CONTRACT SPECIFICATION

FOR THE DESIGN AND FURNISH OF THE

ARSENAI RECONSTRUCTION

AUTOMATIC TRAIN CONTROL (ATC)

PROJECT
# ARSENAL RECONSTRUCTION

AUTOMATIC TRAIN CONTROL (ATC) PROJECT

CONTRACT DOCUMENTS

## TABLE OF CONTENTS

### DIVISION 1 – GENERAL REQUIREMENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>TITLE</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>01010</td>
<td>SUMMARY OF WORK</td>
<td>01010 - 1 to 01010 - 4</td>
</tr>
<tr>
<td>01025</td>
<td>MEASUREMENT AND PAYMENT</td>
<td>01025 - 1 to 01025 - 4</td>
</tr>
<tr>
<td>01300</td>
<td>SUBMITTALS</td>
<td>01300 - 1 to 01300 - 4</td>
</tr>
<tr>
<td>01720</td>
<td>PROJECT RECORD DOCUMENTS</td>
<td>01720 - 1 to 01720 - 2</td>
</tr>
<tr>
<td>01730</td>
<td>TRAINING</td>
<td>01730 - 1 to 01730 - 4</td>
</tr>
</tbody>
</table>

### DIVISION 13 – SIGNAL AND COMMUNICATION SYSTEM

<table>
<thead>
<tr>
<th>SECTION</th>
<th>TITLE</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>13570</td>
<td>BASIC REQUIREMENTS FOR SIGNAL SYSTEM</td>
<td>13570 - 1 to 13570 - 10</td>
</tr>
<tr>
<td>13572</td>
<td>INTERNAL WIRE AND CABLE</td>
<td>13572 - 1 to 13572 - 4</td>
</tr>
<tr>
<td>13573</td>
<td>WIRED INSTRUMENT HOUSINGS</td>
<td>13573 - 1 to 13573 - 12</td>
</tr>
<tr>
<td>13574</td>
<td>TRAIN DETECTION</td>
<td>13574 - 1 to 13574 - 8</td>
</tr>
<tr>
<td>13575</td>
<td>SWITCH AND LOCK LAYOUTS</td>
<td>13575 - 1 to 13575 - 4</td>
</tr>
<tr>
<td>13576</td>
<td>COLORLIGHT SIGNALS</td>
<td>13576 - 1 to 13576 - 4</td>
</tr>
<tr>
<td>13579</td>
<td>RELAYS</td>
<td>13579 - 1 to 13579 - 6</td>
</tr>
<tr>
<td>13582</td>
<td>LOCAL CONTROL PANELS</td>
<td>13582 - 1 to 13582 - 4</td>
</tr>
<tr>
<td>13585</td>
<td>MISC COMPONENTS AND PRODUCTS</td>
<td>13585 - 1 to 13585 - 12</td>
</tr>
<tr>
<td>13603</td>
<td>AC POWER SUPPLY SYSTEMS</td>
<td>13603 - 1 to 13603 - 6</td>
</tr>
<tr>
<td>13604</td>
<td>DC POWER SUPPLIES</td>
<td>13604 - 1 to 13604 - 6</td>
</tr>
<tr>
<td>13621</td>
<td>TESTING</td>
<td>13621 - 1 to 13621 – 8</td>
</tr>
</tbody>
</table>

### DIVISION 16 – FIBER OPTIC COMMUNICATION SYSTEM

<table>
<thead>
<tr>
<th>SECTION</th>
<th>TITLE</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>16710</td>
<td>FIBER OPTIC CABLE AND EQUIPMENT</td>
<td>16710 - 1 to 16710 - 8</td>
</tr>
</tbody>
</table>

### APPENDIX “A” – STANDARD SPECIFICATION FOR STRANDED INSTRUMENT WIRE – SPEC. NO. F-S-206

### APPENDIX “B” – STANDARD SPECIFICATION FOR PAD MOUNTED SIGNAL POWER TRANSFORMERS FOR REGIONAL RAIL DIVISION – SPEC. NO. F-E-234
PART 1 – GENERAL

1.1 Description of Work

This project provides for the modernization of the communications and signal system including the addition of an Automatic Train Control system from 30th Street to Automatic Signals 301/302 on SEPTA’s Railroad Division’s West Chester Line. This includes the installation of new Civic Interlocking and new Arsenal Interlocking. This system has been designed to specific criteria related to fault tolerance and return to service. As such, all Contractors are advised to bid this work as indicated, and no systems substitutions shall be considered.

A. Related Document

1. Drawings and general provisions of Contract, including Special Conditions and other apply to work of this Section.

B. Project/Work Identification

1. General: Name of project is the Arsenal Reconstruction/ Automatic Train Control (ATC) Project.

2. Contract Documents: Indicate the work of Contract and related provisions of the project, which may include, but are not necessarily limited to the following:
   a. Typical/conceptual circuit drawings.
   b. These Specifications

C. This Contract shall be bid using base bid cost. The description of the work as so specified by the base bid shall be as specified herein.

1. The Contractor’s service shall include all labor, material, equipment, supervision, transportation, and miscellaneous service whether or not specifically required herein to produce a completely designed and tested signaling system consistent with that indicated on the Contract Drawings.

2. The design work shall include providing a detailed, checked hardware design for each location in accordance with all the various, typical Contract Drawings and these Specifications. These designs provided are to be considered conceptual and the Contractor shall produce their final designs based on the intent of these drawings. Some work shall include providing materials and devices required to interface with existing SEPTA and Amtrak locations.
3. For design purposes, this line is considered at running north and south: The northward direction being towards 30th Street and the southward direction being towards Elwyn.

4. Abbreviated Written Summary: In order to simplify the text, use of the words “design”, “furnish”, and “provide” shall mean design, manufacture, furnish, factory test and deliver in a state acceptable to SEPTA.

The work described below consists of, but is not necessarily limited to the detail design, fabrication, factory testing and delivery of new remotely controlled interlockings and cab signal houses as well as all supporting terminal boxes, impedance bonds, track wire junction boxes, wayside colorlight Light Emitting Diode (LED) signals, transponders, electric power switch and lock and derail layouts, snow melter layouts, fiber optic equipment as well as all other equipment and devices as shown on the Contract Drawings and included within these specifications. SEPTA shall be responsible to provide all external signal cabling as well as perform all installation work for the final system.

Briefly, the work of this contract can be summarized as follows. All stationing is provided for reference only.

**42+30 Cab Signal House-West 30th St Interface**
Provide new instrument house, including electronic vital track circuits, impedance bonds, fiber optic telemetry equipment, track wire junction boxes, and all other equipment as shown on the Contract Drawings WCH0083 and described within these Specifications. This house will interface to the existing West Location B house. The circuits will interface with West Interlocking on Track No.6 and 30th St. Interlocking on Track No.5.

**West Comm Node**
Provide new fiber optic telemetry equipment within the existing house. Provide fiber optic cable along project right of way.

**Walnut RIH**
Provide new fiber optic telemetry equipment within the existing house. Provide fiber optic cable along project right of way.

**70+62 Cab Signal House**
Provide new instrument house, including electronic vital and overlay track circuits, impedance bonds, fiber optic telemetry equipment, track wire junction boxes, and all other equipment as shown on the Contract Drawings WCH0136 and described within these Specifications.

**University City Comm Node**
Provide new fiber optic telemetry equipment within the existing house. Provide fiber optic cable along project right of way.

**Civic Interlocking**  
Provide new remotely controlled Central Instrument House (CIH) and supplemental equipment housings including electronic vital and overlay track circuits, impedance bonds, electric switch and lock layouts, snow melter layouts, colorlight signals, fiber optic telemetry equipment, track wire junction boxes and all other equipment as shown on the Contract Drawings WCH0166 and described within these Specifications.

**Arsenal Interlocking**  
Provide new remotely controlled Central Instrument House (CIH) and supplemental equipment housings including electronic vital and overlay track circuits, impedance bonds, electric switch and lock layouts, snow melter layouts, colorlight signals, fiber optic telemetry equipment, track wire junction boxes and all other equipment as shown on the Contract Drawings WCH0234 and described within these Specifications.

**Arsenal RIH**  
Provide new fiber optic telemetry equipment within the existing house. Provide fiber optic cable along project right of way.

**162+10 Cab Signal House- Phil Interface**  
Provide new instrument house, including electronic vital track circuits, impedance bonds, fiber optic telemetry equipment, track wire junction boxes, and all other equipment as shown on the Contract Drawings WCH0308 and described within these Specifications. This house will interface with Amtrak Phil Interlocking.

**49th St Comm Node**  
Provide new fiber optic telemetry equipment within the existing house. Provide fiber optic cable along project right of way.

5. The Contractor shall furnish all materials and products necessary for completion of the work in accordance with the Contract Documents, whether or not specifically mentioned but in the opinion of the SEPTA Project Manager otherwise deemed to be necessary.

1.2 **Quality Assurance**

A. **Quality Assurance (QA) Program**

1. The Contractor shall maintain a quality control program to ensure compliance with the quality standards of these Specifications and the industry in general. The Contractor shall furnish, upon request by the SEPTA Project Manager,
copies of his complete quality control manual including a description of the organization to be used on this Contract including sub-contractors. This QA plan shall include the QA programs of all the sub-contractors and or equipment suppliers the Contractor plans to partner with on this project.

2. Each Quality Assurance plan shall detail the methods, procedures, and processes the Contractor uses to show compliance with their quality control program and standards.

3. The Contractor shall perform all material, mechanical, and/or electrical assembly, dimensional, and operational tests as required to confirm that the equipment meets all requirements of this Specification and of applicable codes, standards, and regulations.

PART 2 – PRODUCTS

A. All materials to be provided under this project shall be as identified on the Contract Drawings and Material Reference Sheet.

B. Where no specific material specification is provided on the Contract Drawings or named in this specification the Contractor shall engineer and provide any and all materials required by the Contractor’s design, as approved by the SEPTA Project Manager.

C. No materials used on this project may be procured, manufactured, constructed, etc. until approval to do so is received by the SEPTA Project Manager.

D. All materials shall be delivered F.O.B. to a location as so specified by the SEPTA Project Manager. The cost of all material handling and delivery shall be the responsibility of the Contractor.

E. Coordinate the delivery of all materials required under this Contract so that they will be received by SEPTA Monday through Friday, between the hours of 8:00 am and 2:00 pm at the location as directed by the SEPTA Project Manager.

PART 3 – EXECUTION

Not applicable

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This Section specifies the general requirements for measurement of payments in addition to the requirements and provisions set forth in this Contract.

B. Contractor shall provide an itemized and detailed cost breakdown of all deliverables required by the Contract showing the values allocated to each including as applicable, the design, manufacturing and testing costs.

1.02 RELATED WORK

None

1.03 MEASUREMENT OF QUANTITIES

A. The work performed under the Contract will not be measured, except to establish percentage of completion for each value line item.

1.04 SCOPE OF PAYMENT

A. Payment will not be made until the SEPTA Project Manager approved the work for payment.

B. All costs for work to be performed shall be covered by the prices indicated on the detailed cost breakdown.

1.05 SCHEDULE OF PAYMENTS

A. The Contractor shall supply complete line item, per unit costs for the work tasks as herein identified to the SEPTA Project Manager supported by detailed cost breakdowns.

B. Schedule of Value documents shall be provided on Excel Spreadsheets.

1.06 SCHEDULE OF PAYMENTS BREAKDOWN

A. Central Instrument and Supplementary Locations:

1. This work consists of design, manufacturing and testing of the new Interlocking Central Instrument Houses and supplementary control
housings required for the new Interlocking locations.

2. Partial payments shall be made for completing the design, manufacture, testing and final delivery, and acceptance. Payments will be weighted in accordance with the values determined in the detailed cost breakdown for this item of the work.

B. Cab Signal Control Houses:
   1. This work consists of design, manufacturing and testing of the cab signal houses required for the new locations.

   2. Partial payments shall be made for completing the design, manufacture, testing and final delivery, and acceptance. Payments will be weighted in accordance with the values determined in the detailed cost breakdown for this item of the work.

C. Communications Equipment:
   1. This work consists of design, manufacturing and testing of the communications equipment required for the new locations.

   2. Partial payments shall be made for completing the design, manufacture, testing and final delivery, and acceptance. Payments will be weighted in accordance with the values determined in the detailed cost breakdown for this item of the work.

D. Miscellaneous Ground Materials and Equipment:
   1. This work consists of designing, procuring and furnishing all miscellaneous ground materials, devices and equipment required to be installed at all locations as required by these Contract Drawings and as specified herein.

   2. Partial payments shall be considered for each item on the list. Individual item payments will be weighted in accordance with the values determined on the detailed cost breakdown for each miscellaneous item to be provided under this Contract.

PART 2 – PRODUCTS
Not Used.

PART 3 - EXECUTION
Not Used
END OF SECTION
PART 1 – GENERAL

1.1 Description of Work

Make all submittals required by the Contract Documents or requested by the SEPTA Project Manager and revise and resubmit as necessary to establish compliance with the Contract Documents.

1.2 Quality Assurance

A. Prior to each submittal, carefully review and coordinate all aspects of each item being submitted and verify that each item and the submittal for it conforms in all respects with the requirements of the Contract Documents. The Contractor, by affixing his or her signature to each submittal, certifies that this coordination has been performed.

B. The Contractor shall determine and verify all project interface requirements, existing circuitry, catalog numbers, technical specifications, and any other similar data.

1.3 Substitutions

A. When submitting proposed substitutions as “or equal”, include all pertinent data establishing quality, appearance, workmanship, design, capacity, functionality, and all other requirements.

B. Where approved, the Contractor shall assume full responsibility for the complete functional and operability of the “or equal” regardless of the SEPTA Project Manager’s approval to proceed.

C. The Contractor shall be required to meet all criteria necessary for consideration of product “or equal” status including SEPTA’s future product maintainability, employee familiarity, bench stock requirements, etc.

D. The SEPTA Project Manager shall be the sole judge in determining “or equal” status and his determination shall be final.
1.4 Contractor’s Drawings

A. General

1. The Contractor’s Drawings shall show the general arrangement and such details as are necessary to provide a comprehensive description and depiction of the system.

2. As indicated below prepare such Drawings as are necessary to adequately document the installation for SEPTA’s future construction, maintenance, and operations.

3. Prepare all drawings using AutoCAD by Autodesk. All C&S drawings shall be field print paper size that is 11 inches by 17 inches.

4. The Contractor shall make a minimum of four (4) detailed design submissions:
   a. Preliminary (30% complete)
   b. Pre-Final (75% complete)
   c. Final (100% complete)
   d. “Contractor As-built” which shall be the set shipped from the factory

5. Each and every submittal as described in #4 above shall have a power calculation sheet included.

6. All signal design drawings shall be submitted in electronic format on a USB stick or approved alternate format for SEPTA’s use. Electronic submittal shall have an ASCII format drawing index text file included. The text file shall contain the project name and a list of the drawings and associated files and creation date. Contractor using a later version of AutoCAD will upgrade four of SEPTA’s Signal Engineering workstations with this version.

7. Format:
   a. All signal circuit designs shall be printed on good quality vellum with printing on the front, on an 11 x 17 inch drawing. All drawings shall be developed and submitted utilizing computer-aided drafting techniques. All lettering, line work and layout format shall be approved by the SEPTA Project Manager.
   b. All symbols used in documents and drawings shall conform to a list of standard symbols as shown in AREMA Signal Manual Section 16.2 and the Contract Drawings.
   c. All drawings shall not be “clustered” and shall be laid out to be easy to read and legible.
1.5 SEPTA Project Manager’s Review

A. The SEPTA Project Manager’s review of drawings will be for conformance with the design concept only and should not be construed:
   1. As permitting any departure from the Contract requirements.
   2. As offering relief from the responsibility for any errors, including details, dimensions, and materials.
   3. As approving departures from details furnished by the SEPTA Project Engineer except as otherwise provided in writing.

B. Submittals reviewed by the SEPTA Project Manager and returned to the Contractor will be marked with one of the following designations:

   1. No Exceptions Taken
   2. Proceed as Noted
   3. Revise as Noted and Resubmit
   4. Rejected/Resubmit
   5. Review no Required

C. The Contractor shall not proceed with procurement, manufacture, or fabrication of items submitted for review until such submittals have been designated by the SEPTA Project Manager as “No Exceptions Taken” or “Proceed as Noted” unless specifically authorized to do so by the SEPTA Project Manager.

PART 2 – PRODUCTS

Not Applicable

PART 3 – EXECUTION

Not Applicable

END OF SECTION
SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 Description of Work

A. The Contractor shall re-design the typical Contract Drawings into individual design packages by location for future use by SEPTA’s construction and maintenance personnel. This final design package shall include, but not be limited to all detailed drawings for such items as: main terminal boards, rack assignments, junction box wiring details, energy loops, contact and case wire assignments, grounding details, switch and signal wiring details, house, case and rack layouts, and all other drawings required.

B. This Section also specified the requirements for the preparation of the Project’s “As-Built” Drawings.

1.2 General Requirements

A. During the progress of the work, keep a master set of prints identified as “AS-BUILT” drawings on which all deviations from the approved Contract Drawings are kept and the reason for the deviation.

B. All drafting work shall conform to acceptable standards for clarity and consistency, and shall be of the utmost quality and accuracy. SEPTA shall provide prior approval of the Contractor’s CADD Signal Symbol Tables.

C. SEPTA shall provide the Contractor with a typical title block for the “As-built” drawings. “As-built” drawings shall be numbered by location with each location having a cover sheet, revision block, and index, etc.

D. The Contractor shall ensure that all information shown on each signal drawing is accurate prior to attesting that the location is “As-built”.

E. A final acceptance of the work and full payment shall be contingent upon SEPTA’s acceptance of all “As-built” drawings and documentation.

F. At the conclusion of the project, the Contractor shall deliver five (5) sets of each location’s “As-built” drawings to the SEPTA Project Engineer no later than ten (10) days after final equipment delivery. In addition, the Contractor shall furnish two (2) copies of all “As-built” drawings on
Vellum and on three (3) USB Drives formatted in the version of AutoCAD as directed by the SEPTA Project Manager.

G. In addition, one (1) set of “As-built” drawings for each location provided under this Contract shall be provided. This set shall be shipped inside each respective wired housing and shall be used for future reference by maintenance forces.

