

## **SECTION 18700**

### **HIGHWAY GRADE CROSSING WARNING SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.01 DESCRIPTION**

- A. Section includes requirements for highway grade crossing warning systems.
- B. Where shown on the Contract Drawings or as required to accommodate associated other work of the Contract, make modifications to the existing highway grade crossing warning systems including such work as replacing, rewiring, or relocating of existing equipment or providing new control equipment and trackside equipment.
- C. Provide continuous operation of the highway grade crossing warning systems in preparation for, and during, track installation and rehabilitation work.

##### **1.02 REFERENCE STANDARDS**

- A. American Railway Engineering and Maintenance of Way Association (AREMA):
  - 1. Communications and Signals Manual of Recommended Practices (C&S Manual). When following the recommendations of the AREMA C&S Manual substitute the word "shall" for the word "should" in the applicable Manual Part.
- B. Code of Federal Regulations (CFR), Title 49, Transportation:
  - 1. Part 234 Grade Crossing Signal System Safety
  - 2. Part 236 Rules, Standards, and Instructions for Railroad Signal System
- C. General Orders (G.O.) of the State of California Public Utilities Commission (CPUC) shall apply:
  - 1. G.O. 75D: Protection of Crossing at Grade of Roads, Highways, and Streets with Railroads

##### **1.03 SYSTEM DESCRIPTION**

- A. Furnish and install new train detection equipment, wideband shunts, narrowband shunts, tuned joint couplers, dummy loads, shunt housings, insulated joints, and track connections for designated existing crossings.
- B. Provide continuous highway grade crossing warning during all phases of rail construction. Refer to Section 01011, Work Planning. At no time shall the work of the Contractor cause delay to train operation, cause an unsafe signaling condition to exist, or reduce the effectiveness or quality of the existing or new grade crossing warning systems.

- C. Provide rail bonding for new or modified rail joints or turnouts as shown on the Contract Drawings. Provide rail bonding, as necessary, to maintain existing systems during construction.
- D. Protect existing signaling cabling and, where necessary, relocate existing cabling in order to prevent damage to the cabling during track installation, profiling, or grade crossing work.
- E. Record the final as-built conditions of the crossing warning system for each crossing.
- F. Perform and document all tests and inspections in accordance with CFR 49 regulations and these specifications.

#### **1.04 SUBMITTALS**

- A. Provide submittals for highway grade crossing devices, equipment, systems, assemblies, and detailed design in accordance with the requirements of Section 18000, General Signaling Requirements.
  - 1. Submit, for approval by the Engineer, proposed plan for providing alternate methods of crossing warning during cutover and whenever the existing automatic crossing warning devices are deactivated, altered, or modified in order to accommodate construction work. Alternate methods shall conform to applicable parts of CFR, Title 49, including Part 234, and local ordinances.
  - 2. Alternative Foundation Design: If the Contractor proposes foundations different from those shown on the Contract Drawings, submit drawings of the type of foundations, including size and details of the galvanized anchor bolts, nuts, and washers the Engineer's approval. Include structural calculations with loadings and wind shear parameters. The Contractor's alternate final design drawings and calculations shall be approved and stamped by a professional engineer registered in California.
- B. Detailed Work Plan: The following work plan shall be coordinated with and integrated with submittals made under Section 01011, Work Planning. Submit a detailed work plan, for approval and coordination by the Engineer, prior to making the changeover from the existing crossing warning system to the new crossing warning system. The Contractor's proposed plan shall detail the amount of time the warning system will be out-of-service and the substitute warning which will be provided to allow normal railroad operations to be maintained. Change over of control, testing, and temporary-warning procedures shall be coordinated with the Engineer.
- C. Submit for approval of the Engineer a procedure plan for conducting quality assurance, component integrity, circuit continuity, circuit breakdown, and system operation tests.
- D. Submit product data for products furnished under this Section.

- E. Submit documentation of acceptance testing.
- F. Submit test reports.

