

DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES

OFFICE ENGINEER

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*Flex your power!
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September 13, 2012

07-LA-5-29.4/31.6

07-1218W4

Project ID 0700021119

ACIM-005-3(078)N

Addendum No. 1

Dear Contractor:

This addendum is being issued to the contract for CONSTRUCTION ON STATE HIGHWAY IN LOS ANGELES COUNTY IN BURBANK FROM WEST MAGNOLIA BOULEVARD OVERCROSSING TO 0.3 MILE NORTH OF BUENA VISTA STREET/WINONA AVENUE UNDERCROSSING.

Submit bids for this work with the understanding and full consideration of this addendum. The revisions declared in this addendum are an essential part of the contract.

Bids for this work will be opened on Thursday, October 4, 2012.

This addendum is being issued to revise the Project Plans, the Notice to Bidders and Special Provisions, the Bid book and provide an additional Information Handout.

Project Plan Sheets 2, 24, 27, 28, 29, 78, 146, 151, 158, 163, 170, 179, 188, 192, 206, 227, 233, 237, 239, 242, 247, 252, 254, 255, 258, 259, 260, 261, 262, 263, 264, 265, 268, 272, 273, 276, 278, 279, 280, 281, 286, 287, 289, 298, 301, 302, 303, 306, 307, 308, 311, 312, 323, 324, 326, 329, 330, 331, 338, 339, 351, 363, 364, 370, 371, 379, 402, 404, 407, 408, 409, 414, 416, 417, 418, 419, 420, 421, 425, 427, 428, 435, 454, 478, 479, 480, 482, 487, 492, 516, 520, 523, 920, 921, 922, 923, 924, 927, 931, 932, 950, 964, 977, 978, 988, 992, 1020, 1021, 1022, 1023, 1040, 1041, 1118, 1121, 1122, 1127, 1136, 1152, 1153, 1154, 1155, 1156, 1157, 1158, 1185, 1186, 1187, 1188, 1189, 1190, 1198, 1217, 1218, 1220, 1221, 1222, 1223, 1226, 1244, 1258, 1280, 1281, 1302, 1304, 1305, 1306, 1308, 1309, 1319, 1326, 1329, 1384, 1486, 1496, 1497, 1502, 1550, 1606, 1609, 1626, 1634, 1654, 1662, 1684, 1686, 1687, 1688, 1690, 1691, 1693, 1696, 1698, 1720, 1721, 1722, 1723, 1727, 1728, 1729, 1733, 1734, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1742, 1743, 1744, 1763, 1765, 1771, 1775, 1826, 1828, 1834, 1835, 1837, 1838, 1847 and 1914 are revised. Copies of the revised sheets are attached for substitution for the like-numbered sheets.

Project Plan Sheets 242A, 255A, 262A, 278A, 278B, 278C, 278D, 278E, 278F, 278G, 278H, 278I, 278J, 278K, 278L, 278M, 281A, 292A, 326A, 326B, 359A, 362A, 505A, 505B, 607A AND 1827A are added. Copies of the added sheets are attached for addition to the project plans.

In the Notice to Bidders and Special Provisions, in the Registered Person signature and seal sheet, the signature and seal sheet are added as attached.

In the Special Provisions, Section 5-1.15, "SUPPLEMENTAL PROJECT INFORMATION," is revised as attached.

In the Special Provisions, Section 8-1.02, "STATE-FURNISHED MATERIALS," is revised as attached.

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In the Special Provisions, Section 9, "DESCRIPTION OF BRIDGE WORK," is revised as attached.

In the Special Provisions, Section 10-1.20, "TEMPORARY DRAINAGE SAN FERNANDO BOULEVARD EXCAVATION," subsection "PAYMENT," the first paragraph is revised as follows:

"The lump sum price paid for temporary drainage San Fernando Boulevard excavation includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the concrete slurry backfill and temporary drainage inlet protection, complete in place, including removal of materials, cleanup and disposal of retained sediment and debris, and backfilling and repairing holes, depressions and other ground disturbance, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer."