H. The Contractor shall also furnish at the end of the project, two (2) copies of the following on USB Drives:

1. All project related correspondence,
2. Copies of all test reports, forms, and all other test documentation,
3. Copies of all submittals,
4. Specifications, internal wiring plans, parts lists, and all other technical documentation generated as a result of this project,
5. Copies of the approved project schedule, and
6. Copies of the approved payment schedule.

PART 2 – PRODUCTS

Not Applicable

PART 3 – EXECUTION

Not Applicable

END OF SECTION
SECTION 01730

TRAINING

PART 1 – GENERAL

1.1 Description

A. Purpose

This Section specifies furnishing training to SEPTA personnel to gain the knowledge to operate and maintain certain signal equipment provided under this Contract.

B. Training Program

This signal training shall be divided into two categories: Maintenance and Engineering.

Personnel to receive Signal Maintenance training:

<table>
<thead>
<tr>
<th>Attendees</th>
<th>No. to Attend</th>
<th>No. of Classes</th>
<th>No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisory Personnel</td>
<td>16</td>
<td>As Approved</td>
<td>As Approved</td>
</tr>
<tr>
<td>Maintenance Personnel</td>
<td>70</td>
<td>As Approved</td>
<td>As Approved</td>
</tr>
</tbody>
</table>

Personnel to receive Engineering training:

<table>
<thead>
<tr>
<th>Attendees</th>
<th>No. to Attend</th>
<th>No. of Classes</th>
<th>No. of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not to exceed</td>
<td>16</td>
<td>As Approved</td>
<td>As Approved</td>
</tr>
</tbody>
</table>

1. Class size for training should be limited to fifteen (15) per class.

2. Training will be held at a SEPTA location and shall be scheduled at the convenience of SEPTA and staffed by the Contractor so as not to conflict with SEPTA’s maintenance operations. SEPTA will provide the necessary seating, lighting, and restroom facilities.

3. Each training course shall be held on consecutive days, excluding weekends and holidays. Each session of training shall be for eight hour periods. Training shall be conducted by instructors that are experienced with the equipment.
4. Courses shall include hands-on training, as appropriate for the course material.

5. In addition to the personnel specified to receive training herein, SEPTA may authorize others to observe any or all training sessions.

1.3 Submittals

A. Training Plan:

Submit to the SEPTA Project Manager, within 180 days after Notice to Proceed, three (3) copies of the complete training plan for providing the training described herein. The training plan shall include the following information:

1. A proposed schedule
2. Resumes of personnel proposed to be instructors
3. An overview of the subjects to be covered
4. An overview of the hands-on experience to be included
5. A list of the manuals, as-built documentation, and other printed materials to be utilized as training aides.

B. Training Program:

The Contractor shall submit three (3) copies of the complete program at least sixty (60) days prior to the scheduled start of the training. Each training program shall contain, as a minimum, the following information:

1. A detailed outline of the material to be covered in the course and the duration in hours of the training.
2. Copies of the visual aides, manuals, as built documentation, and other printed materials to be used during the course.
3. Detailed descriptions of the procedures to be performed during hands-on training, including test equipment to be used.

C. Manuals:

All training manuals shall be as follows:

1. All manuals shall be furnished in three ring binders, one manual per binder or set of binders.
2. One digital copy of each manual shall be furnished in Microsoft Word document software.
3. The outline and finished versions of each training manual shall be approved by the SEPTA Project Manager.

D. Organization:
1. Each manual shall contain a Table of Contents with sufficient
detail to allow rapid referencing of sections and pages.
2. Each manual shall contain a glossary that shall define all
abbreviations and technical terms used.
3. Each manual shall contain an index with sufficient detail to allow
rapid referencing of functions.
4. Illustrations shall be included within the body of the manual.

PART 2 – PRODUCTS

2.1 Training

A. This program shall be designed to train SEPTA personnel in the operation,
inspection, maintenance, testing, installation, diagnosing and
troubleshooting all Vital Microprocessor Interlocking System (VMIS)
equipment, Electronic Track Circuit equipment, Fiber Optic
communications equipment, overlay track circuit equipment and other
equipment as required by the Project Manager.

B. Classroom training shall be aided by illustrated and diagrammatic text
material furnished by the Contractor. All training material shall become
the property of the Authority. The classroom portion of the training
program shall be conducted no less than 90 days after being notified by
the SEPTA Project Manager.

C. The Contractor shall supply instruction manuals for each student. The
manuals shall be so written that the average qualified technician is
enabled, by the reading thereof, to maintain, repair, test, and adjust the
equipment. SEPTA reserves the right to make copies of these manuals as
required for future training programs. These manuals shall include, but
not be limited to, the following:
1. Complete description of operation and usage.
2. Theory of operation.
3. Complete block schematic, and wiring diagrams of systems and
   subsystems.
4. Diagrams showing interconnections to external equipment,
   including input and output connections, and cabinet equipment
   interconnections.
5. Complete installation, alignment, and adjustment procedures.
6. Diagnostic procedures to locate or isolate failed components.
7. Routine preventive maintenance procedures.
8. Complete replacement parts list.

2.2 Training Engineering and Software Program
A. This program shall provide the SEPTA engineering personnel with an understanding of the design criteria and programming philosophies as they apply to the Vital Microprocessor Interlocking System (VMIS) equipment and the Electronic Track Circuit equipment. Additionally, the training provides SEPTA engineering personnel with an understanding of the software requirements of the system.

B. The Contractor shall be prepared to implement the engineering training program beginning no less than 90 days after being notified by the SEPTA Project Manager.

C. The Contractor shall supply instruction manuals for each student. The manuals shall be so written that the average qualified engineer is enabled, by the reading thereof, to understand, read, and write Boolean software. SEPTA reserves the right to make copies of these manuals as required for future training programs. These manuals shall include, but not be limited to, the following:

1. System overview and description
2. Equipment configuration.
5. Function and settings of all switches.
7. Basic programming techniques.
8. General Boolean logic rules.
10. Software practices.

END OF SECTION
SECTION 13570

BASIC REQUIREMENTS FOR SIGNAL SYSTEMS

PART 1 - GENERAL

A. All field installation work shall be done by SEPTA forces. Contractor shall provide the detailed design and all materials required for SEPTA’s construction.

B. All external cable shall be provided by SEPTA.

C. Signal System Operation:

The existing signaling system is a bi-directional, Automatic Train Control System (ATC) using wayside position light signals and cab signaling. The interlockings are relay-based controlling electric switches. There are existing stop signal overrun protection and speed and train separation enforcement.

The new system shall provide for new cab signaling with wayside signals only at the Interlockings providing bi-directional signaling (NORAC Rule 562). The system shall also provide safe train separation, overspeed protection and stop signal overrun detection.

New Civic Interlocking and new Arsenal Interlocking shall provide for 100Hz steady-energy track circuits provided with 100 Hz cab signaling and audio frequency overlay (“overlay”) track circuits for signal overrun detection. New redundant, Vital Microprocessor Interlocking Systems shall be provided for driving new electric power switches and LED type colorlight signals through vital interposer relays. The Interlockings shall include supplementary systems such as snowmelters, redundant standby power, fire and intrusion detection as well as other systems as described within the Contract Drawings. The new interlockings shall interface to the existing Railroad Operations Control Center Centralized Traffic Control (CTC) system provided by ARINC. Modifications to the CTC to support the new work shall be provided by others.

The Contractor shall coordinate their design with the new ACSES Positive Train Control (PTC) system design to be provided by others.

D. Configuration:

As indicated by the Contract Drawings, the design intent of the new signal system shall be to install a new system of Automatic Train Control on the West Chester Line from 30th St. to Automatic Signals 301/302 and interface to Amtrak Phil Interlocking. This work therein shall include, but not necessarily be limited to the following:
• Providing new Cab Signal control locations,
• Providing new remote controlled Civic and Arsenal Interlockings, with supplementary “A” and or “B” locations.
• Communications Node Houses, and
• Provide miscellaneous ground materials as so specified and as shown on the Contract Drawings.

E. Communication Work:
• Fiber optic cable will be installed in existing Comm Node houses, existing Radio Instrument Houses and proposed signal houses.
• The FO cable system to be designed is for the use of SEPTA and shall be comprised of commercial-of-the-shelf (COTS) products to the greatest extent possible.
• Aerial all-dielectric self-supporting (ADSS) self-supporting fiber optic cable. The fiber trunk from West Comm Node to University Comm Node to 49th St Comm Node shall be a 144 single-mode all dielectric self-supporting aerial cable designed for easy, economical one-step installation and with loose tube design to provide stable performance over a wide temperature range.

F. The Contractor shall provide the final design and furnish all materials required for installation by SEPTA’s field forces from the overall operational intent as described herein and as shown on the Contract Drawings.

1.1 Description of Work

A. The system to be provided shall be designed with the primary focus on safety, availability, reliability and maintainability.

B. The basic requirements and design criteria of these Specifications and Contract Drawings are written to establish guidelines in providing equipment, material, hardware, and necessary appurtenances required by the work.

C. Design and workmanship of apparatus shall comply with the “Rules, Standards and Instructions for the Installation, Inspection, Maintenance, and Repair of Signal and Train Control Systems, Devices, and Appliances” as set forth by the Office of Safety of the FRA.

D. Design, furnish, and factory test the signal equipment to provide the highest degree of safety and reliability. Provide a signal system consistent with the intent of these typical designs and this Specification.

E. Signal aspects shall comply with the NORAC (Northeast Operating Rules Advisory Committee) Rule Book and supplementary instructions.
F. Unless otherwise specified herein, provide materials in accordance with applicable AREMA, AREMA, IEEE, NEMA, FRA, and Authority standards, practices, and recommendations.

G. The Contractor shall provide fully detailed circuit designs for each individual location required by the new signal system that meets the intent as illustrated by the typical drawings included in the Contract Documents. The Contractor shall design in detail, check and finalize the hardware design in accordance with the design intent for the proposed equipment. The Contractor shall design all vital and non-vital software from templates to be provided by SEPTA. The Contractor shall provide all material and equipment whether or not specifically delineated but as may be required by the detailed design to provide a safe and workable signal system.

H. The Contract Drawings show the general arrangement of signal and signal power apparatus to be provided. Provide all material and appurtenances to ensure the installation of a fully functional signal and signal power systems.

I. Provide factory wired and tested apparatus including; instrument housings, junction boxes, colorlight signals, local control panels, switch and lock movements, snow melters, and other systems and devices as shown on the Contract Drawings and as indicated in these Specifications.

1.2 Quality Assurance


B. If a conflict exists between standards and regulations as specified herein, the opinion of SEPTA shall govern.

C. To be considered qualified to bid this contract, all manufacturers shall be required to show through documentation or by some other form of demonstration acceptable to the SEPTA Project Manager, that they possess the requisite technical experience and knowledge to perform this life/safety critical work, in a timely, professional, and competent manner.

D. All Vital Microprocessor Interlocking System equipment to be provided under this Contract shall be the Microlok II as manufactured by Ansaldo STS of Pittsburgh, Pa.
E. All Electronic Track circuit equipments to be provided under this Contract shall be the Electro-Code and Electrified Electrocode as manufactured by Alstom or General Electric Transportation Systems).

F. Where required by the SEPTA Project Manager, all vital microprocessor, vital track circuit and audio frequency track circuit equipment shall be provided with an FTA, FMEA, or other analysis attesting to each unit’s safe and reliable operation in a 13KV, 25hz traction power territory and any and all other documentation that the SEPTA Project Manager may require to substantiate the devices suitability for operation on the West Chester Line.

G. All signal materials shall be as shown on the Contract Drawings and as described within these Specifications. Where no material specification has been provided the Contractor shall SEPTA Project Manager the proper component to the satisfaction of the SEPTA Project Manager. Any and all material substitutions shall be by approval of SEPTA Project Manager only.

1.3 Reference Standards

A. The standards of AREMA Communications and Signals Division, National Electrical Manufacturers Association, Underwriter’s Laboratories, Institute of Electrical and Electronic Engineers, and SEPTA shall be adhered to in every instance where such standards have been established for the particular type of work, material, or equipment to be installed, except where such requirements conflict with this Specification.

B. Pertinent provisions of the following listed standards shall apply to the work of this Specification except as they may be modified herein and are hereby made a part of this Specification where the requirements of the following do not conflict with these Specifications.

1.4 Warranty

Provide warranty on all equipment and systems provided under this Contract, in accordance with the terms of the Agreement. Costs associated with work, services, and materials to provide such warranty shall be considered included in the Contract amount and no extra payment will be made.

The warranty period shall commence at the time the complete system is powered up.

1.5 Staging Equipment
A. Furnish the following items not later than one hundred-eighty (180) days after Contract Notice to Proceed. Delivery location to be as specified by the SEPTA Project Manager.

1. Two (2) each of each specialty vital relay to be used (Light outs, switch control, etc.)
2. Five (5) each of each type of non-vital relay to be used.
3. Ten (10) each of each type and size of fuse or breaker used.
4. Two (2) spare LED’s of each color used on the project.
5. Furnish for each wayside case and signal instrument house containing plug-in relays, ten (10) test tools or relay wrenches, as required, for different types of plug-in relays.
6. If the type of plug-in relays furnished, whether vital or non-vital, or both, require special inserting or extracting tools for contacts, provide ten (10) of each special tool for each location using that equipment.
7. Two (2) complete vital track circuit assemblies consisting of one control unit and two track interface units.
8. One (1) complete Siemens Systems SE-3 steady energy track circuit assembly.
9. One complete overlay track circuit and one spare transmitter and receiver PC Card for each frequency used.
10. One (1) signal transformer of each type used.
11. One (1) rectifier and power supply of each type used.
12. Two (2) resistors, reactors, capacitors, and connectors of each type used.
13. Ten (10) of each type model board LED’s
14. Five (5) of each type of model board lever and pushbutton.
16. Two (2) spare fiber optic transmitter and receiver boards for each frequency used.
17. One (1) spare fiber distribution panel assemblies
18. (1) spare Ansaldo STS AC-mini impedance bonds of each type used.
19. Seven (7) Electrocode TIS-4 Track Input Simulator P/N 800-087041-001
20. Two (2) portable, memory variable interrogator units, Dell Precision M6400 Covet, operating under and provided with Microsoft Windows XP. The units shall be provided with wireless connectivity, CD-R/W capability, 500G hard drive, and configured with all necessary software to interrogate, display, record, test, and simulate all memory variables and logic equations. The devices shall be provided with Microsoft Office suite for generating reports and analyzing and tracking events. All required licensing shall be included.
22. Provide Two (2) spare card files containing one (1) full spare set of PC boards each, used at interlockings on this project
1.6 Installation Equipment

A. Furnish the following items not later than one ninety (90) days after Contract Notice to Proceed. Delivery location to be specified by the SEPTA Project Manager.

1. Each wayside signal assembly including foundation.
2. Each instrument house and case foundation.
3. Each track wire junction box.
4. Each high tension transformer assembly including foundation.
5. Each switch and lock assembly.
6. Each snow melter assembly
7. Each AC-mini impedance bond

PART 2 – PRODUCTS

2.1 Materials

A. Provide all material and apparatus as shown on the Contract Drawings.

B. Provide new products and components that are free of manufacturing defects. Provide electrical components rated to operate at power, voltage, current, frequency, and temperature levels, exceeding by 20%, those to which these components shall be subjected to when in service, unless otherwise specified herein.

C. Equipment and Environment:

1. Housings and Wayside Equipment
   a. Provide equipment in houses or cases to function in accordance with these Specifications and within a temperature range of -22 degrees F to 158 degrees F at relative humidity of 0 percent to 95 percent.
   b. Provide signal equipment for outside use to operate satisfactorily in weather conditions including rain, snow, dirt, temperature variations, and humidity variations. In addition, follow recommendations of AREMA Signal Manual, Part 2.3.25 to minimize condensation and frost build-up.
   c. The Contractor shall provide supplemental control locations houses (Loc. A, Loc. B, etc) to support the main CIL’s as required by the Contractor’s design.

2. Electric Environment:

   Determine the electrical environment to which signal equipment will be exposed. Provide a signal system and equipment that performs
satisfactorily in an electrified commuter rail environment utilizing 25 Hz alternating current propulsion power system.

2.2 Design Criteria

A. General Design Requirements:

1. Contractor shall provide vital and non-vital software design.

2. Contractor shall provide a fully detailed circuit design for each location from the typical Contract Drawings. All designs shall be approved by the SEPTA Project Manager prior to commencing manufacture or material procurement. The detailed designs shall include, but not necessarily be limited to the following plans and drawings:
   a. Energy loops,
   b. Main terminal board,
   c. Relay and equipment rack layouts,
   d. Relay contact assignments
   e. Ground equipment wiring details,
   f. Input and output board assignments,
   g. Cable and wiring plans, and
   h. Other detailed signaling drawings as required by the SEPTA Project Engineer.

3. Command and control systems shall be centralized to the CIL. Those devices required to be deployed at outlying locations shall only be high reliability, discrete devices to minimize nuisance failures.

4. The VMIS equipment deployed in the interlocking shall be in a normal strandby configuration.

5. The contractor shall provide detailed circuit designs and shall provide all circuit plan wiring and circuit tagging with the appropriate circuit nomenclature.

6. The Contractor shall provide all repeater relays as required by the detailed design and as approved by the SEPTA Project Manager. All repeater relays shall be provided with a minimum of one (1) spare front-heel-back combination from the same contact.

B. Fail-Safe Design Criteria:

The Contractor shall provide designs, materials and equipment that are failsafe and have a demonstrated history of reliability and maintainability in an AC electrified territory under conditions as may be found along this Line. In preparing the design, the Contractor shall bring to the attention of the
SEPTA Project Manager, any condition or situation that in their opinion, does not meet this criteria.

1. Design vital circuits based on fail-safe design practices and principles, i.e.: broken wires, damaged or dirty contacts, relay failing to respond when energized, or loss of power shall not result in an unsafe condition.

2. Design vital repeater relay circuits on the cascade principal. Paralleling of vital repeater relays is not allowed. Assign repeater relay contacts so safety is not compromised by failure of repeater relay to energize.

3. Double break vital circuits. Begin double break when circuit first leaves housing in which the coil is located and continues until positive and negative energy is reached.