**1.05 DELIVERY, HANDLING, AND STORAGE**

- A. Package printed circuit cards separate from the constant warning time (CWT) units and all other electronic components with removable cards for shipment to the field. Protect each CWT unit and printed circuit card from damage or loss during handling and shipment.
- B. Protect precast concrete foundation units during handling to avoid damage in transit and at storage locations. Support, cushion, and stack to protect the edges of the units. Replace chipped, cracked, or damaged units.

**1.06 SPARE PARTS AND SPECIAL TOOLS**

- A. Refer to Section 01600, Materials, for general requirements for spare parts. Furnish for spare parts a constant warning type (CWT) crossing train detection equipment cabinet complete with modules for a two-track operation, associated surge panels, and programming keypad.

**PART 2 – PRODUCTS**

**2.01 EQUIPMENT - GENERAL**

- A. Furnish materials and equipment for installation and for interconnection of the highway crossing warning as indicated on the Contract Drawings and specified herein. Materials and equipment shall be the products of manufacturers regularly engaged in the production of such material and equipment and shall be the manufacturer's latest design. Signaling materials and equipment shall be of a type and model that are in standard operation on major railway systems.
- B. Only those existing materials and equipment specifically identified on the Contract Drawings for re-use, relocation, or modification shall be incorporated in the highway grade crossing warning systems. Materials and equipment shall conform to the provisions of AREMA Signal Manual, except as modified in this Section.
- C. Furnish trackside equipment, such as tuned joint couplers, narrow band shunts, and wideband shunts, as shown on the Contract Drawings. Furnish equipment shelters, predictors, track filters, chokes, and other equipment as shown on the Contract Drawings and as required for complete installation.
- D. Refer to Section 01600, Materials, for lists of Owner-furnished equipment. Conduct and document acceptance testing of all components prior to transporting them from Owner-designated storage location.

**2.02 ELECTRICAL AND ELECTRONIC COMPONENTS - GENERAL**

- A. Design fusing and furnish fuses and printed circuit cards, connectors, and files in accordance with Section 18000, General Signaling Requirements.

**2.03 CROSSING WARNING TRAIN DETECTION EQUIPMENT**

- A. Furnish constant warning time (CWT) type crossing train detection equipment, terminating shunts, surge panels, and arresters for the crossing configurations shown on the Contract Drawings.
- B. Furnish each CWT unit complete with the basic complement of printed circuit cards and additional circuit card(s) for functions such as upstream detection, downstream detection, preemption initiation, event recording, and the like, as shown on the Contract Drawings.
- C. Make CWT unit audio frequency assignments following manufacturers' application guidelines with special attention being paid to frequency versus approach length and placement of adjacent channel narrow band termination shunts. Acceptable primary frequencies in Hz are 86, 114, 156, 211, 285, 348, 430, 525, 645, 790, and 970. Constant warning time systems shall include a high frequency, AFO track circuit for the island circuit. Acceptable island frequencies are 10.0, 11.5, 13.2, and 15.2 kHz or the Harmon (GETSGS) Random Signature Island frequency.
- D. Each highway grade crossing unit shall consist of a primary grade crossing CWT controller and a redundant standby grade crossing CWT controller. Provide an automatic transfer unit to transfer the approach control function from the primary CWT controller to the standby CWT controller in event of the failure of the primary unit and back to the primary unit if the standby unit were to fail. House the automatic transfer unit in the same cabinet as the CWT normal and standby controller.
- E. Furnish constant warning time controller capable of detecting train movements on two separate track sections. Design CWT unit to allow selection of a different frequency for each track.
- F. Constant warning time crossing train detection equipment shall be GETSGS (Harmon Electronics') Model HXP-3R2 or equivalent. Termination shunts shall be the CWT manufacturer's recommended type shunt for the frequency and application used. Furnish multi-frequency selectable termination shunts.
- G. Furnish termination shunts, adjustable inductors, filters, code isolation units, and the like, as recommended by the CWT controller equipment manufacturer, as shown on the Contract Drawings.
- H. Provide solid-state vital "AND" gate or equal as shown on the Contract Drawings.
- I. The placement of the crossing approach start shunts shown on the Contract Drawings is based upon the maximum authorized train speed of 79 MPH and a crossing warning time of 25 seconds. Four seconds has been added to account for equipment reaction time. Additional time, if required to accommodate the individual crossings' unique characteristics or as required for traffic signal preemption requirements, shall be as specified in the Contract Documents. Take

necessary field measurements at the grade crossing and verify that the crossing warning time and shunt placement are valid for site conditions. Bring any discrepancies to the attention of the Engineer.