In the Special Provisions, Section 10-1.40, "EXISTING HIGHWAY FACILITIES," subsection "MODIFY INLET," is added after the subsection "ADJUST INLET," as attached.

In the Special Provisions, Section 10-1.725, "TEMPORARY SCREENING WALL," is added as attached.

In the Special Provisions, Section 10-1.73, "PILING," subsection "CONSTRUCTION," the sixth paragraph is revised as follows:

"Permanent Steel Isolation Casing Installation

Permanent steel casings shall be installed by placing in a drilled hole. The provisions of Section 49-1.08, "Pile Driving Acceptance Criteria," of the Standard Specifications shall not apply to permanent steel casings."

In the Special Provisions, Section 10-1.73, "PILING," subsection "MEASUREMENT AND PAYMENT (PILING)," the following paragraph is added after the second paragraph.

"The contract price paid per pound for isolation casing shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing isolation casing, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer."

In the Special Provisions, Section 10-1.103, "UNDERDRAIN," is revised as attached.

In the Special Provisions, Section 10-1.112, "MISCELLANEOUS METAL (AUSTIN VAULT)," is revised as attached.

In the Special Provisions, Section 10-1.1125, "MISCELLANEOUS METAL (BRIDGE)," is added as attached.

In the Special Provisions, Section 14-1, "RAILROAD TRACK CONSTRUCTION," is revised as attached.

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To Bid book holders:

Replace the entire "Bid Item List" in the Bid book with the attached revised Bid Item List. The revised Bid Item List is to be used in the bid.

Attached are copies of the Information Handout for Railroad General Safety and Track Maintenance.

Inquiries or questions in regard to this addendum must be communicated as a bidder inquiry and must be made as noted in the Notice to Bidders section of the Notice to Bidders and Special Provisions.

Indicate receipt of this addendum by filling in the number of this addendum in the space provided on the signature page of the Bid book.

Submit bids in the Bid book you now possess. Holders who have already mailed their book will be contacted to arrange for the return of their book.

Inform subcontractors and suppliers as necessary.

This addendum and attachments are available for the Contractors' download on the Web site:

http://www.dot.ca.gov/hq/esc/oe/project_ads_addenda/07/07-1218W4

If you are not a Bid book holder, but request a book to bid on this project, you must comply with the requirements of this letter before submitting your bid.

Sincerely,



REBECCA D. HARNAGEL
Chief, Office of Plans, Specifications & Estimates
Office Engineer
Division of Engineering Services

Attachments

5-1.15 SUPPLEMENTAL PROJECT INFORMATION

The Department makes the following supplemental project information available:

Supplemental Project Information

Means	Description
Included in the Information Handout (the State)	<p>Foundation Report for Burbank Blvd OC (Replace), Bridge No. 53-3057.</p> <p>Revised Foundation Report for Burbank Blvd OC, Bridge No. 53-3057</p> <p>Foundation Report for Abut3-Right Retaining Wall.</p> <p>Foundation Report for Abut3-Left Retaining Wall.</p> <p>Foundation Report for Retaining Wall No.1561(L-shaped Wall).</p> <p>Foundation Report for MSE Wall No.1565.</p> <p>Foundation Report for MSE Wall No.1567.</p> <p>Foundation Report for Type 1 Wall No.1576.</p> <p>Foundation Report for MSE Wall No.1585.</p> <p>Foundation Report for Stough Canyon Culvert Cover Structure No. 53-3077M.</p> <p>Foundation Report for Retaining Wall No.1575 from STA 575+68 to STA 580+58.</p> <p>Foundation Report for Retaining Wall 1575 over Stough Canyon Channel and Burbank Western Channel, from STA 573+73 to STA 575+68.</p> <p>Foundation Report for Buena Vista - Winona Undercrossing Widening, Bridge No.53-1110.</p> <p>Foundation Report for Empire Ave Undercrossing, Bridge No.53-2920.</p> <p>Foundation Report for Victory Place Separation (New), Bridge No.53C-2171.</p> <p>Foundation Report for LAFCD Burbank Western Channel (Cover), Bridge No. 53-3078.</p> <p>Foundation Report for Retaining Wall No.25 with Addendum.</p> <p>Foundation Report for Retaining Wall No.26 with Addendum.</p> <p>Foundation Report for Soundwall No.1584.</p> <p>Foundation Report for Retaining Wall No.1595.</p> <p>Foundation Report for Retaining Wall No.1601.</p> <p>Foundation Report for Retaining Wall No.1604 with Addendum.</p> <p>Foundation Report for Retaining Wall No.1605.</p> <p>Foundation Report for Retaining Wall No.1606 with Addendum.</p> <p>Foundation Report for Retaining Wall No.1607.</p> <p>Foundation Report for Retaining Wall No.1610.</p> <p>Foundation Report for Retaining Wall No.1613 with Addendum.</p> <p>Foundation Report for Retaining Wall No.1615.</p> <p>Foundation Report for Retaining Wall No.1630.</p> <p>Foundation Report for Retaining Wall No.1635.</p> <p>Foundation Report for Retaining Wall No.1655.</p> <p>Foundation Report for Retaining Wall No.1662.</p> <p>Foundation Report for Retaining Wall No.1665.</p> <p>Foundation Report for Retaining Wall No.1670.</p>

	<p>Structure Hydraulics and Hydrology Preliminary Hydraulic Report, Burbank Western Channel.</p> <p>Foundation Report for Victory Place Separation (New), Bridge No. 53C-2171.</p> <p>Lead Site Investigation Report.</p> <p>Parcel Acquisition Site Investigation Report.</p> <p>Revised Site Investigation Report.</p> <p>Addendum to Revised Site Investigation Report.</p> <p>California Environmental Protection Agency, Department of Toxic Substances Control - Variance No. V09HQSCD006</p>
Included in the Information Handout (Los Angeles County, Metrolink, and the City of Burbank)	<p>Los Angeles County Flood Control Permit No. PCFL T201200741.</p> <p>Los Angeles County Flood Control Permit No. PCFL T201200801.</p> <p>Right of Entry and Construction Permit ROE 012013.</p> <p>City of Burbank Offsite Excavation Permit No. PW1208293.</p> <p>Geotechnical Exploration for the Empire Avenue Storm Water Pump Station.</p> <p>The American Railway Engineering and Maintenance-of-Way Association (Manual).</p> <p>Burbank Department of Power and Water Standard Plans.</p> <p>Geotechnical Investigation.</p> <p>Addendum to Geotechnical Investigation report.</p> <p>LADOT Camera Poles Details.</p> <p>SCRRA Excavation support Guidelines.</p> <p>SCRRA Engineering Standards.</p> <p>SCRRA Form 6. Temporary Right of way Entry.</p> <p>SCRRA Track Charts 2008.</p> <p>Site Investigation - Phase II Hazardous Waste.</p> <p>Standard Specifications for Public Works Construction.</p> <p>General Safety Regulations for Third Party Construction and Maintenance Activity on SCRRA Member Agency Property.</p> <p>Track Maintenance, Right of Way and Structures, Engineering Instructions 5th Edition.</p>
Available as specified in the Standard Specifications	<p>Cross sections</p> <p>Bridge as-built drawings</p>

8-1.02 STATE-FURNISHED MATERIALS

The State furnishes you with:

- Loop detector sensor units
- Model 2070 and 170E controller assemblies, including controller unit, completely wired controller cabinet, and detector sensor units
- Model 2070-6B Modems
- Components of battery backup system as follows:

- Inverter/charger unit
- Power transfer relay
- Manually-operated bypass switch
- Battery harness
- Utility interconnect wires
- Battery temperature probe
- Relay contact wires