4. Use contacts of each track relay solely to control its own first repeater relay.

5. Arrange relay circuits so heel of relay contact is connected towards circuit load, and front or back contact is connected towards energy source.

C. Vital Relay Control Circuits:

1. Provide vital control circuits based on closed circuit design principles with additional requirements as follows:
   a. No common return on open line wire;
   b. No polar relays;
   c. 12 VDC vital signal control circuits;
   d. All vital line circuits will be double broke.

D. All detailed designs shall be checked by a knowledgeable and qualified Contractor employee other than the original circuit designer who shall initial each drawing to indicate the circuit check has been made.

PART 3 – EXECUTION

3.1 Installation Criteria

A. Provide circuits based upon criteria identified herein and on the Contract Drawings. Provide detailed design and wiring drawings based on the Contract Drawings to perform the functions as so shown.

B. The Contractor shall re-design and renumber the Contract Drawings into a complete design packages based on the typical designs for each location.

3.2 Modular Design
A. Employ modular design throughout the system.

END OF SECTION
SECTION 13572
INTERNAL WIRE AND CABLE

PART 1 – GENERAL

1.1 Description

A. This Section specified the furnishing and installing of wire and cable for the instrument houses, wayside cases, switch machines, signal heads, etc. All intra-rack and rack-to-rack wire and cable shall conform to the requirements of these Specifications.

1.2 Quality Assurance

A. Stranded wire, including individual conductors of multi-conductor cables shall be in accordance with SEPTA Standard F-S-206.

B. All conductors must be sized per the NEC and shall not be smaller than the minimum conductor sizes specified herein.

1.3 Submittals

A. All internal cable and wire manufacturers supplying products under this Section must be approved, unless otherwise waived by the SEPTA Project Manager.

B. The Contractor shall submit the following for approval; complete technical data describing the internal wire and cable.

1.4 Product Delivery, Storage, and Handling

A. Protect cables and wires from damage throughout installation, delivery, and handling.

PART 2 – PRODUCTS

2.1 General

A. There shall be no point-to-point redundancy of wires for increased current capacity.

B. All wiring shall be accomplished with approved solderless connections. All wire shall be stranded unless otherwise approved for a specific applicant.
C. All wire insulation shall be colored black, except ground wires that shall be colored green.

D. Unless otherwise directed, wiring shall be as follows:
   1. Rack-to-rack circuit wiring shall be minimum size No. 16 AWG.
   2. Intra rack wiring shall be minimum size No. 16 AWG.
   3. Power feed wiring for main battery charger circuits, minimum size No. 6 AWG.
   4. Power feed wiring to Electronic Track circuit apparatus, minimum size No. 6 AWG.
   5. Power feed wiring from main power buss to individual racks, minimum size No. 10
   6. Intra rack wiring from rack power buss to equipment shall be minimum size No. 10.
   7. Steady energy track circuit wiring shall be two (2), No. 10 black and white colored twisted wires.

E. Both ends of each cable wire and all single wires that terminate in the cases, junction boxes, instrument houses, signals, switches, or on all racks and any equipment of the signal system shall be permanently identified with a tag.

F. The Contractor shall make and install all tagging on field equipment such as switch machines, junction boxes, and signal heads prior to shipment of equipment.

2.2 Materials

A. Requirements for Stranded Wire for General Use

   1. The requirements for wire described herein shall consist of these Specifications and the Military Specification MIL-W-22759. Where there is a discrepancy between these Specifications and the requirements of the applicable Military Specification, the requirements of these Specifications shall govern.

B. Internal Cable

   1. Cables shall be made by assembling the individual or twisted pairs of insulated wires into a tight, cylindrical form. Individual or twisted pairs shall be assembled helically and with adjacent layers wound in opposite directions.

2.3 Tags

A. Tags for identification of individual cable conductors and wires shall be the sleeve type as manufactured by Raychem Corporation, Thermofit Marker System (TMS), or approved equal.
PART 3 – EXECUTION

3.1 General

A. Provide sufficient slack in wires adjacent to their terminals to permit movement of equipment. Slack shall be arranged in a neat and orderly manner.

B. No splices shall be made in any wire.

C. The wiring shall be cabled and held in place by the wraps so as to present a neat and orderly appearance.

D. All wiring harnesses or securing attachments such as wire tie bars shall be covered with heat shrinkable tubing or taping to protect wire from physical trauma and abrasion.

3.2 Tagging

A. Tag all circuits with a plastic, three (3) line type tag which designates terminations and circuit nomenclature in accordance with the following typical:

1st line: FROM (Destination)
2nd line: CIRCUIT NOMENCLATURE
3rd line: TO (Destination)

Tagging shall have permanence and legibility. Sleeve tags shall be readable in an upright position and located on the conductor next to the terminal. All jumper wires on the same relay plugboard shall be provided with tags.

B. Terminal board wiring shall be provided with a flat tag stapled to the terminal board meeting these requirements.

C. All equipment devices, racks, etc. shall be provided with an identification tag.

D. All wiring shall be tagged with nomenclature shown on drawings.

3.3 Wire Termination

A. Provide insulated solderless eye wire terminals at each wire end. Terminals shall conform to the requirements of AREMA Signal Manual Part 14.1.1. Spade lug or fork lug wire terminals shall not be used.

B. Terminate all conductors entering instrument housings on Siemens Insulated Test Links and Terminals or Weidemuller connectors or approved equal. Weidemuller Type Dual-In-Line (DIN) rail connectors shall be the quick disconnect, hinged bayonet type.
C. In accordance with AREMA Drawing 10701, each binding post (10709) shall be furnished with two binding nuts (10706), one clamp nut (10707), and three washers (10708).

D. Binding posts and exposed terminals of other apparatus for circuits exceeding 100 volts shall be equipped with insulating nuts and sleeves.

3.4 Installation

A. Install internal wire and cable in accordance with the applicable requirements of AREMA Signal Manual Part 10.4.40, as specified herein and as on Contract Drawings.

B. Install wires and cables in a neat, workmanlike manner. Cables in ladders shall be laid therein and not pulled into same. Cables and wires shall be installed with a minimum amount of cross-over in the ladders and shall not be pulled tightly around bends. All exposed wires and cables entering or leaving equipment racks or housings shall be protected from abrasion by sharp metallic edges and nylon strap edges.

C. Provide and install nylon straps for bundling and cabling of conductors where two or more single conductors are exposed in internal rack bundles, cable ladders or whenever wires are to be bundled. Tape shall not be used for this purpose. Straps shall be installed at internals not greater than five feet along the cable run. Wires of multi-conductor cables exposed by the stripping of the cable jacket for terminations shall be trained in a neat, workmanlike manner and tied approximately every three inches with nylon straps.

D. Tie wrap all rack wiring neatly into compact bundles. The main bundles and branches shall be secured to the racks in a manner which shall preclude physical damage due to pressure or abrasion. Prevent the wire weight from being supported by the wire terminations, connections or plug couplers. The arrangement of the wire bundles and cables shall be such that they do not interfere with visual inspection, troubleshooting or repair of the rack-mounted equipment.

E. Route all rack-to-rack wiring via the overhead cable ladders with one foot of slack between the cable ladders and each rack to which the cable or wire is connected.

F. “Clean” wiring shall be geographically separated from “dirty” wiring by a minimum of six (6) inches when routing circuit wiring in the instrument houses.

END OF SECTION
SECTION 13573
WIRED INSTRUMENT HOUSINGS

PART 1 – GENERAL

1.1 Description

A. This Section specifies the design, wiring, furnishing, and factory testing of a number of Cab Signal locations (CSH), Interlocking Central Instrument Locations (CIL) and supplementary Interlocking locations herein referred to as “Instrument Housings” with all relays, transformers, resistors, power supplies, rectifiers, emergency control panels, and all other material and apparatus in accordance with the Contract Drawings and Specifications.

B. Provide Instrument Housings of appropriate size to adequately house equipment and provide spare space as described herein.

C. Provide all required appliances to effect a complete installation for each of the locations as shown on the Contract Drawings and as specified herein. Include the necessary electrical supply, lighting, HVAC, means of cable entry, instrument racks, and other equipment as required.

D. Provide the size and type of main terminal board (MTB) as required by these Specifications for the appropriate location.

F. All incoming wires, including spare wires shall be terminated on AREMA type terminal binding posts. The MTB shall be fully equipped with required number of terminals, tags, and row identification and accessories as required.

G. Furnish and install instrument racks for all microprocessor based equipment utilized in the Central Instrument Houses in accordance with these Specifications.

H. The microprocessor racks shall be fully equipped with the required number and type of card files, surge protectors, relays, plug boards, plug connectors, busses, terminals, and all miscellaneous electrical and mechanical components specified or necessary. Weidemuller type, DIN rail mounted terminal strips shall be located on the upper portion of the rack for connecting wires and cables. Spare space and spare terminals shall be provided as specified. Insulated terminals shall be spaced as specified in Part 14.1.5 of the AREMA Signal Manual. All VMIS units shall be provided fully loaded with the full component of PC cards with the types as required by these Specifications. The ratio of I/O cards shall
be as directed by the SEPTA Project Engineer. In addition, twenty (20) spare, cardfile empty PC card slot covers shall be provided.

I. Provide junction boxes for use in connection with switch and lock movement layouts, signal layouts, track wire rail connection and as specified herein and as shown on the Contract Drawings. Junction boxes shall be in accordance with manufacturer’s standard with adequate space for double post AREMA terminals, terminal boards, wire, cable and other associated apparatus.

J. All Interlocking locations shall be provided with a securable, exterior mounted AC receptacle for connecting an emergency generator to power necessary systems in the event of a loss of signal power. This receptacle shall be wired to the load center bus powering the critical interlocking functions as so shown on the Contract Drawings.

K. All fiber distribution panels used at all cab signal, Interlocking and supplementary locations shall conform to the following:
   a. Fiber MulitMedia Outlet Box - Part No. M40A1-B-262
   b. Fiber panel – Part No. M40ST8-262

   (All parts numbers are from Anixter.)

L. All fiber transmitters and receivers assemblies used at all cab signal, Interlocking and supplementary locations shall be as applied to single mode fibers optic cable and shall be manufactured by International Fiber Systems Incorporated (IFS).

M. All fiber distribution panels used at all Interlockings shall conform to the following:
   Part No. 207404 Corning-C CCH-12-19T- 12 Port panel ST SM loaded
   Part No. 250825 Corning-C ICH-02P 12 – F Wall mount enclosure

   (All parts numbers are from Anixter.)

N. All fiber optic modems shall conform to the following:
   1. Vital fiber modems shall be as manufactured by TC Communications Model No. TC 1200
   2. Non-vital modems shall be as manufactured by IFS Model No. 2125

1.2 Quality Control
A. All Instrument Housings shall be as manufactured by PTMW for previous SEPTA projects.

B. Conduct factory tests for each Instrument Housing and associated signal equipment to ensure the proper functioning of the equipment in accordance with a SEPTA approved Factory Test Procedure.

C. Inspect each Instrument Housing after manufacture and factory testing is complete and correct any deficiencies noted. Conduct this inspection in conformance with a SEPTA approved pre-shipment factory inspection procedure.

1.3 Submittals

A. Unless otherwise waived by the SEPTA Project Manager, submit three (3) reproducible copies of the following for approval for each Instrument Housing to be provided:

1. Drawings showing the proposed size and equipment layout of each Instrument Housing including as a minimum, all MTB, instrument racks, lighting, HVAC, convenience outlet arrangement, cable egress and routing, grounding, power, battery trays and racks, fire detection and suppression equipment, intrusion detection equipment, plan files and tables, and Local Control Panel;

2. Drawings of each instrument rack, MTB and wallboard mounting showing the detail arrangement and description of mounted equipment and proposed method of inter and intra rack wiring;

3. Size and type of internal wire for use in Instrument Housings;

4. Load calculations for each Instrument Housing to indicate rating of house electrical service panel, power equipment, HVAC equipment, voltage drops, and current draws, etc.;

5. Catalog cuts and descriptive literature for all equipment and systems to be provided within the Instrument Housings;

6. Drawings showing faceplate, location, size, wiring details, and mounting arrangement of Local Control Panel;

7. Detailed circuit and layout drawings for type of fire and intrusion alarm systems;

8. Drawings of maintainer’s call including sonalert equipment.

9. Completed and approved factory test procedures prior to shipping and Instrument Houses to site.

B. Submit details of Instrument Housing factors pertaining to weight and mechanical strength for installation, handling, and loading.

C. Drawings of each type junction box for switch, signal, and track circuits, including terminals boards, terminals, wiring, mounting details, and any
other integral components. Submittal to consist of drawings depicting construction of junction box, size, terminal arrangement, and grounding arrangement for each junction box including catalog cuts and descriptive literature for each type junction box.

1.4 Delivery, Storage, and Handling

A. Make provisions and be responsible for the delivery and handling of all materials and equipment required by this Contract.

B. Instrument racks and MTBs shall be properly secured to prevent damage to all mounted equipment.

C. Vital relays, printed circuit cards and all other sensitive electronic equipment shall be shipped separately, but identified for the locations in which they are to be installed.

D. Fasten and brace the house and equipment shipped within to prevent damage during transit. Replace any equipment damaged during transit at no additional cost to the Contract.

PART 2 – PRODUCTS

2.1 General

A. All Instrument Housing walls, doors and floor shall be constructed of No. 12 gauge galvannealed steel (ASTM A525). Roof shall be constructed of No. 14 gauge galvannealed steel (ASTM A525). Exterior roof to be finished with 2-3 mils thick white polyester powdercoat and under the floor, walls to be finished with 2-3 mils thick anti-graffiti gray polyurethane powdercoat. The house shall be complete with wire chases, access to underground and aerial cable entrance behind the Main Terminal Board, lined with hot and cold insulating material and structure so as not to sweat. Each Instrument Housing shall provide adequate space without crowding for the all equipment and cable terminations. In addition, each CIL shall be provided with additional spare space for future equipment installations with space requirements to be determined by the Project Manager.

B. The Instrument Houses shall be provided with a Local Control Panel, a wall hung desk 34 ½” x 30” with a locked drawer and compartmented riser (Dayton Model 1W952), two round steel bench stool with back rests (Dayton Model 1W712). All other Instrument housings shall be provided with the wall hung desk as specified herein.
C. The interior of all Instrument Housings shall be lined with a high efficiency “Thermax” insulation, 2” thick on the walls and 4” thick on the ceiling.

D. Auxiliary hardware such as hinges and hasps shall be stainless steel.


F. All external wires and cables entering the Instrument Housings shall be terminated on a Main Terminal Board. Terminal and wall mounting boards shall be constructed of ¾” plywood treated with fire-resistant paint.

G. Each Instrument Housing shall have an aerial cable entrance conveniently located relative to the Main Terminal Board and provisions for underground cable entrance bushings located at the rear of the Main Terminal Board. Entrance hardware shall be included to provide weatherproof entrance of cables. Underground cable entry between grade and bottom of case shall be protected with underground conduit and sealed for weatherproof entrance of cables.

H. All relay, microprocessor and electronic equipment racks are to be installed in bays and there shall be one overhead fluorescent light for each bay. All bays shall be arranged and sufficient space provided for personnel in the bays to view control devices on either side of the bay. Each CIL, supplementary location and CSH shall be provided with one (1) outlet for each six (6) feet around the internal perimeter of the house. All outlets shall be fed from the commercial power company where such a feed exists. All wayside case compartments shall have one light front and back in each side of the case and the case shall have one outlet front and back.

No equipment or wiring terminations shall be mounted closer than one (1) foot from the floor.

No wire termination points shall be mounted directly underneath any protruding equipment to minimize the likelihood of head injuries due employees checking wires under the equipment. Wire terminations shall not be installed below four (4) feet from the floor except cable / wire terminations

All relays shall be installed in relay racks in a logical order recognizing the relationships between associated relay functions. Wasted rack space shall be minimized.
I. Each Instrument Housing shall be provided with four (4) outside ground terminals and ground clamps. Ground clamps shall be sized to connect #6 AWG bare copper to form a ground grid. All ground rods shall be Copperclad steel in 8 foot lengths and 3/4” diameter. All ground equipment shall be as manufactured by Erico Products, Inc.

J. Instrument Housings shall have sufficient structural strength to permit lifting by overhead crane with all equipment, except plug-in apparatus, installed and wired. Eye bolts, or suitable arrangement shall be provided for lifting.

K. The doors of the houses shall be hinged and gasketed so that they will provide a dustproof and weatherproof seal and shall be provided with handles and Best Locking hasps with a three-point vandal-resistant locking device which shall insure that the door cannot be locked until it is completely closed. Each door shall contain ventilating openings which shall be covered by fine copper or brass mesh screens and protected by caps which will prevent entrance of moisture.

L. Each CIL, supplementary locations and CSH shall have two hinged doors for personnel entry.

M. To accommodate 60/100 Hz power, each instrument housing shall be equipped with entrance hardware, circuit breakers and panel wiring in accordance with NEMA standards. All power service locations shall be tagged for identification as either 60Hz or 100Hz.

O. Each CIL, supplementary locations and CSH shall be equipped with the following equipment powered off of the 220 Volt, 3 Wire, 60Hz power supply and terminated on individual circuit breakers providing two 110 Volt circuits. One of each of the following equipment shall be furnished for each 15 feet of housing length and fraction thereof unless otherwise specified. The commercial power equipment electrical load shall be divided equally between the two 110 Volt circuits.

1. 750 CFM exhaust fans thermostatically controlled.
2. 1200 watt electric heaters thermostatically controlled.
3. Convenience outlets.
4. Industrial type fluorescent light, double tube, four (4) feet in length in reflector housing. Fluorescent tubes to be equipped with unbreakable clear polycarbonate safety shields. Lights shall be provided for each bay, terminal board, walkway, and the operator’s area.
5. One retractable reel trouble light capable of reaching all areas within the housing.
6. One 18,300 BTU, 1 phase, 230/208-1, 60 Hz air conditioner w/ 5 Kw resistant heater (Bard part number WA182-A05XWXXXJ). The air conditioner unit, heater, and ventilation fan shall be circuited such that no two systems can be operated at the same time. Provisions shall be made to close ventilation openings when either the heater or air conditioner unit is operating.

P. The Contractor shall furnish and install smoke detection equipment in each new CIL and supplementary locations. The equipment shall consist of one or more detector heads mounted above the racks in the house.

