous proper operation of all connected equipment. The voltage regulation shall not exceed five percent of the nominal output voltage, with line voltages between 105 and 125 VAC.
b. Ripple shall not exceed one percent at full rated load.

2.02 BATTERIES

A. Two sets of lead-acid batteries shall be provided for each crossing warning system. One consisting of 6 cells of 240 AH rated batteries for Audio Frequency Overlay (AFO) and general circuit operations and a second set of 7 cells of 240 AH batteries for operation of the flashing lights and gates.

B. Batteries shall be sealed maintenance free cells using gelled electrolyte contained in a leak proof, flame retardant container.

2.03 OTHER POWER DEVICES

A. Fuses provided by Contractor shall meet the following requirements:

1. Nonrenewable, of fiber-case, time lag, Fusetron type.
2. Correct size and rating to protect the electrical equipment from overload.

3. Fuses installed in equipment racks: indicating type with fuse alarm circuits provided to alarm individual fuse failure. Switch actuating indicating fuses shall not be allowed. Fuses shall provide an electrical connection directly to the alarm circuit.
4. In DC branch circuits, where fusing is impractical, a protective resistance unit shall be provided.
5. All fuses shall be centrally located on power distribution panels or racks.

B. Circuit Interrupters (Breakers) provided by Contractor shall meet the following requirements:

1. Equipment intended to break current at fault levels shall have interrupting rating sufficient for the system voltage and the current which is available at the line terminals of the equipment.
2. Equipment intended to break current at other than fault levels shall have an interrupting rating at system voltage sufficient for the current to be interrupted.
3. Circuit interrupters may be required in lieu of fuses at the discretion of the Engineer.

ARTICLE 3 – EXECUTION

3.01 POWER CABLE

A. Contractor shall provide and install power cable in conduit for the distribution of power to equipment locations from the service meter to the equipment housing. Unless otherwise specified, power cable shall be as specified in Section 13575, “Wire and Cable.”

B. Where power comes from an adjacent substation, signal or communication location, Contractor shall provide and install power cable in conduit from the source location to the equipment housing. Power cable shall be as specified in Section 13575, “Wire and Cable.”

C. Where power comes from the local commercial power source the following shall be provided and installed:

1. A pole-mounted power distribution box, which will be used to house a watt-hour meter and its enclosure, associated circuit breakers and other appropriate electrical items and hardware.
2. Power cable in conduit from the signal location to the power distribution box.
3. Meter and incoming cable from power source to the distribution box shall be provided and installed by the local power company. Contractor shall

interface with the local power company through the Engineer before installation of power distribution equipment.

4. Power distribution box and associated equipment shall meet all applicable code requirements and standards.

D. Power cable shall be installed per Section 13574, “Signal Installation.”

3.02 POWER EQUIPMENT

A. Power Supplies

1. Wall mount all power supplies.

B. Transformers

1. Install transformers in accordance with manufacturer's instructions.
2. Conduit Connections: Use flexible metal conduit not less than 458 mm (18 inches) or more than 915 mm (36 inches) in length unless otherwise approved.
3. Comply with NFPA 70, Article 450, and ANSI C2, Section 15.
4. Verify all circuits are connected as indicated.
5. Perform insulation and circuit continuity tests prior to connecting primary service.
6. Grounding shall be as specified in Sections 13574, “Signal Installation,” and 13578, “Housings and Housing Equipment.”

3.03 POWER SUPPLIES

A. Mounting height of power supplies, battery chargers, and rectifiers shall be restricted to an area between 457.2 mm (1.5 feet) and 1764 mm (5.5 feet) above the finished floor.

B. An approved method shall be used to mount a typed or machine printed nametag for each power supply, battery charger, rectifier and other power-related devices, on the front plate of the equipment. The nametag shall be easily replaceable, but not come off during normal service.

C. All power supplies, battery chargers, rectifiers and other power-related devices shall be tested in accordance with the manufacturer’s recommendations.

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the work of this Section. Payment for this work shall be incidental to the payment for Section 13572 – Grade Crossing Warning System.