- J. Furnish data recorder with the CWT unit capable of recording train speed, warning time, time and date, adjacent and auxiliary crossing detection times, and equipment errors. The recorder shall be capable of furnishing a report with only warning time, train speed, and time and date information and a separate report that includes error data.

#### **2.04 CROSSING WARNING GATES AND FLASHING LIGHTS**

- A. Furnish each highway grade crossing warning device assembly complete with all associated hardware consisting of mast mounted gate mechanism, mast, junction box base, gate arm, flashing light unit(s), bell, signs, and miscellaneous hardware as shown on the Contract Drawings and as specified herein.
- B. The crossing gate warning device assembly shall conform to the requirements of CPUC GO No. 75D; CFR, Title 49, Part 234; and the recommendations of the relevant sub-parts of the AREMA C&S Manual Section 3.
- C. The gate mechanism housing shall be cast aluminum for mounting on a 5-inch diameter 16 feet aluminum pole and furnished complete with mounting brackets, counter-weight assembly, and counter-weights. Provide either single sided counter-weight brackets or double-sided counter-weight brackets as recommended by the manufacturer. Fit gate arm bracket with a breakaway arm adapter as shown in the AREMA C&S Manual, Part 3.2.21.
- D. The gate mechanism shall be of the power-up, power-down electro-mechanical type complete with internal relay and adjustable snubbing resistor. .
- E. Furnish gate arms lengths required per PCJPB signal standards and site conditions. Arms shall be of the aluminum with fiberglass extensions and fiberglass tip type. Gate arm lamps shall be 4-inch diameter conforming to the recommendations of AREMA C&S Manual, Part 3.2.40 except that LED lamps shall be used. Provide high intensity lamps when shown on the Contract Drawings. Fit lamp wiring harness with a five wire pull-apart connector for interconnection to the gate mechanism and securely fasten to the gate arm.
- F. Provide gate arm wind guards conforming to AREMA C&S Manual Part 3.2.22 with each gate assembly.
- G. Provide flashing light crossing signal units as shown on the Contract Drawings. Light units shall have 12-inch roundels with LED's and be complete with steel backgrounds, steel hoods, junction box, and cross-arm brackets.
- H. Provide a crossing warning bell conforming to the recommendations of AREMA C&S Manual, Part 3.2.61 with each gate assembly, except that the bell shall be mounted on the cantilever structure when a cantilever is shown.
- I. Railroad crossing signs, multiple track signs, and the like, shall be extruded aluminum, reflex-reflective sheet type as recommended in the AREMA C&S

Manual Parts, 3.2.70 and 3.2.75, respectively. Provide signs complete with all hardware for mounting on 5-inch mast or on a cantilever mast. All highway grade crossings shall conform to CPUC required signage.

## 2.05 FOUNDATIONS

- A. Provide foundations for wayside equipment cases, highway grade crossing gates, flashers, and cantilevers as specified herein.
- B. Precast or cast-in-place reinforced concrete foundations shall be monolithic or sectional construction and shall conform to the requirements for concrete work as specified in Sections 03300, Cast-in-Place Concrete, and 03400, Precast Concrete Structures.
- C. Provide precast concrete foundations complete with anchor bolts, nuts, and washers in accordance with the recommendations of AREMA C&S Manual, Part 14.4.
- D. All galvanized steel foundations to be furnished and installed shall be complete with Section 18360, Signal Systems Miscellaneous Products, and the recommendations of AREMA C&S Manual, Part 15.3.1.
- E. Galvanized steel foundations shall be constructed of steel angle and plate welded together. Foundations shall be constructed of 2-1/2 inch by 2-1/2 inch by 1/4-inch steel angle and 1/4 inch steel plate.
- F. Bolts, nuts, and washers shall be galvanized. Nuts and threads shall be in accordance with the recommendations of AREMA C&S Manual, Part 14.6.20. Plain washers shall be in accordance with the recommendations of AREMA C&S Manual, Part 14.6.21. Steel shall be in accordance with the recommendations of AREMA C&S Manual, Part 15.1.4, Section 1. Bolts shall be of sufficient length to provide for leveling of the device.
- G. Place a conduit with a minimum 3-inch inside diameter in cast-in-place cantilever structure foundations for routing of cables to the cantilever junction box. The conduit shall protrude from the foundation sufficiently to enter cantilever structure ensuring cable is not exposed.