- Components of railroad signaling equipments and warning devices:
 1. 8 foot x 10 foot Prewired Main Crossing House for Roadway/Pedestrian Crossing. Batteries Included.
 2. 10 foot x 10 foot Prewired North East End of Siding House for CP Hollywood. Batteries and local control point are included.
 3. (9) Safetran S-40 Gate Complete with 5 inch x 16 foot Mast, Split (clamp) Base, S-40 Gate Mechanism with Hardware, 2-way flasher assembly, Complete Gate Assembly, Electronic Bell, Cross bucks, Pedestrian Crossing Sign and Hardware (see Standard 8309), adjustable wind guard, and 60-inch foundation.
 4. (2) 6 foot x 6 foot Prewired House for Intermediate Single Track. Batteries included. 6 foot x 6 foot Prewired House for Intermediate Double Track. Batteries are included. M-23A Switch Machine and #24 LH Layout.

The State furnishes you with completely wired controller cabinets with auxiliary equipment and controller unit for ramp metering systems and traffic monitoring stations at the Department of Transportation, District Maintenance Yard at 7310 East Bandini Boulevard, Commerce, CA 90040. At least 48 hours before you pick up the materials, inform the Engineer what you will pick up and when you will pick it up.

The State furnishes you with components of railroad signaling equipments and warning devices at SCRRA Free On Board (F.O.B.) Contractor's trucks at 186 University Parkway, Pomona, CA 91768. At least 48 hours before you pick up the materials, inform the Engineer what you will pick up and when you will pick it up.

SECTION 9. DESCRIPTION OF BRIDGE WORK

The bridge work consists of widening existing structures, constructing new structures, constructing new retaining wall and soundwalls and modifying channel as shown on the plans of the following structures.

BUENA VISTA - WINONA UC (WIDEN)

Bridge No. 53-1110

EMPIRE AVE UC (REPLACE)

Bridge No. 53-2920

VICTORY PLACE SEPARATION

Bridge No. 53C-2171

BURBANK WESTERN CHANNEL

Bridge No. 53-3078

BURBANK BLVD OC (REPLACE)

Bridge No. 53-3057

STOUGH CANYON CULVERT COVER

Bridge No. 53-3077M

RETAINING WALL 25

Bridge No. RW25

RETAINING WALL 26

Bridge No. RW26

RETAINING WALL 1606

Bridge No. 1606

RETAINING WALL 1665

Bridge No. RW1665

RETAINING WALL 1630

Bridge No. RW1630

RETAINING WALL 1610

Bridge No. RW1610

RETAINING WALL 1604

Bridge No. RW1604

SOUND WALL 1584

Bridge No. SW1584

RETAINING WALL 1615

Bridge No. RW1615

RETAINING WALL 1635

Bridge No. RW1635

RETAINING WALL 1613

Bridge No. RW1613

RETAINING WALL 1607
Bridge No. RW1607

RETAINING WALL 1595
Bridge No. RW1595

RETAINING WALL 1670
Bridge No. RW1670

RETAINING WALL 1662
Bridge No. RW1662

RETAINING WALL 1655
Bridge No. RW1655

RETAINING WALL 1605
Bridge No. RW1605

RETAINING WALL 1601
Bridge No. RW1601

RETAINING WALL 1565
Bridge No. 53E0161

RETAINING WALL 1567
Bridge No. 53E0162

RETAINING WALL 1575
Bridge No. 53E0163

RETAINING WALL 1585
Bridge No. 53E0164

RETAINING WALL 1576
Bridge No. RW1576

Empire Avenue Underpass

A two-span built-up steel girder bridge, approximately 239'-10" long. The underpass is split into two identical and parallel bridges, approximately 18'-4" in width and with a 4" gap between adjacent superstructures.