END OF SECTION

SECTION 13581

SIGNALING SYSTEM TEST AND INSPECTION

ARTICLE 1 – GENERAL

1.01 SUMMARY

A. The Work of this Section consists of testing and inspecting the Signal System as described in the Contract Documents and as specified herein.

B. Through testing and inspection Contractor shall verify the Signaling System meets Contract specifications and all technical and performance requirements. Contractor shall test and inspect all items of hardware and software that it supplies, and furnish test results to the Engineer.

C. Tests and inspections shall be conducted according to procedures submitted by Contractor and approved by the Engineer. Suppliers' existing inspection and factory acceptance test (FAT) procedures may be utilized upon the Engineer's approval.

D. Contractor shall furnish all labor and materials necessary to perform tests, record data, and prepare reports.

E. Changes required to bring the system into compliance shall be at no additional cost to Authority, including costs for additional testing.

F. Upon completion of each test, all test equipment and temporary facilities shall be removed and the system restored to full operational status.

1.02 RELATED SECTIONS

A. Section 13570, "Signal System."

B. Section 13572, "Grade Crossing Warning System."

1.03 REFERENCED STANDARDS

A. American Railway Engineering and Maintenance of Way Association (AREMA) Signal Manual of Recommended Practices.

B. Federal Railway Administration, Part 236 – Rules, Standards and Instructions.

1.04 SUBMITTALS

A. See Section 13570, “Signal System,” 1.05, “Submittals” for the list of submittals required for this Section.

1.05 STATISTICAL SAMPLING PLANS

A. Sampling plans may be used when tests are destructive, or when quality trend data, inherent characteristics of the product, or the non-critical application of the product indicate that a reduction in testing or inspection can be achieved without jeopardizing quality.

B. Contractor shall provide details on any sampling plans and submit the proposed sampling plan to the Engineer for approval prior to its use.

C. Any sampling plan used shall provide valid confidence and quality levels, as solely determined by the Engineer.

1.06 TEST EQUIPMENT AND CALIBRATION

A. Contractor shall supply all test equipment required for factory and field testing.

B. Each piece of test equipment shall have its own permanently affixed identification number and shall be calibrated, adjusted and maintained at prescribed intervals, or prior to use, against certified equipment having known valid relationships to nationally recognized standards. Calibration shall be traceable to the National Institute of Standards and Technology (NIST).

C. The method and interval of calibration for each item shall be defined, based on type of equipment, stability, characteristics, required accuracy, intended use and other conditions affecting measurement control.

D. When measuring and test equipment are found to be out of calibration, the Engineer will conduct and document an evaluation of the validity of previous inspection and test results to determine the acceptability of items previously inspected and tested. If it is determined that the testing and inspection is invalid, a retest shall be conducted with properly certified test equipment and resubmitted for approval. Any additional testing shall be performed at Contractor’s expense.

E. Out-of-calibration tools and equipment shall be tagged and not used until they have been re-calibrated and verified.

F. If any tools or equipment are consistently found to be out of calibration, as determined by the Engineer, they shall be repaired or replaced by Contractor.

G. A calibration shall be performed when inaccuracy is suspected.

H. All calibrations/certifications shall be recorded and become part of the quality assurance records.

ARTICLE 2 – PRODUCTS

2.01 INSPECTION AND TEST PLAN

A. Contractor shall submit an Inspection and Test Plan for the Signal System to the Engineer for approval. The purpose of this plan shall be to:

1. Identify all of the inspections and tests to be performed.
2. Ensure that testing is in compliance with the overall Quality Assurance Program.
3. Achieve mutual understanding between Contractor and the Engineer on the range, depth, and other aspects of tests to be conducted.