1. The detector heads shall detect the presence of smoke and invisible products of combustion by the ionization chamber principle. They shall be mounted on four (4) inch pull boxes and connected into a fire indicating cabinet by two No. 14 AWG wires run in conduit.

2. The fire indicating cabinets shall be dustproof and shall be provided with contacts for indication via the code system to the control office and shall contain supervisory and power relays, constant voltage transformer and other components to supervise the system in accordance with the Underwriters’ Laboratories, Inc. requirements.

3. In operation, no valving or timing mechanisms shall be necessary and there shall be no moving parts in the system. Each detector head shall be capable of having its sensitivity changed without removing it from its base. The heads shall be capable of being removed from their bases for sensitivity checks if it is desired to do so.

4. The smoke detecting and thermal detecting systems shall be the PYROTRONICS System, as manufactured by Baker Industries, Inc. The equipment shall be listed by the Underwriters’ Laboratories, Inc. The manufacturer shall recommend the number and location of heads to completely and adequately protect each enclosure.

5. The Contractor shall provide a 5 amp circuit breaker for the powering of the fire indicating cabinet. The power shall be obtained from the 110 Volt, 60 or 100 Hz power source in each house.

Q. Each Instrument Housing shall be equipped with a fire extinguisher with mounting brackets. The size shall be a minimum of 20 pounds charge each and be rated “ABC”.

R. Each Instrument Housing shall be equipped with a grounding bus. Each grounding bus shall be made of a copper bar, shall measure 1/8 inch by 3 inches by 12 inches, minimum and shall be insulated from the housing.
Each grounding bus shall have a smooth flat surface drilled to accept the following connectors:
1. Connector suitable for terminating the shield of the multi-conductor signal cables.
2. Connector suitable for terminating the ground wire to the racks within the housing.
3. Connector suitable for terminating the ground wire from the made ground external to the housing.
4. Connector suitable for terminating the ground wire to the housing.
5. Ground wiring, colored green and solid, shall run along the bottom of the housings.

S. Wiring between instrument racks, wall mounting equipment boards and the Main Terminal Boards shall be carried overhead at rack-top level in metal wire chases which are closed on three sides and open on the top. Wire chases shall be free of sharp edges.

T. The CIL and supplementary locations shall be equipped with an intrusion alarm system in accordance with the Contract Drawings.

U. Interior surfaces of all housings, hardware, and fittings shall be finished in accordance with AREMA Signal Manual, Part 2.4.30.

V. The Contractor shall furnish foundations and foundation mounting hardware to provide substantial support for the each instrument housing. Precast concrete or steel foundations shall be furnished where site conditions permit.

2.2 Main Terminal Boards (MTB) and Equipment Racks

A. Provide MTB’s constructed of (minimum) 14 gauge, cold-rolled steel, with open frame weldments of 19 inches width and with panel mounting angles having standard EIA hole spacing. All MTB’s shall be comprised of ¾” marine plywood painted with a fire retardant paint.

B. Provide shock mounting base arrangement. Provide bases of the same width as the rack with a height of three and one-half inches.

C. The CIL, supplementary locations and CSH shall be equipped with shock mounted equipment racks on which the relays will be mounted.

D. Each individual rack shall be grounded to the ground bus. The racks shall be insulated from each other and from any supporting framework and shall only be electrically connected by the common ground bus.

E. MTB Accessories
1. Terminate incoming wires, including spare wires on AREMA terminal binding posts. Provide MTB’s complete with terminal blocks, tags, rack and row identification, and accessories.

2. Terminal Installation
   a. Provide terminal blocks utilizing test link straps to permit each internal wire and field wire interconnection to be separated on an individual basis without removing either wire from its terminal.
   b. Provide ten percent, spare terminal posts on each rack, whichever is greater.
   c. Provide approved communication type terminals for terminating communications type cables.
   d. Provide wire wound resistors on terminal board with one-half inch clearance between adjacent resistors.

3. Grounding Post
   a. Provide one bolted type grounding post with each rack to permit removal of ground wire connection for testing.

2.3 Relay Racks

   A. Instrument Housings shall be equipped with shock mounted equipment racks constructed of (minimum) 14 gauge, cold-rolled steel, with open frame weldments of 19 inches width on which the relays will be mounted.

   B. Each individual rack shall be grounded to the ground bus. The racks shall be insulated from each other and from any supporting framework and shall only be electrical connected by the common ground bus.

   C. Each relay rack shall contain a minimum of ten percent spare space.

   D. Each relay and microprocessor equipment racks shall be accessible from the front and rear.

2.4 Wiring

   A. All inside wire shall be in the compliance with the requirements of Section 13572.

   B. Inside wire shall be 600 Volt rated wire, insulated with ethylene tetrafluorethylene (EFTE) fluorocarbon resin, clean stripping, continuous temperature rating of 150°C and minimum insulated wall thickness of 15 mils (.015 inches) in accordance with SEPTA Specifications. Wires shall be tinned: Sizes, unless otherwise indicated on the Contract Drawings, shall be as follows:

   1. Vital circuits #16 AWG, 19 strand
2. Non-vital circuits #20 gauge solid or stranded
3. Track circuits #10 AWG, 37 strand
4. Lighting circuits #10 AWG, 37 strand
5. All energy loop wiring #10 AWG, 37 strand

C. Each row or relays shall be supplied with individual energy loops, with test links, supplied from the relay racks DC power supply bus. Each end of energy loop shall be terminated on a dedicated individual terminal of the bus.

D. Sufficient slack shall be provided in wire adjacent to their terminals to permit movement of equipment. Slack shall be arranged in a neat and orderly manner.

E. No splices shall be made in any wire.

F. The wiring shall be cabled and ty-wrapped in place so as to present a neat and orderly appearance.

2.5 Miscellaneous

A. Line Circuit Protection: Line circuits, including spares, entering instrument housings or cases shall be protected by Siemens Clearview air gap arresters.

B. Track Circuit Surge Protection: Track cables entering instrument housing shall be protected by Siemens heavy duty equalizers using three post terminals. All arresters are to be grounded.

C. Ground Detection
   1. Push-to-test ground detectors shall be provided for each CIL, supplementary locations and CSH.

D. Floor Matting
   1. Provide a vinyl floor matting to cover free floor space of each Instrument Housing.

2.6 Identification of Equipment

A. Three shall be an identifying nameplate for each relay, transformer, resistor, and individual devices and components as well as for each relay and equipment rack and the Main Terminal Board.

2.7 Junction Boxes
A. Provide junction boxes with gaskets to prevent entrance of moisture and dust in accordance with recommendations of AREMA Signal Manual, Part 15.2.10.

B. Provide all junction boxes with a means of applying standard Authority padlocks, one per door or cover as described.

C. Switch-and-Lock Movement Layout and Junction Boxes
1. Provide switch-and-lock movements to include one cast iron junction box with each layout.
2. Provide junction boxes complete with pedestal, similar to that manufactured by GRS Co. (Alstom) Cat No. A91-230: Ansaldo STS PC No. N374993, Siemens or approved equal to terminal underground cables.
3. Provide junction boxes complete with double-post AREMA terminals.

D. Signal Junction Boxes
1. Provide a junction box for each signal layout. Provide junction box for mast and catenary mounted signals.
2. Provide AREMA terminals as specified in Section 13585, Miscellaneous Components, of these Specifications within the junction boxes.
3. Junction boxes shall be sized by the Contractor. Boxes should be sized sufficiently to avoid crowding. Lighting converter shall be installed in junction boxes.
4. Boxes shall be cast aluminum, hinge and hasp fittings are to be aluminum, gaskets are to be installed between the cover and box to provide a weather-tight seal.
5. Provide terminal boards of ¾ inch wood, mounted in box.

E. Track circuit track wire junction boxes as manufactured by Siemens.

F. Snow Melter Junction Boxes
1. Provide junction boxes for each switch layout.

2.9 Painting

A. The interior of the instrument housings shall be painted according to the manufacturer’s standard. Interior color shall be white.

B. Provide MTB’s, relay racks, terminal boards, apparatus boards and shelves painted with approved, fire retardant, ANSI 61 gray paint.

C. Provide equipment with manufacturer applied corrosion resistant undercoatings.
D. Provide instrument housings the exterior painted in accordance with AREMA Signal Manual, Part 2.4.30. Primer shall be red lead oxide primer or approved equal.

E. The roof of the instrument housings shall be primed and painted with two (2) coats of an approved sunlight reflective enamel based paint.

F. Instrument housings shall be given a final transparent top coating that will enable easy cleaning of graffiti.

PART 3 – EXECUTION

3.1 Tests

A. Each Instrument Housing shall be factory tested to ensure the functioning of the equipment and systems contained within in accordance with a SEPTA approved Factory Test Procedure.

B. All inspections and testing shall be documented on forms the format and content of which shall be approved by the SEPTA Project Manager.

C. No Instrument Housing shall be shipped to SEPTA without the approval of the SEPTA Project Manager. In requesting authority to ship, the Contractor shall submit the locations, inspection, and testing forms for approval to ship.

D. Each inspection and factory test form shall be signed and dated complete by the Contractor’s test technician.

E. Each Instrument Housing shall be delivered with three (3) boxes \ cases per housing of the manufacturers recommended graffiti removing solvent and wraps.

F. Perform all factory tests as specified in Section 13621, Testing.

END OF SECTION
SECTION 13574  
TRAIN DETECTION  

PART 1 - GENERAL  

1.1 DESCRIPTION OF WORK  

A. This Section specifies the design and furnishing of Vital Track Circuits for train control and Audio Frequency Overlay ("Overlay") Circuits for Home Signal Overruns.  

B. Overlay Track Circuits shall be provided to drive a vital biased relay meeting manufacturer’s specification for overlay equipment in use.  

C. All track circuits shall be safe, reliable, available, maintainable and compatible with 100Hz cab signaling, 13KV AC traction power systems and all other frequencies installed in the rails.  

1.2 QUALITY ASSURANCE  

A. Overlay Track Circuits shall conform to AREMA Signal Manual of Recommended Practices, Part 3.1.23 "Recommended Design Criteria and Functional Guidelines for Audio Frequency Circuits" where applicable. The overlay track circuits shall have a record of reliable service for vital circuits in AC electrified rail territory. Overlay equipment shall provide stable operation with variations in ballast resistance, impedance bonds, insulated joints or the presence of other operating signal equipment.  

B. Contractor shall provide documentation to substantiate that all overlay track circuits to be provided under this Contract will operate reliably and safely under all conditions, for the use indicated. This shall include providing a Failure Tree Analysis (FTA) or Failure Modes and Error Analysis (FMEA) describing the mean-time-between-unsafe–failure (MTBUF) for the track circuit device proposed.  

C. All electronic track circuits shall be used between interlockings.  

D. All steady energy track circuits shall be for use as interlocking track circuits.  

E. All Overlay units shall be as manufactured by Siemens for overrun detection, as previously approved for use on SEPTA.  

1.3 SUBMITTALS
A. The Contractor shall submit to the SEPTA Project Manager for approval, prior to purchase or fabrication of any track circuit equipment, schematic representations, operating descriptions, typical applications, frequency usage tables, operating and maintenance manuals, field adjustment, maintenance and test procedures and interconnection diagrams of the track circuit equipment and methods which he proposes to use.

B. The Contractor shall submit track circuit adjustment tables for each type track circuit to be provided under this Contract showing as a minimum, calculations showing the minimum and maximum current and/or signal strength required for different lengths track circuits and impedance bond configurations. These calculations shall be used to adjust the track circuit at time of installation.

C. All overlay frequencies shall be approved by the SEPTA Project Manager and shown on the approved drawings.

D. The Contractor shall submit all of the above items, as well as factory and field test procedures prior to fabrication, procurement, or shipment of any of the items.

1.4 DELIVERY

A. Equipment shall be protected from damage throughout delivery, storage and handling.

PART 2 - PRODUCTS

2.1 MATERIALS

Wiring for the steady energy track circuits, electronic track circuits and overlay track circuits shall be in accordance with Section 13572 Internal Wire and Cable.

2.2 TRACK CIRCUITS

A. AC Steady Energy:

1. Track circuits shall be vital and shall be the double-rail steady energy operation with reversible bi-directional cab feeds. They shall be capable of normal operation on 100 Hz steady energy and shall provide immunity to 25 Hz and 60 Hz or direct current propulsion currents. They shall contain no active electronic components.

2. Track circuit equipment shall permit application in lengths of as much as 6,000 feet at 100 Hz. Track circuits shall have a shunting sensitivity of
0.25 ohms, or less at infinite ballast resistance when adjusted for a minimum ballast resistance of 3 ohms per 1000 feet. Track circuits shall operate successfully with a minimum ballast resistance of 3 ohms per thousand feet.

3. The track circuit proposed shall utilize a track transformer for coupling and isolation of track rails from the vital relay driver and a cab-signal transformer to provide adequate energy for cab-signal operation. The transformers shall be equipped with primary winding and secondary winding taps to permit adjustment of the track circuit or cab-signal operation and the specified shunting sensitivity.

4. Track and cab-signal transformers shall be air cooled type. Multiple tap transformers shall be provided for voltage level adjustment, and track isolation.

5. A reactor shall be provided for each signal feed end of each track circuit.

6. Each suppressor shall effectively minimize the wear due to arcing of the coding contact that feeds energy to the inductive winding which is protected.

7. Where vital track circuit and overlays are on the same track wires, filters shall be provided to prevent track circuits from interfering with overlay track circuit.

8. The track relay shall have a minimum of one front/back contact as the standard arrangement.

9. Filters used in fail-safe circuits shall prevent undesirable signals from passing through the tuned unit at a level that could cause unsafe conditions, even in the event of component failures with in the filter.

10. The track circuit shall be compatible with both normal and reverse fed cab signal carriers and shall be capable of resetting on coded energy up to cab rates of 420 codes per minute or less.

11. The track circuit shall include vital track relay driver as indicated below:
   a. The relay driver shall facilitate inputs for track and local power conditions and shall serve as a product summation device.
   b. The relay driver shall facilitate outputs powering vital track relay.
   c. The relay driver shall provide optimum performance when the track to local phase relationship is ±63 degrees at minimum ballast resistance and maximum track circuit length.
   d. The relay driver shall utilize a two (2) element tuned resonant unit for each input, or approved equal.
   e. The relay driver shall be provided with internal current limiting protection.
   f. The relay driver shall be provided with internal diode failure protection.
   g. The relay driver local input circuit shall provide voltage regulation.
   h. The relay driver shall provide immunity at any level of electrified traction power applied at track and local input conditions.
   i. The relay driver shall utilize a track input tuned filter and local input tuned filter. The track filter shall prevent track input noise and
traction power imbalance from influencing track circuit performance.

B. Electronic Track Circuits

1. All Electronic Track Circuit equipment shall be vital and shall be capable of being programmed and or re-programmable by SEPTA personnel, with no special computer language training required and only the skill set as found in a typical Carrier’s Signal Engineering Department.

2. Equipment shall operate from a nominal input voltage of 12 VDC and over the range of 9.5 to 16.5 VDC. Equipment shall operate over the specified input voltage range without requiring any adjustment.

3. Equipment shall provide automatic restart of operation after a DC power failure. As the battery voltage gradually increases, the equipment shall not try to resume normal operation until the battery voltage reaches the lower limit of the operational voltage range, as specified in a. above.

4. Equipment shall operate with a ripple voltage of up to 1.0 peak to peak on the DC voltage supply.

5. Equipment shall be capable of operating with the DC battery positive grounded, battery negative grounded, or with the battery floating ungrounded.

6. Equipment shall be protected against damage resulting from accidental application of incorrect polarity of the DC voltage supply.

7. Equipment shall utilize DIP switch keying.

8. System shall be protected against lightning and other voltage surges in the rail and power supply leads when installed with external surge protection.

9. Equipment shall be designed with convection cooling so that heat generating components (e.g., transistors with heat sinks and large wattage resistors) shall not be located next to other components that are affected by temperature.

10. The Processor Units shall be equipped with on-board diagnostics. These diagnostics shall quickly and reliably identify failed printed circuit cards. Indications shall isolate a failure to a particular function, or to the interface between two functions.

11. Wiring harnesses within the equipment case shall be arranged so that any printed circuit board may be easily removed for troubleshooting or testing without interference.

12. All connections to external track circuit apparatus and DC power shall be AREMA terminal posts, or approved equivalent.

13. Equipment shall operate normally and provide required shunting and broken rail detection for all values of ballast resistance between 2.0 ohms/1000 feet and 50 ohms/1000 feet, or higher, without requiring any adjustments.

14. Equipment shall, upon detection of broken rail, cause the appropriate outputs to be de-energized.
15. Equipment shall provide shunting so that a 0.25 ohm resistance connected across the rails shall be detected and cause the appropriate outputs to be de-energized.

16. Equipment shall be capable of operating reliably and safely on track circuits having interference of up to 5 VAC RMS rail-to-rail voltage from 60 Hz power lines operating at 60 Hz with harmonics up to 1200 Hz.

17. Equipment installed in wired instrument housings shall be suitable for mounting on standard 19-inch rack.

18. Equipment shall be designed so that circuit boards are accessible and removable:
   (a) From the front of the equipment.
   (b) Without requiring interface wiring to be removed or disconnected.
   (c) Without requiring the removal of other circuit boards.

19. Equipment shall be designed so that the Printed Circuit Boards (PCB’s) cannot be inserted upside down, and so that no damage or unsafe operation will occur if the circuit board is plugged into the wrong slot.

20. Equipment shall operate normally and reliably, and accept inputs from standard vital neutral relays in accordance with AREMA Signal Manual. The unit shall provide outputs which operate standard plug-in vital, neutral, regular release relays of 200 ohms to 1000 ohms resistance.

21. The track circuit system should include the required cab generator unit that produces standard 100 Hz at 50, 75, 120, 180, 270, and 420 pulses per minute. The unit should be self-contained including filters, transformers, etc., for the generation of the cab signal current. The equipment design should at least be as compatible as the electronic track circuit equipment in regard to interference to or from the audio frequency overlay. This should have capacity drive 3 amps at 6500' with a ballast resistance of 3 ohms/1000' and with a shunt of 0.25 ohms applied at the entering end.