Buena Vista Street Underpass

A two-span, combination built-up steel girder and rolled steel beam girder bridge, approximately 159'-9" long. The underpass is split into two identical and parallel bridges, approximately 18'-4" in width and with a 4" gap between adjacent superstructures. A third parallel substructure will be built to accommodate future widening

Retaining Wall No.1
A 2100' long MSE wall.

Retaining Wall No.2
A 3430'-2" long MSE wall.

Retaining Wall No.3
A 2095' long MSE wall.

Retaining Wall No.4
A 2060' long MSE wall.

Retaining Wall No.5
A 285' long MSE wall.

Retaining Wall No.6
An approximately 64' long cast-in-place retaining wall.

Retaining Wall No.7
An approximately 56' long cast-in-place retaining wall.

Retaining Wall No.8
An approximately 140' long cast-in-place retaining wall.

Retaining Wall No.9
An approximately 30' long cast-in-place retaining wall.

MODIFY INLET

Existing concrete drainage inlets shall be modified as shown on the plans.

Modify drainage inlet consists of removing portions of existing drainage inlets as shown on the plans.

Concrete removal must be performed without damage to concrete to remain in place. Damage to concrete must be repaired to a condition equal to that prior to beginning of removal operations at your expense.

Existing reinforcement incorporated in new work must be protected from damage and must be cleaned of adhering materials before being embedded into new concrete.

Concrete shall be minor concrete conforming to the provisions in Section 90-10, "Minor Concrete," of the Standard Specifications. The concrete shall contain not less than 590 pounds of cementitious material per cubic yard.

Reinforcement must conform to Section 52, "Reinforcement," of the Standard Specifications.

Existing frames and grates must be removed and disposed of.

Frames and grates incorporated into the modified inlets must conform to the provisions in Section 75, "Miscellaneous Metals," of the Standard Specifications.

Where inlets are located in areas to be paved or surfaced, no individual structure shall be modified to final grade until the paving or surfacing has been completed immediately adjacent to the structure.

Modify inlets will be measured by the unit.

The contract unit price paid for modify inlet shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in modifying inlets, including removing and disposal of portions of inlets, bar reinforcing steel, concrete and structure excavation and structure backfill, removing and disposing of frames and grates, furnishing and installing new frames, grates and closure plates on top of inlets, and furnishing and wrapping the inlets with polystyrene foam as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.725 TEMPORARY SCREENING WALL

This work includes preparing Temporary Screening Wall (TSW) plan, erecting, repairing or replacing, relocating, and removing and disposing of temporary screening wall. You must design, construct, and maintain TSW along the Temporary Construction Easement (TCE) line from 1583+65.36 to 1604+24.11 "A" line as shown on the plans adjacent to Leland Way. TSW must be safe, provide the necessary rigidity, and support the loads imposed.

You must conform to the provisions as specified in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications and these special provisions.

SUBMITTALS

Temporary Screening Wall (TSW) Plan

General

Within 20 days of contract approval:

1. Submit 3 copies of your TSW Plan to the Engineer. Allow 15 days for the Department's review.
2. Resubmit a revised TSW Plan within 10 days of receiving the Engineer's comments
3. When the Engineer approves the TSW Plan, submit an electronic copy and 4 printed copies of the approved TSW Plan.

Submit a Certificate of Compliance as specified in Section 6-1.07, "Certificates of Compliance" of the Standard Specifications for plywood and wood frame.

You must design footings or supports to carry the imposed loads. Temporary screening wall must be designed to withstand all imposed loads during erection, construction, and removal. Wind loads must be included in the design of the bracing or methods. Design calculations must be submitted with shop drawings and work plans.

CONSTRUCTION

You must erect an 8-foot high temporary screening wall made of 1/2" thick, double plywood panel without longitudinal gaps before any construction work occurs adjacent to Leland Way.

MEASUREMENT AND PAYMENT

Temporary screening wall will be measured by the linear foot.