## 2.06 HARDWARE

- A. Furnish hardware in accordance with Section 18360, Signal Systems Miscellaneous Products.

## 2.07 CONDUIT

- A. Conduit shall conform to the specifications in Section 18360, Signal Systems Miscellaneous Products.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Install and adjust equipment and materials in accordance with the appropriate requirements and recommendations of the equipment manufacturer, in conformance with the recommendations of the applicable parts of the AREMA C&S Manual; as required by CFR 49, Parts 234 and 236; applicable CPUC regulations; or as otherwise specified herein.
- B. Where existing Grade Crossing Warning System Shelters and gate assemblies are indicated to be relocated, remove, protect, transport, store, disassemble, re-configure where necessary, reassemble and reinstall as shown in the Contract Drawings.

### **3.02 INSULATED JOINTS**

- A. Install insulated joints as specified in Section 20120, Track Appurtenances and Other Track Materials. Test each insulated joint in accordance with the requirements of the AREMA C&S Manual, Part 8.6.35, and per bonded joint and insulated joint section.

### **3.03 RAIL BONDING**

- A. Install new, or maintain existing, and test rail bonding for electrical continuity as required for continuous train detection within the approach limits of the crossings.
- B. Double bond frog assemblies, switch points, and rail joints as specified in Section 18400, Rail Bonding, with the type of bonds specified in Section 18400, Rail Bonding.
- C. Make signal connection to rails using weld type track circuit connectors per PCJPB standards.

### **3.04 CROSSING WARNING SYSTEM**

- A. Install, connect, and test new equipment and cabling to the greatest extent practicable without disruption of the existing highway grade crossing or signal systems.

### **3.05 TRACK CIRCUITS**

- A. Install and adjust all track circuits in accordance with the requirements of CFR49, Parts 234 and 236, the recommendations of AREMA C&S Manual, Parts 8.6.1, and as specified herein.
- B. Make all track circuit rail connections using weld type connectors.
- C. Adjust each track circuit for a detection sensitivity of 0.06 ohm throughout the length of the track circuit, including within the shunt fouling limits of turnouts.

- D. Record voltage and current measurements at both feed and receive ends of each track circuit in a format approved by the Engineer.

### **3.06 HIGHWAY GRADE CROSSING EQUIPMENT**

- A. Install grade crossing warning equipment in conformance with CFR, Title 49 Part 234; CPUC G.O. 75D; approved submittals; and as shown on the Contract Drawings.
- B. The final voltage adjustment and alignment of the flashing light units and final balancing of the gate arms shall be made at the time of the functional test. Final adjustments and alignments shall be made in conformance with the requirements of CFR 49 Part 234 and the recommendations of the AREMA C&S Manual, Parts 3.3.1 and 3.3.5 and.
- C. Provide new cabling between the wayside gate/flasher and the crossing control shelter except where the Contract Drawings specifically specify the re-use of the existing cabling.
- D. Install Owner-furnished/Contractor -furnished pedestrian gates in accordance with the Contract Drawings and installation instructions furnished by the Engineer.