22. All electric keying / registering of electronic track circuits shall be accomplished using internally mounted DIP switches.

C. Overlay Track Circuit System

1. System shall consist of a transmitter which applies a discrete audio frequency signal to the rails at one end of a track circuit and a receiver that accepts this discrete signal at the other end of the track circuit which will drive a vital biased relay meeting manufacturer’s specifications for overlay equipment in use. Overlay track circuits shall be used for interlocking overrun detection. It shall output a discrete signal on one end of the rails and accept this signal from the other end of the track circuit and drive a vital biased relay meeting manufacturer’s specifications for overlay equipment in use.

2. The overlay equipment shall be provided with internal surge protection.

3. The overlay equipment shall be provided with lightning surge protection and voltage equalization devices on the track wire side.
4. Transmitter and receiver cards of different frequencies shall be indexed or color coded to prevent the inadvertent installation of improper frequencies.
5. The overlay equipment shall be protected on the audio tone and power supply side of the device with the equipment manufacturer’s specified surge protection and/or approved equipment.
6. All overlay equipment shall be the shunt type.
7. Transmitter
   a. Train detection frequency transmitters and associated input equipment shall consist of:
      1. Oscillators
      2. Tuned power amplifier
      3. Surge protection
   b. This equipment shall operate from 12 VDC and be equipped with standard AREMA terminals.
   c. This equipment shall produce sufficient signal and modulation to operate a receiver at least 3000 feet away.
8. Receiver
   a. The equipment receiving the train detection signal from the transmitter shall produce a dc voltage of the required polarity to drive a vital biased relay only when the received signal is of the same frequency and address as the transmitter.
   b. This equipment shall operate from 12 VDC and be equipped with standard AREMA terminals.
   c. Receivers shall be provided with an LED relay drive indicator.
9. Transceiver
   a. Train detection frequency transmitters and associated input equipment shall consist of:
      1. Oscillators
      2. Tuned power amplifier
      3. Surge protection
   b. The equipment receiving the train detection signal from the transmitter shall produce a dc voltage of the required polarity to drive a vital biased relay only when the received signal is the same frequency and digital address as the transmitter.
   c. The transceiver shall be housed in one unit and it shall operate from 12 VDC and be equipped with standard AREMA terminals.
10. Shunting Sensitivity

    Overlay track circuit shunting sensitivity shall be effective at 0.25 ohms. The system shall de-energize the relay drive output of the receiver unit and/or the transceiver unit with a track shunt applied at or between the transmitter and receiver track connections when initially adjusted to the
manufacturer’s specifications and track circuit parameters remain constant.

13. Post-Shunt and Pre-Shunt

Overlay track circuits shall be adjustable so that post-shunt and pre-shunt distances shall not exceed 10 feet with a shunting sensitivity as specified within these specifications, unless otherwise directed.

2.3 TRACK JUNCTION BOXES

A. All track circuits shall be connected to the rails via a track junction box, unless otherwise directed to connect to the rails to the new Instrument Housing.

B. Track junction boxes shall be constructed of cast iron, and shall be placed in the gauge of the track midway between the two rails. Junction boxes shall be Model #463, part #091463-249X as manufactured by Siemens, or an approved equal.

C. Junction boxes shall be provided with watertight track wire connectors.

2.4 IMPEDANCE BONDS

A. Impedance bond shall be a dry type, self cooled unit as manufactured by Ansaldo STS AC-mini. The bond windings and magnetic circuit shall be encapsulated, watertight and covered on four sides by an integral wrap-around steel cover. The impedance bond shall serve to permit 25 Hz or 60 Hz traction power current to bypass insulated joints and at the same time have a high impedance to 100 Hz track circuit energy.

B. Impedance bond shall be such that audio frequency track circuits up to 20 KHz can be superimposed on 100 Hz track circuits.

C. The current capacity of track windings of each bond and bond connections for 25 Hz propulsion current shall be 300 amperes per rail continuous and 1000 amperes per rail for a one minute peak. The impedance bond shall function properly with traction current imbalance of no greater than 12%.

D. The track winding shall have an untuned impedance of not less than 1.0 ohm at 0.2 power factor at 100 Hz at any voltage between 1.0 volt and 12 volts. The two halves of the bond track winding shall be equal and balanced. The center tap shall be connected to two terminals, one on each side of the bond, and to the cover plate. Each terminal lug shall accept up to two 2/0 cables. The center tap lug shall accept up to four 2/0 cables. The terminal lugs shall be NEMA standard cable connectors. All hardware for the terminal lugs and impedance bonds are to be included.
E. The size of the impedance bond shall permit center mounting on the ties.

PART 3 - EXECUTION

3.1 TESTING

A. All components of all Track Circuit equipment furnished by the Contractor shall be factory tested in accordance with procedures previously submitted by the Contractor and approved by the SEPTA Project Manager.

B. Perform all factory tests as specified in Section 13621, Testing.

END OF SECTION
SECTION 13575

SWITCH AND LOCK LAYOUT

PART 1 – GENERAL

1.1 Description

A. The work under this Section includes furnishing of electrically operated power switch machines, and all switch operating rod layouts complete with lock rod, operating rod, front rod, point detector rod, saddles plates, mounting hardware, identification numerals, and all the hardware required for installing it on the ties.

B. Provide complete switch layouts consisting of the switch and lock mechanisms, junction boxes, rods, mounting holes, mounting bolts, wiring inlets, contacts, terminal binding posts, screws, nuts, washers, and all other hardware required for a complete and operable installation.

1.2 Quality Assurance

A. Comply with the requirements of Section 01400.

B. Power operated switch and lock mechanisms shall be the M23B as manufactured by Ansaldo STS. All switch rods and hardware shall be manufactured by GNB.

C. American Standards shall apply to threaded parts of the switch layouts.

D. Each switch mechanism shall be tested before shipping. This factory testing shall be conducted in accordance with an approved factory test procedure.

E. All power switch mechanisms shall be provided with run-through lock out devices.

1.3 Submittals

A. Submit the following plans and procedures to the SEPTA Project Manager for approval prior to procurement of the equipment.
   1. Switch and lock movement layout drawing.
   2. Plans for top line assembly of the switch machine together with a bill of materials.
3. Installation plans of the switch and lock movement layouts showing all switch and lock layout measurements, mounting details and connections to the track switch points.

1.4 Product Delivery, Storage, and Handling

A. Each switch-and-lock layout, mechanism and all its associated hardware shall be clearly marked on the shipped crate with the appropriate switch number and location as shown on the Contract Drawings.

B. Switch-and-lock layout including mechanism, rods, and all component parts shall be protected against damage or loss during handling and shipment.

C. Prior to shipment, coat with petroleum jelly or other approved preservative all parts that are not painted or made of non-corroding materials.

D. Plug or cap all unused threaded outlets.

PART 2 – PRODUCTS

2.1 Switch and Lock Layouts

A. The Contractor shall furnish all new switch layouts. Layouts shall be designed to mount without requiring the switch timbers to be dapped.

B. The Contractor shall verify all dimensions and field installation requirements prior to procurement. The Contractor shall furnish all required installation materials and hardware, required for each layout.

C. Right and left hand electric switch layouts shall be high voltage electric machines with 110 VDC motors, and each switch mechanism shall be provided with 115V/15W heaters for motor and circuit controller compartments.

D. Switch layouts shall be complete with all necessary rods and other hardware to mechanically couple the switch operating mechanisms to the switch points including the necessary riser and or junction boxes, cable and electrical fittings to interconnect the machine to the instrument houses.

E. Pedestal mounted termination boxes shall be furnished for the switch mechanism control for termination of direct burial cable. Box shall be capable of terminating 17 cable conductors and shall be similar to Siemens 091626.
F. Each switch-and-lock movement shall be supplied with an internal wiring diagram of a plastic laminated or plastic encased type and shall be fastened to the underside of the contact compartment cover.

2.2 Switch Hardware

A. Track switch operating layouts shall include lock rods, lock rod lugs, point detector rods, throw rods, throw rod brackets, point detector rod lugs, saddle plates, and all other required rods, screws, nuts, bolts, washers, plates, and hardware necessary to mount the switch machines and connect them to the points. Switch rods shall be vertical rods.

B. Track switch operating layouts shall be electrically insulated one running rail from the other.

C. Track switch operating layouts shall include the necessary electrical and mechanical fittings to permit interconnection of the switch machine with controls and indications located in the signal instrument house, including junction boxes, pedestals, foundations, mounting brackets, conduit, hoses, tubing, terminals, and hardware.


E. Malleable metal numbers and letters, painted white, not less than three inches high and approximately 3/16 thick, shall be securely fastened to the cover of each switch machine. The numbering shall be as shown on the Contract Drawings. Two letters, “N” and “R” made of malleable metals, painted black, shall be used to denote the normal and reverse position of the switch points. The letters shall be drilled to provide means to attach them to a tie.

F. Each switch machine shall be equipped with padlocks. Padlocks shall be used to restrict entry to the inside of the switch machine and junction box. All padlocks shall conform to these Specifications.

G. Provide one set of switch-and-lock movement adjusting wrenches, and one set of switch point blocking wedges and clamp for emergency blocking and clamping of track switch points with each switch layout.

2.3 Rods and Hardware

A. When the switch-and-lock movement layouts, as submitted by the Contractor require offsets in the track connecting rods, then such offsets
shall be standard and made by the manufacturer during production of the layout.

B. Provide ample threaded area on each rod to accommodate a wide latitude in operating adjustments.

C. All front rods shall be of the swivel type, insulated, and adjustable.

D. Provide extension or mounting plates and tie straps for each switch-and-lock movement layout.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Switch layouts shall be designed and furnished for installation without the need for dapping the timbers.

3.2 TESTING

A. All switch mechanisms to be furnished by the Contractor shall be factory tested in accordance with procedures previously submitted by the Contractor and approved by the SEPTA Project Manager.

B. Perform all factory tests as specified in Section 13621, Testing.

END OF SECTION
SECTION 13576

COLORLIGHT SIGNAL LAYOUTS

PART 1 – GENERAL

1.1 Description of Work

A. This Section includes requirements for the designing and furnishing interlocking, wayside Colorlight Signals (CL), the number and configuration of which are shown on the Contract Drawings.

B. The Contractor shall design and furnish all parts for each specific CL signal including, mounting brackets, hoods, backgrounds, masts, lockable junction box bases, lockable access ladders, reflective Interlocking Signal number plates, LED signal inserts, signal foundations, and all other materials as so required.

C. Each respective CL signal shall be provided with all materials as required for the specific set of signal aspects to be provided by the individual signal. All aspects shall be as specified herein.

1.2 Quality Assurance

A. All CL signals shall be as manufactured by Siemens.

B. All Light Emitting Diode (LED) type CL signals shall be as manufactured by Gelcore.

C. American Standards shall apply to all threaded parts of each signal layout.

D. All signals shall be inspected and tested at their point of manufacture prior to shipping.

1.3 Submittals

A. The following shall be submitted:

I. Documentation showing each proposed signal assembly and layout, including masts, foundations ladder details, access platforms, signal mounting details, LED specifications, and mounting details, junction box details, catenary mounting details including methods of providing employee fall protection, structural/civil engineering calculations for non-standard applications, foundation installation details, base terminal board
details, foundation bolt hole spacing, cable installation details, and all other technical data required by the SEPTA Project Manager.

2. Factory CL Signal Test Procedure.

1.4 Delivery

A. All equipment shall be delivered to a location as provided by the SEPTA Project Manager.

B. All wayside signal equipment shall be protected from damage during delivery and handling.

C. All signal equipment and component parts shipped shall be properly created and protected at the point of manufacturer to prevent damage in shipment. All exterior openings shall be sealed during shipment.

PART 2 – PRODUCTS

A. All Colorlight Signals (CS) shall be as the eight (8) inch diameter type as manufactured by Siemens Systems. Each wayside CL signal shall be configured with two (2) individual signal heads\units. Each of the signal heads\units shall be capable of providing for three (3) different colors.

The type of CL signal aspects to be utilized in this project shall be follows:

- Red over Red - Stop Signal
- Red over Yellow - Restricting Signal
- Flashing Green over Red - Follow the cab aspect

B. Signals shall be provided with backgrounds and hoods for all top and bottom heads\units. All lenses shall be the conical, clear polycarbonate type and shall be provided with individual visors.

C. All signal lamping shall be the Light Emitting Diode (LED) type as manufactured by Gelcore. The applied voltage and frequency shall be as determined by the Contractor in their final design. In addition, the LED’s shall be provided with light out detection

D. Each high type signal shall be provided with a five (5) inch aluminum signal mast with platforms and ladders as manufactured by Siemens. Each signal head shall be provided with twenty-four (24) way junction box base, ladders, lockable access ladder stay, ladder foundation and SEPTA standard locks. Rear signal access maintenance platform shall be
provided. Each signal mast shall be provided with junction boxes for cable terminations.

F. All signals shall also be provided with signal and ladder foundations and mounting hardware.

G. Where signals are to be mounted on the catenary structure doll masts, stand off brackets, bolt assemblies, saddles, and all other mounting parts and hardware shall be provided in lieu of the ground mounted signal masts.

PART 3 – EXECUTION

3.1 SIGNAL DESIGN

A. The intent of the design is for the CL signals to be driven directly through vital relays from the CIL’s. As such, the Contractor shall be responsible to provide the detailed signal lighting design including, cable specifications, as well as providing all signal lighting materials and equipment required for implementation, other than cable, as approved by the SEPTA Project Manager.

3.2 TESTING

A. All CL signals to be furnished by the Contractor shall be factory tested in accordance with procedures previously submitted by the Contractor and approved by the SEPTA Project Manager.

B. Perform all factory tests as specified in Section 13621, Testing.

END OF SECTION
SECTION 13579

RELAYS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide all relays required for the new signal system as shown on the Contract Drawings and as specified herein. Relays shall be plug-in types. Provide relays of each type required to be uniform in design and contact assembly and be similar or equal and compatible to those shown. Provide all relays as required by the typical design as well as those required to be drop shipped.

B. Provide relays with a sufficient number of contacts for the number of circuits to be controlled and an adequate number of spare contacts. Provide each relay or relay-repeater combination with at least one spare front-heel-back contact or one spare independent front and one spare independent back contact.

C. Operating voltage of vital relays, expressed herein as 10-16 Volts nominal shall be manufacturer’s standard as approved by the SEPTA Project Manager. All vital relays shall be the dual coil, 500 Ohm type.

D. Provide all relays and equipment specified to be capable of rated performance through an operating temperature range of -40 to +160 degrees F.

E. Provide all relays within dustproof enclosures except that provisions shall be made for ventilation, where required, for heat dissipation.

F. Provide relays capable of being tested from the front of the relay.

G. Locate the tag showing relay pick-up and drop-away values inside the relay cover for easy viewing.

H. The use of nylon or plastic stop pins in relays is not acceptable.

1.2 Quality Assurance

A. Provide vital relays meeting the requirements of AREMA Signal Manual, Part 6.2.1, where the AREMA requirements do not conflict with any requirements specified in this Section.
B. The factory testing of each relay shall be the manufacturer’s standard. All factory test results shall be recorded on approved Factory Test Report Forms. Each Factory Test Report shall be dated and signed by the Test Technician.

C. Vital relays shall be Alstom Type B or Siemens Type ST.

1.3 Submittals

A. Unless otherwise waived by the SEPTA Project Manager, submit for approval all relay specifications, solid state relay specifications, biased neutral switch machine controller, and special mounting or supporting arrangements and contact stacking arrangements for all relay types proposed. Include any information on arc suppression, where arc suppression is required or any other proposed features or options.

B. The Contractor shall submit a standard SEPTA Relay Record Test Form for each vital relay furnished under this Contract. A sample record form will be provided to the Contractor by the Authority. The Contractor shall be responsible for providing record forms of like documentation and composition. Use typewritten characters to fill in all information requested on the form and then verify in the field in its final configuration, for accuracy of relay serial number, location, and relay identification. Indexing of form cards shall be by serial number, and turned over to the authority in a metal file cabinet upon final Contractor verification. All measured test relay values shall be provided on software compatible for electronically inputting into the SEPTA RailDoc’s test program.

1.4 Delivery, Storage, and Handling

A. Make provisions and be responsible for the delivery and handling of all materials and equipment required by this Section.

B. Ship all vital relays separately from the wired racks or enclosure in which they are to be used. Package all relays individually, each in a sturdy corrugated cardboard carton with the drawings number of the relay printed on the outside of the carton. Store relays in a protected area until tested and installed in racks.

PART 2 – PRODUCTS

2.1 Materials

A. Vital DC Relays
1. Provide vital DC relays of the plug-in type and rack mount. Provide with a transparent dust cover made of a non-flammable composition, which shall not support combustion.

2. These relays, with a nominal operating voltage of 10-16 Volts, shall be capable of operating continuously without resultant damage with a minimum voltage range of seven to 21 Volts inclusive applied to their operating circuits.

3. Provide biased neutral vital relays designed so that their armature shall not pick-up with the permanent magnet demagnetized. Provide relays design so that their armature shall not pick up due to an interruption of the normal magnetic circuit when no current is applied to coils. Provide biased neutral vital relays designed so that up to at least 50 times working energization applied for two seconds at both normal and reverse polarity shall not affect their operating characteristics by more than two percent, and shall not pick up their armature on reverse polarity.

4. Provide each vital relay with a minimum of six dependent front-back contacts except for special function relays. All front contacts shall be silver-to-metallized carbon which meets the requirements of the AREMA Signal Manual, Part 6.2.1.

5. Provide arc suppression for vital relays built into the relay or into its plugboard.

6. Provide relays with identical contact arrangements for similar types of relays except special function relays.

7. All vital type relays or plugboards shall incorporate posts for test dropping relays and terminal posts for voltage and current measurements. Provide separate test points for each coil of the relay when connected in a circuit separately. Plug-boards for plug-in relays shall be equipped with removable contacts. Plugboards shall be furnished with a full complement of hardware. Method of connecting wire to contact shall be submitted to the SEPTA Project Manager for approval.

B. Vital Time-Element Relays

1. Provide microprocessor-based, plug-in type, vital time-element relays. Provide time-element relays for nominal 10 to 16 Volt DC operation.

2. Provide vital time-element relays with a minimum of two contacts that close only at the end of the adjusted timing cycle and at least two independent check contacts, which when closed, check the normal or de-energized position of the relay.