B. The Inspection and Test Plan shall contain the following as a minimum:

1. Flow diagram showing the logical sequence of inspections and tests starting with qualification and factory assembly and concluding with system demonstration.
2. List of factory and manufacturer's recommended field test and inspection procedures, proposed submittal schedule, and proposed test schedule.
3. Outline and format of procedures and test data sheets for each type of test.
4. Requirements (if any) for Authority personnel.
5. Recommendations for witnessing by the Engineer.
6. Organization chart and description of Contractor's factory and field test organizations.
7. Diagram showing the flow of quality assurance and test data and its use within Contractor's Engineering and Quality Assurance organizations.
8. A list of all test equipment to be used in testing and calibration of the Signal System. The list shall include manufacturer and model number of each piece of test equipment and shall include date of calibration/certification, which shall be within 60 days prior to use.
9. Proposed test schedule indicating tests that must be conducted during peak hours and tests that could interfere with Authority's revenue service.

2.02 TEST PROCEDURES

A. Contractor shall submit all test procedures to the Engineer for approval at least 60 days before the scheduled test. No test procedures will be approved by the Engineer prior to approval of Contractor's Inspection and Test Plan.

B. Test procedures shall include, as a minimum, the following information:

1. Objective and scope.
2. Test setup.
3. Test prerequisites.
4. Test equipment to be used.
5. Personnel required for the test.
6. Estimated duration of the test.
7. Pass/fail criteria.
8. Samples of data sheets.

C. No material or test equipment will be furnished by Authority for any testing or inspection. Requests for Authority operating personnel shall be submitted to the Engineer no later than 30 days before any testing is to be performed.

D. Supplier's existing test and inspection procedures may be utilized upon the Engineer's approval.

2.03 INSPECTION AND TEST REPORTS

A. Contractor, Subcontractors, and Suppliers shall submit signed inspection and/or test reports for every inspection and/or test performed to the Engineer no later than 10 days after completion.

B. Test reports shall contain, as a minimum, the following information:

1. All data obtained during tests.
2. Analysis of the data.
3. Conclusions relating to the pass/fail criteria outlined in the test procedure.
4. Discrepancies found and corrective action taken.
5. Date of test.
6. Signature of person conducting the test.
7. Space for signature of witness.
8. Specific test equipment used by name, type, serial number, and calibration details.
9. Tested equipment item by serial number.
10. Statement of remediation done to pass tests, retest criteria, and retest results. Test equipment of the same model and, if at all possible, the same unit shall be used during retesting to ensure consistency. Changes made by Contractor in order to pass tests shall be at no additional cost to Authority.

C. Inspection reports shall contain, as a minimum, the following information:

1. Complete description of facilities inspected.
2. Complete description of observations.
3. Discrepancies found and corrective action taken.
4. Date of inspection.
5. Signature of person conducting inspection.
6. Space for signature of witness.

D. All factory and field test reports shall be documented on approved forms and submitted as project record.

2.04 FACTORY INSPECTIONS AND TESTS

A. Contractor shall inspect and test each item to be provided under the Contract. The following inspections and tests shall be included:

1. Receiving inspection of raw materials or component parts at the factory.

    a. These inspection measures shall be used to preclude the use of incorrect or deficient products and to ensure that only products which are acceptable and in compliance with the Contract Documents are used and installed.
    b. All product certifications and Test Reports used as the basis for acceptance by Contractor shall be preserved.

2. In-process inspections of production operations.
3. Factory qualifications testing, if applicable, as described in Article 2.05.
4. First article inspection test, if applicable, as described in Article 2.06.
5. Environmental testing, if applicable, as described in Article 2.07.
6. Factory acceptance tests, as described in Article 2.08.
7. System level inspections and tests as described in Article 2.09.

B. General Requirements for Factory Inspections and Tests

1. Design tests: All subsystems, equipment, and components shall be tested at the factory on the first assembled equipment or system component to demonstrate compliance with specifications and/or industry standards.
2. Production tests: All systems, subsystems, and equipment shall be 100 percent factory inspected and tested to verify the quality and correctness of the manufacturing and assembly process.
3. Components used in a failsafe or vital circuits shall be 100 percent inspected and tested.

4. Other components or units that are not used in a failsafe circuit may be inspected and tested using a sampling plan approved by the Engineer.
5. The Engineer shall have the right to witness inspections or tests in Contractor's, Subcontractors', or Suppliers' plants.
6. Contractor shall obtain the Engineer's approval of test results prior to making any shipment from its or its Suppliers' plants.
7. When approved by the Engineer, Suppliers' existing factory test procedures may be used.