### **3.07 FOUNDATIONS**

- A. Excavate, backfill, compact, and clean-up excavation as specified in Section 02300, Earthwork.
- B. Install each foundation in accordance with the approved installation detail for each type of foundation and as specified herein. The absence of a specific task listing herein does not relieve the Contractor of the responsibility for providing a complete and functional installation. The installation tasks that must be completed by the Contractor are included herein.
- C. Prior to placing precast foundation or constructing cast-in-place foundations, excavate completely to the lines and grades required and install crushed stone base in accordance with the requirements specified.
- D. Install foundations to the lines, grades, and dimensions required as determined by the Contractor and approved by the Engineer. Install mounting bolts of sufficient length to accommodate use of leveling nuts between the base of the mechanism and the top of the foundation.
- E. When placing foundations, ensure that anchor bolts have not been bent and that the threads are undamaged. Protect anchor bolt thread, washers, and nuts by applying friction tape, or other method approved by the Engineer, until such time as the wayside equipment is installed. Bring damaged anchor bolts to the immediate attention of the Engineer. Do not use damaged anchor bolts. Remove and replace damaged anchor bolts and completely or partially remove and replace foundation as determined by the Engineer.



- F. Refer to Section 03170, Concrete Finishing, for requirements for finishing formed surfaces, smooth rubbed finish. Exposed poured concrete foundations shall be rubbed to obtain a uniformly smooth, clean surface of even texture and appearance.
- G. Provide nonconductive material between the foundations and the mounted apparatus to prevent direct contact between the concrete and metal surfaces.

### **3.08 CONDUIT**

- A. Install conduit where shown on the Contract Drawings and as specified herein.
- B. After conductors have been installed, seal ends of conduits terminating in instrument shelters, junction boxes, and equipment cases with an approved type of sealing compound.
- C. Bore or jack conduit under the existing trackbed at any traverse, except that conduit may be placed under the track prior to the track renewal.
- D. Place conduit to a minimum depth of 36 inches below finished grade except where specifically noted otherwise.

### **3.09 REMOVING, REINSTALLING AND SALVAGING EQUIPMENT**

- A. Relocate, reuse, modify, and salvage existing equipment as shown on the Contract Drawings. Refer to Section 02100, Demolition, for salvage requirements. Inventory existing relays and controlling equipment prior to delivering to the Engineer's designated storage location.
  - 1. Newly re-wire any existing equipment designated to be reused except where noted on the Contract Drawings.
- B. Removed equipment and materials not designated for reuse or salvage shall become the property of the Contractor and disposed of. Refer to Section 02110, Site Clearing, for disposal requirements.
- C. Change existing crossing warning systems over to the new systems as expeditiously as practicable. Remove retired equipment immediately and keep work site kept free of debris and packaging materials.

### **3.10 FIELD QUALITY CONTROL**

- A. Perform testing in accordance with Section 18600, Signal Systems Testing, including documentation requirements.
- B. Prepare test procedures and perform and document tests on the highway grade crossing components and systems as follows:
  - 1. Include all tests herein specified, as specified in the FRA Rules, Standards, Instructions for Railroad Signal Systems, CFR 49 Part 234 and 236 and the appropriate sections of the AREMA C&S Manual.

2. Perform pretests on all procedures in advance of actual testing.
  3. Perform applicable tests to each interim signal system, if any, before placing in service.
  4. Actual testing shall be witnessed by the Engineer.
- C. Make measurements at each piece of wayside equipment and record on the as-built record drawings verifying that the equipment is located where shown on the Contract Drawings and as approved by the Engineer. Verify, by measurement, that the equipment does not violate the train dynamic clearance envelope.
- D. Test each grade crossing warning installation in accordance with Section 18600, Signal Systems Testing, and the AREMA C&S Manual, Parts 3.3.1 and 3.3.5. In addition, perform all applicable tests as described in the PCJPB Signals and Communications Test and Maintenance Manual, all manufacturer's recommended test and adjustment procedures, and any tests required by regulation.
- E. Disconnect and ground associated signal equipment not under test. Disconnect or unplug electronic devices or signal equipment prior to any testing.
- F. Follow manufacturer's instructions for testing of operation and electronic equipment.
- G. Submit test data and results to the Engineer's information and approval within 24 hours of placing the apparatus or system in operation.

**END OF SECTION**