The contract price paid per linear foot for temporary screening wall includes full compensation for furnishing all labor, material, tools, equipment, and incidentals, and for doing all the work involved in erecting temporary screening wall, complete in place, including repairing or replacing, relocating, removing and disposing of temporary screening wall, as specified in these special provisions, and as directed by the Engineer.

10-1.103 UNDERDRAIN

Underdrains at bridge abutments, wing walls, and retaining walls shall conform to the provisions in Section 68-1, "Underdrains," of the Standard Specifications and these special provisions.

Filter fabric shall conform to the provisions in Section 88-1.02, "Filtration," of the Standard Specifications and these special provisions. Filter fabric shall be Class A.

Welded steel covers conforming to the provisions in Section 68-1.023, "Underdrain Outlets and Risers," of the Standard Specifications shall be installed on underdrains terminating under ground.

Permeable material used at bridge abutments and wing walls shall be placed in horizontal layers and thoroughly consolidated along with and by the same methods specified for structure backfill in Section 19-3, "Structure Excavation and Backfill," of the Standard Specifications. Ponding and jetting of permeable material or structure backfill adjacent to permeable material will not be permitted.

At the option of the Contractor, Class 1 or Class 2 permeable material shall be used. Filter fabric shall be placed between Class 1 permeable material and backfill. No filter fabric will be required with Class 2 permeable material.

At the option of the Contractor, permeable material may be substituted for structure backfill material when the required width of backfill material adjacent to the neat lines of the permeable material as shown on the plans is approximately one foot or less. The quantity of permeable material substituted for structure backfill material will be measured and paid for by the cubic yard as structure backfill (bridge).

Underdrains used at bridge abutments and wing walls will be measured and paid for at the contract price per linear foot for 8" perforated plastic pipe underdrain.

Cleanout pipe will be measured and paid for as plastic pipe underdrain of various sizes shown on the plans.

Full compensation for filter fabric when required shall be considered as included in the contract price paid per cubic yard for structure backfill (bridge) and no additional compensation will be allowed therefor.

10-1.112 MISCELLANEOUS METAL (AUSTIN VAULT)

Miscellaneous metal (austin vault) must conform to the provisions for miscellaneous bridge metal in Section 75, "Miscellaneous Metal," of the Standard Specifications and these special provisions.

Miscellaneous metal (austin vault) must conform to the requirements in Section 75-1.02 "Miscellaneous Iron and Steel," of the Standard Specifications and consist of the following items:

- A. Steel Ladders
- B. Steel Angles
- C. Stainless Steel Expansion Anchors
- D. Stainless Steel Components of Riser Support Brackets
- E. Steel Handrails
- F. Steel Trash Screen

Cast-in-place inserts must be the ferrule loop type.

Metal parts of concrete anchorage devices must be fabricated from stainless steel conforming to the requirements of ASTM Designation: A276, Type 316.

Miscellaneous metal (austin vault) will be measured and paid for by the pound in accordance with the Section 75-1.06, "Measurement," and 75-1.07, "Payment," of the Standard Specifications.

10-1.1125 MISCELLANEOUS METAL (BRIDGE)

Miscellaneous metal (bridge) shall conform to the provisions for miscellaneous bridge metal in Section 75, "Miscellaneous Metal," of the Standard Specifications and these special provisions.

Miscellaneous metal (bridge) shall consist of the miscellaneous bridge metal items listed in Section 75-1.03, "Miscellaneous Bridge Metal," of the Standard Specifications and the following:

- A. 4" conduits
- B. 1/4" ballast restrainer steel cover plates and ballast restrainers
- C. Steel walkway assemblies (includes 3/8" stiffener, side and checker plates)
- D. ASTM F1554 Grade 55 anchor bolts
- E. Bearing pad restrainers
- F. ASTM A709 sole plates
- G. Sound wall cover plate

Full compensation for installing and painting sound wall cover plate including neoprene strip and anchors shall be considered as included in the contract price paid per pound for miscellaneous metal (bridge) and no additional compensation will be allowed therefor.