3. Provide each vital time-element relay with a time adjustment which can be sealed. When sealed it shall be impossible to adjust the timing interval. The timing interval shall be capable of repeated operation with an error of no more than 0.5 seconds when
the applied voltage is between 9 and 14 Volts and ambient
temperature between -40 and +160 degrees F.

4. Any interception of input power shall cause immediate reset to the
beginning of the present time cycle. The design of the
microprocessor of electronic timer shall be based upon the premise
that the degradation of any component results in a longer time
from the preset time.

5. Microprocessor based vital element relays shall be MicroChron
relay as manufactured by Alstom, or the EVT as manufactured by
Ansaldo STS.

C. Switch Operating Relays.

1. Provide two vital DC biased neutral switch operating relays, one
for normal and one for reverse operation, for each switch and lock
movement furnished or a solid state relay package. Provide all
switch operating relays to be identical.

2. Provide relays meeting the requirements for vital DC relays as
listed above except that a minimum of two front-back dependent
contacts or two independent front contacts and two independent
back contacts shall be required. Each contact shall be equipped
with a magnetic blow-out feature to effectively interrupt high
currents and minimize contact wear. Each contact shall be capable
of interrupting the normal switch-and-lock movement operating
current 10,000 times without its resistance exceeding ten ohms
measured at five amperes.

D. Vital Switch Overload Relays

1. Provide vital overload relays meeting the requirements for vital
DC relays as listed above and as stated herein to detect an over
current condition during the operation of a switch-and-lock
movement or a solid state biased neutral switch machine controller.
Provide one overload relay for each switch machine furnished.

2. Provide overload relays of the same manufacturer as the switch
machine, unless otherwise approved.

3. Provide overload relays with a full complement of contacts,
including a make-before-break contact, to perform all the circuit
requirements associated with switch operation. Furnish relays
equipped with two non-biased coils, one series connected to detect
over-current conditions, and the other to be used in a stick circuits.

E. Non-Vital Relays

1. Provide non-vital relays equipped with six, at minimum, front-back
contacts, LED indication and push-to-test front facilities.
Stationary contacts shall be bifurcated silver, palladium, or approved equal. Movable contacts shall be bifurcated silver, palladium with gold overlay, or approved equal.

2. Provide non-vital relays meeting or exceeding the following requirements:
   a. Maximum Temperature Rise:
      175 degrees F at 30VDC
   b. Insulation Resistance:
      1.5 x 1
   c. Ambient Operating Temp:
      -4° F to +160° F
   d. Dielectric Strength:
      500 volts RMS, 60 Hz between all mutually insulated parts
   e. Mechanical Life:
      100 million cycle operations
   f. Electric Life:
      10 million operations (0.5 ampere resistive load at 77°F)
   g. Contact Resistance:
      a. Before Life: 100 milliohms max @ 6 VDC, 100 ma.
      b. After Life: 200 milliohms max @ 6 VDC, 100 ma.

3. Provide non-vital relays for DIN rail mounting with a transparent dust cover made of a non-flammable composition, which shall not support combustion.

4. The design of the individual relay covers and of the cabinet in which several relays are mounted shall permit viewing the relays without disassembly or other mechanical manipulations, to determine whether each relay is energized to de-energized.

5. Non-vital relays shall be plug-in, DC, neutral relays with a nominal operating voltage of 12 volts as manufactured by Relco, or approved equal. These relays shall pick up with 18 volts or more applied to their operating circuit, and must drop out when this voltage decreases below two volts. Provide relays capable of operating continuously up to a maximum of 24 volts applied to their operating circuit. Non-vital relays shall pick up in less than 24 milliseconds when energized with 18 volts, and shall drop out when de-energized from 24 volts in less than 50 milliseconds. These times shall be measured as a front contact closure or opening from the instant the switch applying the voltage closes and from the instant the switch removing the voltage opens.

6. Contact resistance of non-vital relays front and back contacts shall not exceed five (5) ohms after 10 million operations when breaking a test load equivalent to three non-vital relays connected in parallel and suppressed as required in this Specification. Operating voltage for this test shall be 24 volts. Contact resistance shall be measured with a ten (1) milliampere current. All non-vital relays shall be identical by type, class, or function.
2.2 Identification

Furnish relays with provisions for mounting an approved typed or printed relay name tag for each relay, either on the relay cover or on the relay cabinet front plate, as applicable. Provide tagging that is easily replaceable, but shall not come off during normal service.

PART 3 – EXECUTION

3.1 Factory Installation

A. Install relays on new instrument racks located in the Instrument Housings as specified herein and as shown on the Contract Drawings.

B. Ensure that all AC and DC power buses are open while installing relays and do not re-connect these buses until all relays have been installed.

3.2 TESTING

A. Perform all factory tests as specified in Section 13621, Testing.

END OF SECTION
SECTION 13582
LOCAL CONTROL PANEL

PART 1 - GENERAL

1.1 Description of Work

A. The work to be done under this article shall be to provide a Local Control Panel (LCP) for manual operation of the Interlockings. The LCP shall be similar and consistent with other LCP’s presently in use at SEPTA.

B. The interlocking track plan shall appear on the face of each panel. Signal and switch levers and route and occupancy indications shall be incorporated with the track plan.

C. The following indications and controls are to be provided as part of the panel:
   1. Interlocking Trouble and alarm indications
   2. Track indications
   3. Signal Control and Indication
   4. Signal Fleeting Control and Indication
   5. Signal Call-on Control and Indication
   6. Signal Control and Indication
   7. Traffic Direction Indication
   8. Track Blocking Control and Indication
   9. Snow Melter Control and Indications
  10. Panel Light On-Off Switch
  11. Local/Remote Control Switch and Indication
  12. Special Functions as required by Contract Documents

1.2 Quality Assurance

A. Quality Assurance Program

   1. The Contractor shall provide and maintain a quality control program to ensure compliance with the quality standards of these Specifications consistent with these Specifications

1.3 Submittals

A. The Contractor shall submit the following SEPTA Project Manager for approval:

   1. Panel Face Arrangement Plans
2. Manufacturer’s specification for all panel components including, but not limited to, the supporting frame, enclosure, all display and control materials and the method of application.

3. Assembly plans with a keyed parts list showing ordering numbers for replacement parts for all equipment within the Local Control Panel to be furnished under this Contract.

4. A complete set of plans showing the mechanical details of the Local Control Panel, mounting hardware, fastening details, and plug connected terminations. Separate plans shall be furnished for each location.

5. Factory Test Procedures.

1.4. Delivery

A. Delivery location will be provided by the SEPTA Project Manager.

B. The Contractor shall be responsible for shipment and handling of all equipment and appurtenances under this Contract.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Local Control Panel

1. LCP Equipment

   a. The panel enclosure shall be constructed of 16 gauge galvanized steel. The frame shall be reinforced to provide rigidity required to maintain alignment. Joints shall be formed to a tight fit with abutting edges flush and securely welded. Joints shall be welded their full length and dressed flush on exposed surfaces. Spot welding shall be used when practicable in preference to screws or rivet fasteners. Holes for screws or bolts shall be drilled and countersunk. All bolts, nuts, washers and screws shall be chromate zinc plated. The finished work shall be strong and rigid and neat in appearance. Surfaces shall be smooth and free from warp and buckles.

   b. The enclosure shall have a hinged panel to provide free and ready access to all parts of the interior.

   c. The panel frame shall be equipped with a terminal lug for the purposes of grounding.
2. LCP Panel
   a. The local control panel shall consist of etched phenolic or brushed aluminum in accordance with the Contract Drawings. The track diagram, signal and switch symbols, lettering, and identification numbering shall be configured on this panel generally as shown on the Contract Drawings. The panel shall be equipped with levers, pushbuttons and indicators as shown on the Contract Drawings.
   b. The panel as described above shall be mounted on the CIL wall within proximity to the Vital Microprocessor equipment. Panel shall be locked in place with a locking mechanism and key as provided by Chicago Lock Company, Keyway Lock No. 2382, and all locations shall be keyed alike with the keys required for all vital and non-vital microprocessor equipment. One hundred spare keys shall be also be provided.

3. LCP Pushbuttons
   a. The pushbuttons and levers used on the LCP’s shall be similar and consistent with those used on other LCP’s presently in use at SEPTA.
   b. All pushbuttons shall be momentarily depressed and released by spring action to initiate a function.

4. LCP Indicators
   a. All indications shall be provided by means of individual LED indicators, as required within these Contract Documents.

5. LCP Panel Light
   This switch has two stick positions:
   (a) Down - panel lights off.
   (b) Up - panel lights on.

6. LCP Wiring
   a. The control panel shall be wired with single conductor, not smaller than No. 22 AWG, 19 strand wire, insulated for 600 volt service; wire as specified within the Internal Wire and Cable Section of these
Specifications. The wiring harness shall allow clear access to all lights, levers, and pushbuttons.

PART 3 - EXECUTION

3.3 INSTALLATION

A. Local Control Panels - The local control panels shall be installed in the Central Instrument Locations (CIL) in accordance with the approved drawings and as specified herein.

3.4 PAINTING

A. The LCP panel cabinets shall be finished with an enamel or lacquer. The finish color of the panel shall be grey, ANSI-61 or approved equal.

3.5 TESTING

A. Each local control panel shall be assembled and be included as part of the testing of the CIL in accordance with the approved factory test procedures.

B. Perform all factory tests as specified in Section 13621, Testing.

END OF SECTION
SECTION 13585
MISCELLANEOUS COMPONENTS AND PRODUCTS

PART 1- GENERAL

1.1 Description

A. Provide the various products and components as referenced in this Section and throughout this Specification required to provide for a completely operable signaling system.

1.2 Quality Assurance

A. All materials to be utilized in the design shall be selected, verified and checked for application against the interfacing components or devices to assure proper and safe operation, whether materials are required by these Contract Documents or selected by the Contractor.

B. Provide materials and equipment designed to operate in accordance with all applicable AREMA and local code requirements for the signal related systems being installed under this Contract. Provide all systems and equipment to be in compliance with a Contractor standard quality assurance program.

C. Products and components provided for use on this Contract shall be new and free of manufacturing defects.

D. Provide electrical and electronic components rated to operate at power, voltage, current, and temperature levels exceeding by 20 percent those that the components will be subject to in service, unless otherwise specified herein.

1.3 Submittals

A. Unless otherwise waived by the SEPTA Project Manager, submit complete performance data information and a sample of each type of new component or product as an equivalent to those herein specified. Obtain the SEPTA Project Manager’s written approval for any such equivalent type component or product before proceeding with manufacturer or procurement.
1.4 Delivery and Handling

A. Make provisions and be responsible for the delivery and handling of all materials and equipment required by the work of this Contract.

B. Properly package all materials, equipment, and their component parts at the manufacturer’s point of shipment. Replace any material or equipment damaged, lost, or stolen in shipment at no additional cost to the Contract.

PART 2 – PRODUCTS

2.1 Circuit Breakers, Fuses, and Fuse Clips

A. Provide circuit breakers and fuses of suitable capacities to protect the various pieces of signal apparatus from the effects of short circuit or overloads. Furnish all circuit breakers and fuses required for the equipment and systems in accordance with the Specifications.

1. In general, circuit fuses shall be non-renewable, and shall be of the fiber case, timelag, fusion type.

2. The fuses shall be the correct size and rating and shall protect the electrical equipment and circuits from short-term and long-term overloads. In DC branch circuits, where fusing is impractical, a protective resistance unit may be provided.

B. Fuses and breakers installed on instrument racks shall be of the indicating type with pop up indicators to show that the fuses or breakers have tripped.

C. Arrange fuses as far as possible, such that a blown fuse or a fuse failure will not interfere with the operation of other unaffected circuits. Centrally locate all fuses on the power distribution panels and power racks.

D. Provide fuse clips so constructed that they retain their resilience under all installation and service conditions so as to ensure a positive contact between the clips and the fuse.

E. All fuses shall be provided with “Tron” type fuse clamps.

2.2 Diodes

A. All diodes to be furnished under this Contract shall carry a Joint Electron Device Engineering Council (JEDEC) number or shall be available from more than one manufacturer and shall be used within the published
specifications for such number. All diodes shall be silicon type and shall be capable of tolerating a minimum inverse voltage of 1000 Volts, unless otherwise approved by the SEPTA Project Manager.

2.3 Resistors, Reactors, and Capacitors

A. All resistors, other than those required for electronic circuits, shall be suitable for railway signaling circuits and shall meet all applicable AREMA Specifications as described in Part 14.2.15 of the AREMA Signal Manual.

B. No more than two circuits shall share the same resistor. Resistors shall be arranged, wherever possible, so that a short circuit or defective resistor will interfere with the operation of one route only.

C. All reactors, other than those required for electronic circuits shall be suitable for railway signaling circuits and shall meet all applicable AREMA Specifications as described in Part 14.2.20 of the AREMA Signal Manual.

D. Capacitors shall meet the requirements described in Part 14.2.40 of the AREMA Signal Manual. Capacitors with PCB’s will not be permitted.

E. Resistors, reactors, and capacitors for electronic circuits shall be provided in accordance with applicable requirements of Part 14.2.40 of AREMA Signal Manual.

2.3 Terminal Blocks, Binding Posts, Insulators, and Test Links

A. Provide terminal blocks meeting the requirements as described in Part 14.1.5 of the AREMA Signal Manual.

B. All terminal binding posts, other than those required for communications and supervisory control circuits shall be suitable for railway signaling circuits, and shall meet all applicable AREMA Specifications as described in Part 14.1.10 of the AREMA Signal Manual.

C. Provide all AREMA type terminal posts, location on the MTB in the Instrument Housings with a protective insulator constructed of fire-resistant material. Install this insulator after all wire terminations and connections have been made. The type of insulator may be individual for each terminal post, or may be of a slip-on multiple cover type. If the latter type is used, it shall be designed to cover a maximum of five terminals.
D. All terminal posts, located on terminal boards in the Instrument Housings used to terminate in excess of 100 volt circuits shall be provided with a protective insulator. Insulators shall be individual for each terminal post, Type 023408-7X as manufactured by Siemens, or approved equal.

E. Insulated test links shall be Type 024620 as manufactured by Siemens or approved equal.

F. Communication cable to be terminated on protection block R66C1-6VSR equipped with 1304VSR2 gas tubes. Stencil protection block with pair numbers of main cable.

G. All terminal posts, located on terminal boards in the Instrument Housing shall be permanently identified with a plastic tag as approved by the SEPTA Project Manager.

H. Weidemuller type terminal blocks, and assorted component units such as breakers and fuse holders shall be used for VMIS equipment racks as approved by the SEPTA Project Manager. All Weidemuller terminals shall be the quick disconnect type with the bayonet hinges.

2.4 Lightning Arresters and Equalizers

A. Provide lightning arresters and equalizers mounted on a three post porcelain or approved type base in accordance with AREMA Signal Manual Part 11.3.

2.5 Terminals for Wire and Cable

A. Fit all stranded signal wires terminated on terminal posts under this Contract with an approved type of terminal lug at all points where the wires are terminated. Provide for four types of terminating:
   1. A lug for terminating heavy wires or signal power wire;
   2. A solderless type of terminal with translucent insulation for terminating No. 16 and No. 14 AWG stranded wires;
   3. “Ring Tongue-Flat” terminal and slip-on nylon post insulator for terminating wires larger than No. 14 AWG to a maximum diameter over the insulation of 0.40 inches;
   4. Pre-insulated diamond grip-ring tongue, nylon insulated wire terminal for terminating other stranded wires sized No. 20 and No. 18 AWG with a maximum diameter of 0.125 inches, for terminations on No. 8 studs and one-quarter inch studs.

B. Attach the lugs to the ends of the conductor in such a manner that the flexibility of the conductor shall not be destroyed and the possibility of
breakage at the terminal is reduced to a minimum. Attach lugs to the conductor with a tool made by the same manufacturer as the plug and/or terminal and recommended for the lugs and terminals being used. The tool shall be equipped with a ratchet device to ensure proper indentation of the lug and which shall not release until proper indentation is complete. All crimping tools shall be calibrated. Provide three tools for each type of lug or terminal required for installation to the Authority prior to shipment of the first wired housing.

C. Provide lugs of the solderless crimp-on type. Submit samples of all solderless lugs and other terminals for approval. Use no terminals and solderless lugs until approved by the SEPTA Project Manager.

2.6 Tagging of Cable, Wire, and Equipment

A. Except as otherwise specified in this Section, permanently tag both ends of each cable and each cable wire and all signal wires that terminate in all wayside housings, cases, junction boxes, or on the MTB equipment racks and any equipment of the signal system outside of such locations. Install tags so that they may be read with a minimum of disturbance of the tags and wires. Ring out and identify each conductor before applying the tag.

B. Provide tags for wire and cable identification and for identification of transformers, resistors, reactors, and all other components that meet the following requirements:

1. Sleeve Type Tags – Tags for identification of individual conductors and wires within the Central Instrument Locations, cases, junction boxes, base of signal and switch junction boxes, and similar applications shall be the sleeve type as manufactured by Raychem Corporation, Thermofit Marker System (TMS), or approved equal. Apply the conductor nomenclature in accordance with the manufacturer’s instructions to result in a permanently bonded and legible identification.

2. Flat Plastic Tags – Provide flat plastic laminated type tags for identification of vital relay plug boards, individual transformers, resistors, reactors, terminals, and other miscellaneous components.

a. These tags shall be 1-1/2 inches long by ¾ inch wide with one 5/16 inch hole location in the center of the width. The distance from the edge of tag to the hole shall be approximately 9/32 inch. The untreated tag shall be milk white and approximately 7/100 inch thick.

b. Provide tags that allow for three rows of identifying nomenclature and are capable of receiving typed-on characters by conventional means. The height of the
lettering shall be not less than 1/8 inch. Dot matrix style of
typeset will not be acceptable.
c. After lettering, cover the face side of the tag with a clear
plastic coating of at least 1/100 inch. The back of the tag
shall be covered with a milk white coating of at least 1/100
inch.
d. Provide entrance rack tags with nomenclature applied
showing the terminal post identification on the top line, the
functional nomenclature on the bottom line. Identify
terminal posts by geometry coordinates, such as rack, row,
and post number.
e. Provide flat plastic tags with holes for conductor to pass
through on terminal boards.
f. Provide a permanent flat plastic tag for each overlay on
which the field location (CSH # etc.), direction of use,
frequency, and address shall be listed.