C. Vital Relays

1. All vital relays shall be factory tested in accordance with Section 13588, "Relays and Plugboards," and the AREMA, Communication and Signal Manual of Recommended Practices, Parts 6.2.1 and 6.1.5.
2. Evidence of passing the factory inspection and testing shall be indicated on the relay where practical; otherwise a report submitted with the shipment.

D. Rack Wiring

1. All factory-installed rack wiring shall be tested before shipment.
2. Contractor shall perform point-to-point, wire count and tag checktests to verify the continuity and connection of each conductor.

E. Operational Testing

1. All equipment shall be operationally tested as a complete functional assembly prior to shipment.
2. Contractor shall test each function by simulating operating conditions.
3. Where equipment is related to a safety function, each component or subassembly shall be separately inspected and tested.

F. Notification of Testing

1. In order to have the opportunity to witness testing, the Engineer shall be notified in writing a minimum of 2 weeks in advance of each test.
2. When tests are to be conducted continuously as a production-line routine, inform Engineer in writing at least 2 weeks in advance of the date of testing and the expected duration.

2.05 FACTORY QUALIFICATIONS TESTING

A. Vital components, systems, and equipment shall be proven vital through qualifications testing or other means determined by the Engineer.

B. Qualification testing is required for new or modified components, systems, or equipment to verify that environmental and design requirements of the Contract are met.

C. Qualifications testing may not be required for service-proven components, systems, or equipment based upon service records or previous qualification test records approved by the Engineer.

D. Qualifications testing shall include environmental testing (temperature, humidity, vibration, etc.) as well as testing under normal and abnormal conditions.

2.06 ENVIRONMENTAL TESTING

A. All equipment shall be proven to operate properly over the temperature, humidity, and mechanical vibration and shock range defined in these specifications.

B. Service-proven equipment may not require environmental testing, but shall require evidence of proper performance in previous tests or similar operating environment, subject to Engineer approval.

2.07 FACTORY ACCEPTANCE TESTS

A. Prior to shipments, Contractor shall inspect all products to be delivered for installation into the Work or otherwise delivered to Authority to assure completion and conformance to the Contract Documents.

B. The inspections and preparation for shipment shall be verified by Contractor's quality control personnel. Engineer's approval shall be required before any shipment is made.

2.08 SYSTEM LEVEL FACTORY INSPECTIONS AND TESTS

A. Contractor shall set up all components for a location at the point of assembly and test the components as a system. Contractor shall not conduct System Level Factory Inspections and Tests of a location until its drawings are approved by the Engineer. Refer to Section 13579, "Signal Design."

B. The following tests shall be conducted as a minimum:

1. Visual Inspection

a. Physically inspect all equipment to make sure it conforms to approved drawings.

2. Continuity Verification Test

   a. Ensure all wiring is complete and connects to the proper points.
   b. Ensure there are no extraneous wires.
   c. Verify all wires are tagged as required.

3. Vital Relay Test and Inspection

   a. All vital relays shall be tested as specified in the AREMA Signal Manual.

4. Power Distribution and Failure Alarm Tests

   a. Power distribution and failure alarms shall be tested to verify conformance to specifications.
   b. Verify each energy bus is fed from its discrete power supply, free from shorts and opens.
   c. Verify each power supply operates properly and is effectively protected.
   d. Verify all racks and equipment are connected to power supplies at correct polarity and magnitude.

5. Track Circuits System Test

   a. Connect track circuits as shown on approved drawings, simulating running rails and impedance bonds.
   b. Test audio frequency (AF) and power frequency (PF) track circuits.
   c. Where applicable, test track circuit polarity by simulating the effects of broken down insulated joints.

ARTICLE 3 – EXECUTION

3.01 FIELD INCOMING INSPECTIONS AND TESTS

A. Contractor shall perform receiving inspection at the worksite for incoming products.

   1. Inspection shall preclude the use of incorrect or deficient products and ensure that only products which are acceptable and in compliance with the Contract Documents are used and installed.
   2. All product certifications and Test Reports used as the basis for acceptance by Contractor shall be preserved.