SECTION 14-1. RAILROAD TRACK CONSTRUCTION

14-1.00 ABBREVIATIONS AND GLOSSARY

The following abbreviations and glossary apply to these special provisions.

ABBREVIATIONS

&	And
#	Number
ADM	Add Drop Multiplexer
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
AIS	Alarm Insertion Signal
AISI	American Iron and Steel Institute
AMI	Alternate Mark Inversion (a data transmission protocol)
APD	Avalanche Photo Diode
APL	Average Picture Level
APS	Automatic Protection Switching
AVC	Automatic Vehicle Classification system
AWG	American Wire Gauge
AWM	Appliance Wiring Material
B8ZS	Bit eight Zero Suppression (data transmission protocol)
BER	Bit Error Rate
BERTS	Bit Error Rate Test Set
BITS	Building Integrated Timing Supply
BNC	Bayonet Navy Connector
bps	Bits per second
BPV	Bipolar Violation
CCD	Charged-Coupled Device
CCK	Camera Control Keypad
CCR	Camera Control Receiver
CCT	Camera Control Transmitter
CCTV	Closed Circuit Television
CFR	Code of Federal Regulations
CIDH	Cast-In-Drilled-Hole
CMIP	Common Management Information Protocol
CMISE	Common Management Information Service Element
CMP	Configuration Management Plan
CMS	Changeable Message Sign
CODEC	Coder-Decoder
COMM	Communication
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CTRL	Controller
CTS	Clear to Send
DACCS	Digital Access Cross Connect System
D4	4 th version of the D-signal format for time division multiplexers
dB	Decibel
dBm	Decibel referred to milliwatts
dBm	Decibel above reference noise
DCD	Data Carrier Detect
DCE	Data Communication Equipment
DCS	Digital Cross-connect System
DEMARC	Demarcation

CONTRACT NO. 07-1218W4

REVISED PER ADDENDUM NO. 1 DATED SEPTEMBER 13, 2012

DEMUX	Demultiplexer
DS-1	Digital Signal Level 1. Digital transmission rate of 1.544 megabits per second.
DS-3	Digital Signal Level 3. Digital transmission rate of 44.736 megabits per second.
DTE	Data Terminal Equipment
DWP	Department of Water and Power (Los Angeles)
EIA	Electronics Industries Alliance
EMT	Electrical Metallic Tubing
ESF	Extended Superframe Format
FCC	Federal Communications Commission
FDF	Fiber Distribution Frame
FDU	Fiber Distribution Unit
FRP	Fiberglass Reinforced Plastic
FSK	Frequency-Shift Keying
FXS	Foreign eXchange Subscriber
GUI	Graphical user interface
HVAC	Heating, Ventilation and Air Conditioning
Hz	Hertz
IRE	IRE is a SMPTE standard video reference level
ITU	International Telecommunications Union
JKFD	Jackfield
LA	Los Angeles
M13	Multiplexer, 28 DS-1 circuits to 1 DS-3 circuit
MHz	Megahertz
MUX	Multiplexer
NEMA	National Electrical Manufacturers Association
NHD	North Hollywood
nm	nanometer
NMS	Network Management System
NRZ	Non-Return to Zero
NTSC	National Television Standards Committee
OC	Optical Channel
OD	Outside Diameter
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
OTDR	Optical Time Domain Reflectometer
OW	Order Wire (multiple voice circuit)
P	Pair
P22	Pair 22 American wire gauge
PACBELL	Pacific Bell telephone company
p-p	Peak to peak
PC	Personal computer
PCMS	Pasadena City Municipal Services or Portable Changeable Message Sign
PDA	Power Distribution Assembly
PIN	Positive-Intrinsic-Negative
PR	Pair
PRBS	Pseudo-Random Bit Sequence
QRSS	Quasi-Random Signal Source
RUS	United States Rural Utilities Service
RETMA	Radio Electronics Television Manufacturers Association (former name of EIA)
RF	Radio Frequency
RG	Regulatory Guide
RMS	Ramp Metering System