3. The application of the conductor nomenclature shall be in
accordance with the manufacturer’s instructions and shall result in
a permanently bonded and legible identification.

2.7 Hardware

A. All mounting hardware exposed to the elements and used for signal
equipment, cases, conduit, hangers, brackets, clamps, etc., shall be hot-dip
galvanized, except as otherwise approved.

B. Utilize the hot dip process of galvanizing for coating all hardware. Pickle
all parts so that all scale and adhering impurities are removed. Apply a
continuous and thorough coating of commercially pure zinc so as not to
scale, blister, or be removable by any of the processes of handling or
installation. The finished surfaces shall be free from fine line cracks,
holes, or other indications of faulty galvanizing and be smooth and free
from adhering flux and other impurities. The edges and ends of parts shall
be free from lumps and globules. Coat parts with at least two ounces of
zinc per square foot of galvanized surface, after all bending, cutting,
drilling, and final fabrication.

C. Provide cadmium plated or stainless steel for all nuts, bolts, and washers
used for the mounting of equipment within finished enclosures. As an
alternate, another type of plating or non-corroding metal may be submitted
for approval.

D. Cadmium plating shall be an impervious, dense, hard, fine grained,
continuous, closely adhering coating of commercially pure cadmium, free
from capillaries and shall completely cover the surface of the part in a
smooth bright layer. Plating on raised or prominent portions shall show no evidence of blackness or loose crystalline structure. It shall have a minimum thickness of .0006 inch and shall withstand the salt spray test for at least 1000 hours or an equivalent test.

2.8 Conduit, Boxes, and Fittings

A. Provide conduit as indicated in accordance with the following standards:
2. Liquid Tight Flexible Conduit – furnish as indicated, conforming to UL Standard 360.

B. Outlet boxes and fittings – furnish as indicated and as required conforming to ANSI C33-84 and UL 514. Use cast metal boxes and fittings, hot-dipped, galvanized, cast iron.

C. Outlet boxes and lighting units shall be clearly marked to indicate the type of power fed to or feeding from the device, i.e. 100hz or 60hz.

2.9 Cable Tray

A. Provide cable tray, ladder type sized as required with horizontal and vertical elbows, tees, and fittings as required to make a complete raceway system as indicated.

B. Components and each layout shall be approved.

C. Provide all components of cable tray system from same manufacturer. Cable tray shall conform to NEMA-VEI.

2.10 Electrical Wiring Devices

A. Provide general purpose switches conforming to UL 20.

B. Provide receptacles and plugs conforming to UL-498.

C. Switches and receptacles shall be clearly marked to indicate the type of power fed from the unit, i.e. 100hz or 60hz.

2.11 Ground Rods, Clamps, and Wire

A. Provide ground rods of Copper clad steel with clamps made of a cast bronze clamp body with non-ferrous tamper-proof set screws.

B. Provide No. 6 AWG copper ground wires with green colored insulation.
2.12 Padlocks and Keys

A. Provide all wayside housings, signal heads, ladder guards, switch machines and enclosures with padlocks.

B. Housing padlocks shall be Best No. 41B722-L-XSPL, keyed to SEPTA Key No. R1 core.

C. Signal equipment and device padlocks shall be Best No. 41B722-L-XSPL keyed to SEPTA Key No. R1 core provided for all junction boxes, wayside signals and junction boxes, switch compartments and junction boxes, and other field enclosures and signal enclosures.

2.13 Electric Panelboards

A. Provide enclosure panelboards (load centers) as indicated on the Contract Drawings in conformance with UL 67 (ANSI C33.38) for power distribution.

B. Provide molded-case thermal magnetic circuit breakers as indicated, conforming to UL 489. For receptacle circuits, furnished approved ground fault detector breakers where required.

C. Panelboards shall be clearly marked to indicate the type of power fed from the unit: i.e. 100hz or 60hz.

2.14 Fiber Optic Distribution Panels

A. Provide fiber optic distribution panels shall be provided for each location where fiber optic cables are to be terminated. This includes each interlocking, cab signal, grade crossing (including existing crossing locations where all work will be completed by field personnel) and supplementary locations. The FODS shall be the following:

1. Fiber MultiMedia Outlet Box - Part No. M40A1-B-262
2. Fiber panel – Part No. M40ST8-262
4. Part No. 207404 Corning-C CCH-12-19T - 12 Port panel St SM loaded
5. Part No. 250825 Corning-C ICH-02P 12 – F - Wall mount enclosure

C. All parts numbers are from Anixter, United States.
2.15 Fiber Optic Transmitters and Receivers

A. Provide fiber optic transmitters and receivers shall be provided for each location where fiber optic cables are to be terminated. This includes each interlocking, cab signal, grade crossing (including existing crossing locations where all work will be completed by field personnel) and supplementary locations. Fiber fiber transmitters and receivers assemblies shall be as manufactured by Commnet, and shall utilize a MOSFET drive of vital relays and shall provide for eight (8) channel contact mapping. The devices also shall:

1. All transmitters and receivers shall be applied to a single (1), single mode fibers optic cable strand.
2. The transmitters and receivers shall utilize microprocessor technology that positively ensures that the device will only assume an on or off state under any and all conditions.
3. The receivers units shall be designed to assume the off state when either the power is removed from the unit, the fiber optic cable becomes disconnected or there is no signal coming from a fiber optic transmitter.
4. All units shall be provided with individual LED indicators showing power, carrier and contact status.

2.16 Fiber Optic Splitters \ Couplers

Provide fiber optic splitter \ couplers for each includes each interlocking, cab signal, grade crossing (including existing crossing locations where all work will be completed by field personnel) and supplementary locations and shall be Model No. SDW13550129UC as provided by Fiber Instrument Sales (FIS).

2.17 Vital Microprocessor System (VMS)

A. To ensure the ability to track revisions made to equations in a program with a high degree of accuracy, all VMS equipment shall employ Boolean Logic as the main method used in the programming and execution of the equipment.

B. The VMS equipment, both interlocking and track circuit units to be provided shall provide for separate and distinct programs for compiling and uploading programs. As such, it shall be possible for field maintenance personnel to upload a program to a newly installed board from a personal computer that does not require that the compiler program be resident on the technician’s computer.
C. All VMS equipment using ‘flash EPROM’ for uploading programs into system memory, shall be provided with a removable storage means or mechanism to allow field technicians to replace a CPU, or any other software bearing PC board without the need to re-load software onto the new board (PCMIA cards, EPROMS, etc).

D. As modified above, all VM Interlocking equipment shall be similar to the Microlok II unit as manufactured by Ansaldo STS USA and each unit shall be outfitted as follows:

1. All vital input and output Printed Circuit Boards (PCB’s) shall be the 12VDC sourcing type.
2. All non-vital input and output PCB’s shall be the 12VDC sourcing type.
3. All vital PCB’s shall provide for 16 inputs or outputs
4. All non-vital PCB’s shall provide for 32 inputs or outputs.
5. The unit shall be mountable in a standard 19 inch rack.
6. Each VMIS units shall be provided with:
   a. CPU, communications, vital kill relay drive and power supply PCB’s and cables,
   b. Five (5) Standard Vital Input PCB’s and cables,
   c. Five (5) Standard Vital Output PCB’s and cables,
   d. Three (3) Non-Vital Input PCB’s and cables,
   e. Three (3) Non-Vital Output PCB’s and cables,
   f. Three PCB blanks,
   g. Two (2), 4 MB flash memory cards,
   h. Ten (10) spare EPROM’s of each type used and
   i. Two (2) of each type PCB’s or device used in the final approved design.

E. Event recorders

The inputs for each event recorder used on the project shall be submitted to the SEPTA Engineer for approval prior to completing each locations design.

2.18 A. Snow melters

1. Snowmelter cases in accordance with the Contract drawings and specifications, including one spare circuit per case.

2. Snowmelter equipment in accordance with the Contract drawings and specifications.

3. Snowmelter pedestal junction boxes in accordance with the Contract drawings and specifications, including one spare circuit per case.
2.19 Environmental Protection

Provide protection, as herein specified, for machine-finished surfaces, threaded rods and nuts and other parts that are susceptible to rusting, utilizing a corroding preventive compound, which must have sufficient body to resist weather and rusting for at least six months.

END OF SECTION
PART 1 - GENERAL

1.1 Description of Work

A. The signal power source from 30th St to Arsenal is a single phase 6600 volt, 100 Hz. The Contractor shall design and furnish AC signal power supplies for the new instrument houses and wayside cases at these locations using this source. The Contractor shall supply all single-phase transformers, fuse cutouts, breakers, fuses, CIL and CSH load centers, etc.

B. The Contractor shall provide all design and materials necessary to provide the AC power required at each of these locations, as well as providing the type of power that is necessary to operate the various types of signaling equipment at each of these locations.

C. All power supply equipment used on this project shall be compatible with, and operable from either a 60 Hz or 100 Hz source.

D. The Contractor shall furnish single phase Automatic Transfer Switches (ATS) with number of poles, amperage, voltage, frequency, and withstand current ratings as required by their design. Each automatic transfer switch shall consist of a microprocessor controlled double throw power transfer switch unit interconnected to provide complete automatic operation. All transfer switches and control panels shall be the product of the same manufacturer.

E. As shown on the typical power drawings, each CIL shall be provided with an external emergency generator outlet for interconnecting a portable generator for the purpose of powering the location in the event of a failure of the signal or commercial power feed(s). The outlet shall be a standard weatherproof, lockable type duplex outlet of sufficient capacity and rated to handle the amount of power required by each location. The outlet shall be wired to a normally open, properly sized breaker for connecting the generator onto the main power buss.

1.2 Quality Assurance

A. Equipment shall be designed in accordance with the pertinent provisions of the codes and standards of the following listed organizations:
   2. Institute of Electrical and Electronics Engineers (IEEE).
   5. Occupational Safety and Health Administration (OSHA).
   6. Underwriters Laboratories (UL).

B. Any law or regulation of the State of Pennsylvania or other local regulating body having jurisdiction over this equipment shall apply.
C. The Contractor shall provide and maintain a quality control program to ensure compliance with the quality standards of these Specifications. Within 30 days after Contract award, the Contractor shall furnish to the Project Engineer four copies of his complete quality control and procedures manual, and description of the organization to be used on this Contract.

D. The Contractor shall provide all AC, high and low, power calculations for each location including spare capacity.

E. Automatic Transfer Switches (ATS) shall be the ASCO Series 300 type.

F. Frequency converters shall be as manufactured by Behlman Electronics Corp for railroad applications.

1.3 Submittals

A. All submittals shall conform to the requirements of Specification Section 01300, Submittals.

B. The following shall be submitted for review and acceptance prior to fabrication of the load centers, power supplies, and associated surge protection, detection, and alarm systems:

1. Complete mechanical and circuit drawings of frequency converters, ATS panels, load centers, ground detectors, power supplies, load center breakers, fuses and other protection to be furnished.

2. Complete power calculations for each location showing the locations AC draw including equipment loading and capacity, fuse and breaker sizes and spare capacity as a minimum.

3. Complete performance data of each type and size of power supply, frequency converters, ATS panels, transformers, fuse, breaker, cutouts, arresters and load centers to be furnished.

4. Proposed location and method of mounting transformers, fuse, cutouts, load centers, power supplies, ground detectors, and surge protectors.

5. Complete circuits for low voltage, power off, automatic ground detection and all other alarming.

6. Factory test procedure and forms.

C. Drawings shall be submitted for the complete power layout including surge protection, house load centers, power supplies, frequency converters, switches, ground detectors, fuses, breakers, buses, locations, and sizes of the individual units.

D. Calculations shall be made and submitted for review and acceptance to verify that the ratings of the AC signal power cables, power supplies including breakers, surge suppression, frequency converter, ATS panels, power supplies, and all other equipment required are adequate.

E. The Contractor shall furnish an arrangement drawing, schematic diagrams, detailed terminal diagrams complete with nameplate and terminal strip designations, installation instructions, maintenance and overhaul manuals, and other relevant data. Terminal diagrams shall also show names of individual wire sleeves and cable names.
F. All delivered hardware shall be identified on a list, shown on the installation drawings, or marked and packaged for easy identification in the field.

G. The Contractor shall furnish certified factory test reports for each piece of equipment provided under this Contract.

1.4. Delivery

A. Delivery location will be provided by the SEPTA Project Manager.

B. The Contractor shall be responsible for shipment and handling of all equipment and appurtenances under this Contract.

1.5 General Requirements

A. All equipment shall be designed for a seismic loading of 0.3g in any direction.

B. The Contractor shall furnish all labor, tools and materials required to provide a new signal power system at the locations described in the Contract Drawings.

PART 2 - PRODUCTS

A. Pad Mounted High Tension Transformers

1. To be provided by others

B. Frequency Converters

1. Frequency converters shall be as manufactured by Behlman Electronics Corp. for the railroad industry in frequency ranges of between 25 Hz to 350 Hz and shall be sized as required by the design with an additional 25% spare capacity.

2. The unit shall provide for 100% of rated power into any power factor load.

3. The frequency converter shall provide for an extended temperature range as required by these Specifications.

4. The frequency converter shall provide for overload and short circuit protection with automatic recovery

5. The frequency converter shall provide for surge protection on the units input and outputs with full isolation and redundancy.

6. The frequency converter shall utilize standards AREMA type terminals and shall be provided with alarming capabilities.
C. ATS Panels

1. The ATS shall be electrically operated and mechanically held. The electrical operator shall be a single-solenoid mechanism, momentarily energized. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.

2. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.

3. All main contacts shall be silver composition. Inspection of all contacts shall be possible from the front of the switch without disassembly or disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their travel to inspect and service the contacts when required.

4. Components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

5. A controller shall direct the operation of the automatic transfer switch. The controller's logic shall be controlled by a built-in microprocessor. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.

6. The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit. Logic shall be provided on printed circuit boards.

7. Controller shall have a flush-mounted display with LED indicators for switch position and source acceptability. It shall also include test and time delay bypass switches. A push-button type test switch shall be provided to simulate a normal source failure.

8. The ATS shall be furnished in a NEMA type 1 enclosure with a strip heater with thermostat for Type 3R enclosure requirements.

9. The voltage of each phase of the normal source shall be monitored, with pickup adjustable to 95% of nominal and dropout adjustable from 70% to 90% of pickup setting.

10. Single-phase voltage and frequency sensing of the emergency source shall be provided.

11. An adjustable time delay shall be provided to override momentary normal source outages and delay all transfers. The time delay shall on transfer to emergency shall be adjustable from 0 to 5 minutes.

12. An adjustable time delay shall be provided on retransfer to normal, adjustable to 30 minutes. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.

13. All adjustable time delays shall be field adjustable without the use of special tools.

14. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal.
15. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact, closed, when the ATS is connected to the emergency source.

16. Indicating lights shall be provided, one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red). Also provide indicating lights for both normal and emergency source availability.

17. Terminals shall be provided to indicate actual availability of the normal and emergency sources, as determined by the voltage sensing pickup and dropout settings for each source.

PART 3 - EXECUTION

3.1 TESTING

A. All power supply equipment shall be tested for rated output voltage and current.

B. Each alarm circuit shall be tested individually to assure that it indicates the proper alarm condition as shown on the approved plans.

C. All ground detectors shall be field tested in conjunction with the complete testing and adjustment of the total installed system. Ground detectors shall be operational before tests are made or before energy buses are closed and shall be maintained in operation throughout the testing.

D. All AC power equipment shall be tested in accordance with an AC power test procedure as approved by the SEPTA Project Manager.

E. Perform all factory tests as specified in Section 13621, Testing.

END OF SECTION
SECTION 13604

DC POWER SUPPLIES

PART 1 - GENERAL

1.1 Description of Work

A. The work to be done under this Section consists of the design and furnishing of direct current power supplies of various voltages to supply energy to all signal system equipment.

B. The design and furnishing of ground detection, power supplies, battery chargers, batteries, and secondary surge protection equipment for all equipment to be furnished under this Section.

C. The work under this Section shall include the design and furnishing of all necessary electrical connections, and material between the AC power buses and the battery chargers or power supplies and associated DC power supply equipment, and DC buses in accordance with the National Electrical Code.

D. Unless otherwise approved by the SEPTA Project Manager, all DC power supply equipment and devices shall be provided as shown on the Contract Drawings and the Material Reference Sheets.

1.2 Quality Assurance

A. The battery chargers, batteries, and power supplies furnished under this Contract shall undergo all tests and inspections required to ensure compliance with these Specifications.

B. The factory test of battery chargers, batteries, power supplies and components shall be the manufacturer's standard. Transformers shall meet the requirements of the latest revisions of AREMA Signal Manual Part 14.2.10 where applicable and where the requirements of the AREMA Specifications do not conflict with any requirements specified in this Section.

C. A certification of compliance with factory test requirements shall be submitted prior to delivery of the battery chargers and power supplies.

D. All power supplies shall be compatible with and operable from either a 60 Hz or 100 HZ feed.
E. All DC power supply equipment shall be as manufactured by National Railway Supply Company.

1.3 Submittals

A. All submittals shall conform to the requirements of Specification Section 01300, Submittals.

B. The following shall be submitted for review and acceptance prior to fabrication of the rectifiers, dc power supplies, batteries, and associated surge protection, detection, and alarm systems:
   1. Complete mechanical and circuit drawings of rectifiers, batteries, DC power supplies, load centers, ground detectors, load center breakers, fuses and other protection to be furnished.
   2. Complete power calculations for each location showing the locations DC draw including equipment loading and capacity, fuse and breaker sizes and spare capacity as a minimum.
   3. Complete performance data of each type and size of rectifiers, batteries, DC power supplies, load centers, ground detectors, load center breakers, fuses and other protection to be furnished
   4. Proposed location and method of mounting rectifiers, batteries, DC power supplies, load centers, ground detectors, load center breakers, fuses and other protection to be furnished
   5. Complete circuits for ground detection alarms.
   5. Factory test procedure and forms.

C. Calculations shall be made and submitted for review and acceptance to verify that the ratings of the DC signal power cables, power supplies including breakers, surge suppression, batteries, power supplies, and all other equipment required are adequate.