B. Contractor shall maintain a receiving inspection log for all items received at the worksite. Contractor shall submit the content of the log for the Engineer's approval.

3.02 FIELD INSPECTIONS AND TESTS

A. Contractor shall verify the quality of the installation by visual inspection and by tests of continuity, insulation resistance, resistance of ground connections, vital circuit breakdown, and other tests as required.

B. All tests required shall be performed to ensure the proper and safe operation of all signal equipment and to prove the adequacy and acceptability of the total installation.

C. In the case of testing on operational portions of Authority's LRT system, Contractor shall return the system to operational status after testing.

D. Tests to be performed shall cause each system and subsystem to be sequenced through all required operations and include simulated conditions to prove the installation is in compliance with failsafe requirements.

E. Contractor shall obtain recommended field inspections and tests from all Suppliers for all equipment to be used in this Contract. These manufacturers' recommended field inspections and tests shall be contained in the Inspection and Test Plan.

F. Procedures for all tests shall be submitted for approval to the Engineer at least 60 days before the scheduled test.

G. The Engineer shall have the right to witness all field inspections and tests. The Engineer shall be notified in writing a minimum of 2 weeks in advance of each inspection or test.

H. Test Reports from Contractor and Suppliers shall be submitted within 10 days after performing tests.

I. Test Reports shall include any pass/fail history along with any corrective action taken to bring test into compliance, including recommended changes and retesting.

J. Contractor shall make every effort not to interfere with existing Authority systems during tests and inspections. Operational tests shall be performed during off-peak hours to the extent possible. If interference with existing Authority systems is unavoidable, arrangements must be made with Authority a minimum of two weeks in advance of the test.

3.03 WAYSIDE FIELD INSTALLATION VERIFICATION

A. For each location, Contractor shall install all equipment into its relay/instrument house or case before proceeding with the field tests.

B. The following tests shall be performed to verify all equipment has been installed correctly.

1. Equipment Location Verification Test

a. Verify all field equipment is located and properly identified as required in specifications.

2. Clearance Check

a. Verify that LRV envelope will clear and clearances to other equipment and structures has been properly maintained.

3. Wire and Cable Tests

a. All wire and copper cable shall be tested after installation to ensure it has been installed according to the plans. Test the following at a minimum:

1) Point-to-point continuity and proper connection.
2) Ensure there are no conductor to conductor shorts.

b. Insulation Resistance Test

1) Prior to the test, disconnect power sources, running rail connections, direct connection to ground circuits, and any equipment that may be damaged by the voltages of the test instrument unless connection incorporates an isolation link.
2) Connection to ground for the test shall be the most convenient previously verified low resistance connection to ground available.
3) Test all wire and cable installed at the job site for insulation resistance between the conductor and ground, using a direct resistance reading instrument having a self-contained or generating test voltage of 500 to 1000 VDC.
4) Minimum insulation resistance to ground for circuits operating below 600 volts shall be 50 megohms, and for circuits operating at 600 volts and above, 100 megohms. Wires and cable shall be replaced when insulation

resistances are below these values. Actual resistance readings shall be recorded on test forms.

4. Ground Resistance Test

   a. Test relay/instrument housing ground buses in accordance with a procedure approved by the Engineer to ensure the resistance between each bus and the single point ground source is not greater than 0.5 ohm.
   b. Resistance between a ground rod driven at least 2439 mm (8 feet) from the point under test and each housing, signal head, snowmelter case, terminal case, or junction box shall be less than 15 ohms, or as approved by the Engineer. No chemical salts are permitted to achieve the required ground resistance.
   c. All connections to the ground bus shall be tested to verify proper and adequate connections.
   d. Contractor shall propose test method and test equipment to be used for ground resistance test.

5. Power and Signal Bonding Test

   a. Test a sample of signal bonds and power bonds, as selected by the Engineer, to verify that the resistance across the rail connection is not greater than specified in Section 13574, “Signal Installation“, paragraph 3.06.