E. All delivered hardware shall be identified on a list marked and packaged for easy identification in the field.

G. The Contractor shall furnish certified factory test reports for each piece of equipment provided under this Contract.

H. The intention of this article shall be to provide a minimum standby power duration for each system and or location as specified herein. Therefore, the Contractor shall be responsible to calculate their needed draw, and size their equipment to provide the necessary standby capability. Where the values provided within this Contract are insufficient to meet this standby requirement, the Contractor shall provide all equipment necessary to meet the minimum specified hour needed.
PART 2 - PRODUCTS

2.1 Materials

A. Design Requirements

1. All semiconductors shall be silicon type with JEDEC numbers.
2. Transformers shall not emit audible noise in excess of 75 db, referenced to 0.0002 dynes/cm at a distance of two feet, at rated voltage and current.
3. The battery chargers and power supplies shall be capable of withstanding 600 volts, applied for one minute between both input leads connected together and the case; between both output leads connected together and the case; between both output leads connected together, and both input leads connected together.
4. Input voltage shall be 115 VAC plus or minus 15 percent, plus or minus 0.5 HZ, single-phase, two wire. Power supplies and battery chargers shall be designed to accept 60 Hz or 100 Hz input power at nominal 110 VAC.
5. The Contractor shall furnish and install automatic battery chargers, the taper charge type, for banks of batteries of 12 VDC, 24 VDC and electronic 12 VDC. The chargers shall be capable of providing full charging capacity.
6. The battery chargers shall be a constant voltage, taper charge type with a float-equalize switch.
7. The capacity of the charger and power supplies shall be determined by the Contractor and furnished with a minimum of 125 percent over the calculated capacity.
8. Power supplies shall be designed for continuous operations.
9. The battery chargers shall be equipped to automatically adjust the rate of charge based upon the ambient temperature in the instrument and the temperature of the batteries.
10. Low voltage and power off alarms and indication shall be provided to the field event recorder.
11. The current rating of each battery charger to be supplied shall be adequate to fully charge a completely discharged set of batteries within six (6) hours while carrying the full current requirement.

B. Protection Requirements

1. The power supply shall be so designed so that it will not be damaged by an input voltage range between 0 and 140 VAC.
2. Reverse output current protection will be provided to prevent shorting or sagging of tandem power supplies in the event of filter capacitor failure.
3. The power supply output terminal shall contain a non-conducting device or insulated safety shield to protect personnel from
electrical hazards. The device shall protect and be rated not less than 4 times the out of the power supply.

4. The audio frequency overlay track circuits shall be equipped with surge protection and shall conform to AREMA Manual Part 11.2.1 - Recommended General Surge Protection for Signal System. Power supply output terminal shall contain a non-conducting device or insulated safety shield to protect personnel from electrical hazards. The device shall protect and be rated not less than 4 times the out of the power supply.

5. Primary surge protectors shall be used in track circuits, line circuits, and AC power circuits and conform to AREMA Manual part 11.3.1 - Recommended Function of Primary Surge Protectors for Electrical Surge Protection of Signal Systems.

C. Nickel Cadmium Storage Batteries

1. The nickel cadmium storage batteries shall be sized to provide twenty-four (24) to thirty-six (36) hours of standby service at maximum load after a power failure.

2. The battery capacity shall be calculated at the 8-hour discharge rate to 1.10 volts per cell at a temperature of +25°C (+77°F) when tested in accordance with IEEE Standard 1106-1987, Recommended Practice for Maintenance, Testing, and Replacement of Nickel-Cadmium Storage Batteries for Generating Stations and Substations (ANSI). A copy of all standard practices shall be provided to SEPTA.

3. Each cell, unless otherwise specified, shall include the following parts:
   a. One group of positive plates.
   b. One group of negative plates.
   c. One set of terminals and copper or steel connecting straps to fit the terminal posts.
   d. One set of hard rubber or plastic insulators.
   e. One container.
   f. Electrolyte of potassium hydroxide.

4. Elements
   a. Positive plates shall be of perforated nickel-plate sheet steel pockets or nickel-coated fiber plates with nickel hydrate active material. The plates shall be welded securely to a connecting plate. The pockets shall be mounted in a suitable steel frame.
   b. Negative plates shall be of perforated sheet steel or nickel plated sheet steel pockets or nickel-coated fiber plate with cadmium active material. The plates shall be welded securely to a connecting plate. The pockets shall be mounted in a suitable steel frame.
c. The positive and negative plates shall be connected in correct numbers for each size and type of battery. Each group shall be securely fastened to their terminal posts.

5. Electrolyte
   a. Electrolyte shall be an alkaline solution of potassium hydroxide in distilled or approved water, approximately 1.190-1.200 specific gravity or as recommended by the manufacturer. The potassium hydroxide solution may also include a small amount of lithium hydroxide not less than 1.5% greater than 3.5% by weight.

6. Assembly and Charge
   a. Cells shall be completely assembled and charged ready for service unless otherwise specified.
   b. Charge rates shall be in accordance with the specific manufacturer's recommendations.

7. Identification
   a. Manufacturer's type number and serial number or date code that will identify the date of manufacture shall be permanently stamped legibly on the cell.

8. Plate Insulators
   a. Plate insulators shall be of such quality, material and design as to avoid the necessity of replacement during the guaranteed life of the elements.
   b. The insulator rods or sheets should be made of hard rubber or plastic. They should be alkaline-resistant and free of all impurities that may injure the cell.

9. Battery trays
   a. Battery trays shall be design only for that use and shall match the size of the batteries it protects.

E. Ground Detectors
   1. Ground detectors shall be the push-to-test manual ground detector type as manufactured by Ansaldo or Siemens or approved equal; except as modified herein.
   2. Ground detector resistance shall be no less than 5000 ohms per volt.
   3. Ground detector shall be provided with 0 - 50 metered scale.
   4. Ground detector shall test for positive and negative grounds.
   5. Ground detector shall be provided with a selector switch for testing each power supply individually. Selector switch shall be provided with an “Off” position.

PART 3 - EXECUTION

3.1 Installation
A. Application
1. Fuses providing overload protection for the DC bus branch circuits shall be of the electrical indication type and shall be circuited to provide fuse failure alarm.
2. Battery backup will be designed to connect to the respective DC power supply buses in accordance with the approved plans, and the applicable requirements of AREMA Signal Manual Part 9.5.1.
3. Ground detectors shall be mounted on equipment racks in accordance with the manufacturer's recommendation.

3.2 Testing
A. All DC power supply equipment shall be tested for rated output voltage and grounds in conjunction with the complete factory test procedure as specified in the Testing Section of this Specification.
B. Each alarm circuit shall be tested individually to assure that it indicates the proper alarm condition as shown on the approved plans.
C. Perform all factory tests as specified in Section 13621, Testing.

END OF SECTION
PART 1 - GENERAL

1.1 Description of Work

A. This Section includes the basic requirements for factory tests and inspections which the Contractor shall devise and perform to demonstrate that each part of the signaling system is in compliance with these Specifications.

B. The Contractor shall organize a test program that verifies the adequacy of the system to meet all technical requirements in an orderly and logical sequence.

C. Tests and inspections shall be made during the progress of the work and shall consist of factory manufacturing inspections and factory tests including but not necessarily limited to; circuit breakdown tests, wiring and tagging verification tests, continuity tests, resistance tests, voltage and current tests, timer tests, relay tests, VMIS tests, operating and simulation tests, and other electrical and mechanical tests as required to demonstrate the hardware design.

D. The Contractor shall be responsible for the costs of his personnel and any special equipment and assistance required to conduct all required tests and inspections, and complete the required documentation. When a device or system does not meet the Specification requirements initially, the Contractor shall make the necessary corrections and shall be responsible for the total cost of additional tests and/or inspections required to prove compliance. SEPTA reserves the right to oversee and or conduct any and all tests.

E. Tests to be performed shall cause each system and subsystem to be sequenced through its required operations to prove that the installation complies with all specified requirements.

F. Test procedures and inspections shall be conducted according with the Contractor’s test plan as approved by the SEPTA Project Manager.

G. The results of each test as herein specified shall be recorded at the time test is made and test result documentation furnished to the SEPTA Project Manager.

H. All test reports shall be checked and approved by the Contractor prior to submittal to the SEPTA Project Manager. All test reports shall contain the date and signature of the Test Technician who performed the test.
1.2 Quality Assurance

A. The quality of materials, fabrication and finish of all signal components, and their compliance with these Specifications, shall be assured by the factory tests and inspections which the Contractor shall devise and perform as specified in the various Sections of these Specifications.

B. Use test equipment calibrated to the instrument manufacturers requirements and that have been certified by an accredited testing facility to perform the tests.

C. The quality of the installation shall be assured through the performance by the Contractor of tests and inspections made during the progress of this Contract.

D. The Contractor shall inspect all instrument houses and wayside cases prior to the factory acceptance test. Documentation of such inspections shall be submitted for approval prior to the scheduling of the factory acceptance test.

E. The Contractor shall devise and perform such factory tests as are required to ensure the appropriate degree of quality for items manufactured or fabricated for use on the signal system specified herein.

F. The Contractor shall devise and perform such factory tests as are required by these Specifications to ensure that all systems, subsystems, and operating equipment provided under this Contract function in a safe and proper manner.

1.3 Submittals

A. The Contractor shall submit for approval the following:
   1. The Contractor’s proposed inspection and test programs.
   2. A list of factory tests to be performed.
   3. Copies of the proposed inspection and test forms consisting of pre-printed data sheets and/or inspection sheets for each test
   4. If during the factory test, a discrepancy is found, it shall be noted on the form, corrected and any affected portion of the test shall be repeated. No piece of equipment with an uncorrected discrepancy shall be shipped.
   5. If during the factory test, a discrepancy is found which cannot be corrected, testing shall be discontinued and the SEPTA Project Manager shall be notified and furnished with the test results and all particulars.

PART 2 - PRODUCTS

2.1 Test Equipment and Materials

A. All test instruments and equipment necessary to conduct the tests specified herein shall be available, ready-for-use not less than one week in advance of test need. Ready-for-use shall mean properly matched for test parameters, properly calibrated,
sufficiently supplied with leads, probes, adapters, and stands necessary to conduct the particular test in a completely professional manner.

PART 3 - EXECUTION

3.1 Equipment Factory Tests and Inspections

A. General
   1. All systems, subsystems, and components forming an integral part of a system or subsystem shall be individually inspected and tested.
   2. Each component and unit shall be inspected at its point of manufacture and evidence of this inspection and acceptability shall be indicated on the item where practical.

B. All vital relays shall be factory-tested in accordance with the respective manufacturer’s standards. Where no standards exist, SEPTA’s and or the AREMA Standards shall govern.

C. All equipment not herein named shall be individually inspected and tested prior to shipment in accordance with an approved test plan.

D. The Contractor shall submit test procedures for the following tests as described below. These tests shall be performed to the greatest extent possible at the factory level. Any changes or detachment of wiring and equipment that can cause an unsafe condition shall be retested in the field.
   1. Power Rack and Energy Distribution Circuits
      a. The purpose of this test is to be certain that energy at all required levels is available in each individual Instrument House and Case and properly distributed to equipment. This test shall check that no grounds, shorts, open, crosses or misplaced wiring exist in the power distribution system. Any malfunctions, lack of power, or blown fuses shall be reported for later correction and retesting. All standby or reserve power circuitry shall be checked both for operation and satisfactory operation.
      b. This test shall include the following:
         1) Check AC power for correct voltage and current levels, and phasing where required.
         2) Check DC power for correct voltage and current levels and correct polarity.
         3) Check and adjust transformer taps where required.
         4) Check and make operational all ground detectors.
         5) Check all circuit breakers and fuses for correct size and rating.
         6) Check all battery chargers and batteries for the correct setting, quantities, and operation. Verify full charge battery re-charge time.
7) Check bus-to-bus checks to determine that no shorts, crosses, or grounds exist.

2. Circuit Breakdown Testing
   a. All circuits shall be verified and tested in their entirety for the correct operation of and response to each contact on each individual circuit element. Where parallel paths exist, the tests shall validate each path, and circuits shall be disconnected to ensure the proper test.
   b. Where parallel paths exist in a relay circuit, the circuit shall be checked to prove that all paths are energized from the same fuse.
   c. Each circuit shall be tested by simulating all operating conditions to ensure that the circuit operates in accordance with the circuit and these Specifications. This shall be done by removing contact terminals from plugboards at each contact and checking to see that energized relays drop.
   d. These tests shall also include the verification of correct current where resistors are used to reduce current.
   e. All point-to-point wiring verification tests shall be indicated and documented on the locations test plans. These wiring tests shall also include checking all tags and markings for their presence, legibility, and accuracy. Any discrepancy shall be tagged with a red paper tag fastened to the wire or device with string.
   f. Jumper wires used for temporary connections for these tests shall be of vividly contrasting color to the rack wire. These wires shall be removed at the end of the tests. The test procedure shall include documentation of jumper quantity and a check-off system to ensure that all jumpers have been removed.
   g. Both ends of each wire shall be checked during these tests to be certain that their terminations are solidly applied and that they are properly held in their correct place. The corresponding line on the set of test plans shall be marked with green pencil to indicate the presence of each wire in its proper position and condition.
   h. All circuit elements shall be checked in the breakdown test. All terminations shall be checked to ensure that no extraneous connections exist.
   i. A contrasting colored pencil (brown) shall be used to checkmark each connection on the set of plans to be submitted when requesting permission to ship the location to indicate that each circuit element and termination has been checked as required in this procedure. All coordinates for identifying apparatus locations shall be likewise checked.
   j. As each circuit is checked out, contact by contact, from energy plus to energy minus, the corresponding circuit in the circuit plans shall be delineated with colored pencil so that no wire, contact, coil, device or connection is overlooked.
3. Nomenclature Check:
Both ends of each wire shall be checked during these tests to be certain that their circuit tag nomenclature is correct. The circuit nomenclature on the test set of plans shall be marked with yellow pencil to indicate the circuit nomenclature is correct.

4. Wire Count Test:
The wiring verification test shall also include a count of wires at each termination and assurance of continuity between terminations. The proper number of wires at a position shall be indicated on the test set of plans by a contrasting color to indicate the number of wires is correct.

5. Component Verification Test
Verify that all components, relays, printed circuit boards, resistors, and all other components are the same as called for on the approved circuit drawings and location in proper position. Indicate the proper devices exist at the proper position by marking the test set of plans with a contrasting color to indicate correctness.

6. Instrument House and Wayside Cases
a. The Contractor shall test each wired Instrument House and wayside case in accordance with these Specifications and the Contractors test procedure submitted and approved by the SEPTA Project Manager. These tests shall include, but not necessarily be limited to the following:
   1) Each instrument house and case shall be wired complete at the point of assembly, with all equipment installed. An operational test shall be made in accordance with the approved circuit plans. Functions external to the house and case shall be simulated.
   2) Adjustments and corrections of defects in the wiring shall be made as necessary to obtain proper operation.
   3) All design changes found necessary to obtain proper operation shall be submitted to the SEPTA Project Manager for approval.

7. Solid State Equipment Test
a. All solid-state equipment shall be powered up and allowed to burn in for a period of time to be determined by the SEPTA Project Manager to ensure there are no premature equipment failures.

b. All input and outputs shall be tested to ensure the appropriate I/O bit/point is connected to the appropriate circuit device and or Local Control Panel.

c. Test that the event recorder and data interrogator system are wired and operate properly. Test that all printer functions operate properly.
Verify all data points are assigned and wired as shown on the location circuit plans.

d. Modems, fiber transmitters and receivers, electronic coders, electronic track circuits and overlay track circuits shall be tested to ensure the devices function properly.

e. All VMIS equipment shall be factory tested, using test programs as provided by the Contractor that are necessary to verify the operational methodology of all interlocking fail over scenarios

8. Relay Tests
The Contractor shall test each relay consistent with the following requirements:

a. Energizing and de-energizing the relay a sufficient number of times to determine that the vital relays perform correctly and that the contact stacks operate and meet properly and that the contact ribbons are not damaged.

b. Pickup and drop-away values of each vital relay shall be measured and recorded.

c. Time releases and timing relays operate within the time interval required.

9. Ground Detector Tests:
The Contractor shall test that the ground detectors operate properly for each different voltage quantity monitored.

10. Ground Tests:
All grounded connections shall be tested to determine that the ground wires are of the specified size and are connected at the specified locations.

11. Switch and Lock Tests:
Test each switch machine and electric lock to ensure that they are wired correctly and operate properly. Test timing, hand and power operation, control, indication and overload operation.

12. Colorlight Signal Tests
Test each Colorlight Signal and warning device to ensure the heads are wired correctly and the LED’s energize and illuminate properly. Test the LED’s for light out and flashing light operation.

13. AC and DC Power Equipment Tests:
Test all battery chargers, rectifiers, frequency converters, transfer switches and transformers. Testing shall simulate conditions to be found at the location.

14. Interlocking Tests:
All devices, components and systems shall be actuated and sequenced to ensure that each interlocking device in the wired location functions in accordance with the approved design.

15. Cab Signal House Tests
   All devices, components and systems shall be actuated and sequenced to ensure that each cab signal control house operates properly and in accordance with the approved design.

E. All hardware control equipment shall be operationally tested and inspected as a complete functional assembly prior to shipment to the extent possible. Test each function by simulating operating conditions.

3.2 Calibration of Instruments
   All instruments or recorders employed in these test programs shall bear a record of calibration against certified standards. Such calibrations shall be made at least every 90 days and at such other periods as may be directed by the SEPTA Project Manager. Each test record shall identify the specific instrument employed in the test and the latest date on which calibrated.

3.3 Test documentation
   A. Conduct all tests in accordance with approved test procedures and in accordance with SEPTA’s standards. All test forms shall be created by the Contractor and shall be subject to the approval of the SEPTA Project Manager. Except as otherwise specified, furnish all labor and materials necessary to perform tests, record data, and prepare reports. Tests shall demonstrate compliance with the requirements of these Specifications. Any changes required to bring the system into compliance shall be at no additional cost to SEPTA, including the costs for additional testing.

   B. The results of the inspection and testing of each component of the signaling system, upon documented and attested successful completion shall be forwarded to the SEPTA Project Manager.

END OF SECTION