6. Insulated Joint Test

   a. Verify the integrity of any insulated joints as specified in the AREMA Signal Manual, Part 8.6.35.

7. Power Distribution Test

   a. Turn power on with circuit breakers closed, fuses installed, and relays plugged in.
   b. Check power supply input and output levels.
   c. Verify that fuses do not blow and circuit breakers do not trip during normal operation.

8. Vital Relays Test and Inspection

   a. Perform this test after vital relays are installed in their final location.
   b. Verify the proper operation of each vital relay to verify that no change occurred since factory testing.

c. Complete an AREMA Office Records Test Form for each vital relay.

9. Breakdown Test of Vital Circuitry

a. Verify that all vital circuits are working properly and as specified.
b. Test one circuit at a time.
c. Open the circuit at each contact in the control line of the relay (or other device) operated by the circuit to verify that the contact on the controlling relay is in the circuit under test.

3.07 FIELD FUNCTIONAL ADJUSTMENTS AND TESTING

A. Contractor shall perform field functional adjustments and testing to verify proper operation.

B. The following tests shall be performed, if required by circuit modifications:

1. Interlocking Test

a. Circuit Breakdown Test

1) All wiring shall be tested after installation to ensure continuity and proper connection according to the circuit plans.
2) Where parallel circuits exist, test each parallel path independently to ensure the continuity of each path.
3) Each function shall be tested as a complete system or subsystem for the correct operation in response to circuit element or contact closure.

b. Test interlocking plant functions for correct performance and safety. Include simulated unusual conditions to determine all equipment will respond in a safe and proper manner.

2. Power Frequency Track Circuit Test

a. Test power frequency track circuits to ensure proper design, installation, and adjustment.
b. With a 3 ohm per 305 m (1000 feet) simulated ballast leakage, the track circuit shall deenergize when shunted with a 0.2 ohm shunt anywhere within the circuit. With the 0.2 ohm shunt removed, track circuit shall operate normally.
c. Track circuit shall deenergize when any one of the insulated joints defining track circuit boundaries is shunted.

d. Track circuit relay shall be deenergized when the feed end or relay end of the circuit is disconnected. Track circuit relay shall be deenergized when the local reference voltage is deenergized.

e. The normal operating parameters and track circuit leakage shall be recorded and submitted to the Engineer.

3. Audio Frequency (AF) Track Circuit Test

a. After adjustment, test all track circuits as follows:

1) With a 3 ohm per 1000 feet simulated ballast leakage, the track circuit shall deenergize when shunted with a 0.2 ohm shunt 3.3 feet beyond the receiving end.

2) Place a 0.2 ohm shunt 10 feet beyond the receiving end and the track circuit shall remain energized.

b. All tests and normal operating parameters shall be recorded for each track circuit. These records shall be submitted to the Engineer.

4. Grade Crossing Warning System Test

a. Test as specified in Section 13572, “Grade Crossing Warning System.”

5. Signal Adjustment Test

a. Check signals for proper aspect and lamp voltage.

6. Line Circuit Test

a. Check the integrity of vital and non-vital information sent location to location.

7. Traffic Circuit Test

a. Verify the integrity of traffic circuits between interlocking locations as designed.

8. Train/Wayside Communications Test

a. Verify the operation of the TWC at each location.

9. Signal Sighting Test

a. Verify that the wayside signals can be observed from the vehicle.

3.08 SIGNAL SYSTEM INTEGRATION TESTS

A. After Contractor has completed installation tests and verified system operation within the local limits of work, Contractor shall perform the following tests, at a minimum, utilizing LRVs and any other Authority system elements as necessary:

1. Proper operation of the grade crossing warning system shall be verified when integrated with other equipment as specified in Section 13572, “Grade Crossing Warning System.”

ARTICLE 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement shall be made for the work of this Section.

4.02 PAYMENT

A. No separate payment will be made for the work of this Section. Payment for this work shall be incidental to the payment for Section 13572 – Grade Crossing Warning System.

END OF SECTION