rms	Root-Mean-Square
RTS	Request To Send
Rx	Receive
SF	Superframe Format (D4)
SM	Singlemode
SMFO	Singlemode Fiber Optic
SONET	Synchronous Optical Network
SSOVP	Solid-State Over Voltage Protector
SSPC	Steel Structures Painting Council
ST	Type of connector
TDM	Time Division Multiplexer
THHN	Heat resistant thermoplastic with nylon jacket conductor
THWN	Moisture and heat resistant thermoplastic with nylon jacket conductor
TIA	Telecommunications Industry Association
TL-1	Transaction Language 1
TLP	Transmission Level Point
TOSNET	Traffic Operational System Network
TMC	Traffic Management Center
TSG	Traffic Signal Generator
TSI	Time Slot Interchange
Tx	Transmit
UNC	Unified National Coarse
UNIX	Specific operating system found in real time applications
UV	Ultraviolet
V	Volt
V(ac)	Volt, alternating current
V(dc)	Volt, direct current
VID	Video Identification and date/time Display
VSK	Video Switch Keypad
VSM	Video Switch Matrix
VT-1.5	Virtual Tributary – Level 1.5 (1.728 Mb/s)
VT	Virtual Tributary
W	Watt
WFM	Waveform Monitor
WTO	Wire Transit Only
X.11, X.25	Specific protocol standards generated by the International Telecommunications Union (formerly CCITT)
XHHW	Moisture and heat resistant cross-linked synthetic polymer conductor

GLOSSARY

Breakout: Cable "breakout" is produced by removing jackets just beyond the last tie-wrap point, exposing 0.9 m to 1.8 m of cable buffers, Aramid strength yarn and central fiberglass strength members and cutting Aramid yarn, central strength members and buffer tubes to expose individual glass fibers for splicing or connection to the appropriate device.

Cable Storage Cabinet: A cabinet for holding excess cable slack, allowing flexibility in equipment location and allowing cable pulling for re-splicing.

Channel: An information path between a discrete input and a discrete output. One single input to a multiplexer or output from a demultiplexer.

Closed Circuit Television Assembly: Camera, lens, environmental enclosure, and necessary connectors and cables.

Connector: A mechanical device providing the means for attaching to and decoupling from a transmitter, receiver or another fiber (such as on a patch panel).

Connectorized: A fiber with a connector affixed to it.

Connector Module Housing (CMH): A patch panel used in the FDF to terminate singlemode fibers with most common connector types. It may include a jumper storage shelf and a hinged door.

Couplers: Devices normally located within FDF's mounted in panels, that mate 2 fiber optic connectors to facilitate the transition of optical light signals from one connector into another. They may also be used unmounted, to join 3 simplex fiber runs. Couplers may also be referred to as adapters, feed-through and barrels.

Fiber Distribution Frame (FDF): A rack mounted system usually installed in the TMC that consists of a standard equipment rack, fiber routing guides, horizontal jumper troughs, fiber distribution units (FDU), connector module housings (CMH) and splice module housings (SMH).

FDF's serves as the "home" for passive fiber optic components from cable breakout, for connection by jumpers, to the electronics.

Fiber Distribution Unit (FDU): An enclosure containing a Connector Module Housing (CMH) and a Splice Module Housing enclosure.

Field Cabinet: A roadside cabinet housing controllers or communications equipment.

Intermediate Distribution Frame Room (IDF room): The room or area inside a hub or hut containing the FDF and other distribution hardware.

Jumper: A short fiber optic cable with connectors installed on both ends, typically used for connection within an FDF.

Light Source: A portable piece of fiber optic test equipment used to perform end-to-end attenuation testing in conjunction with a power meter containing a stabilized light source operating at the designed wavelength of the system under test.

Link: A passive section of the system, the ends of which are to be connected to active components. A link may include splices and couplers. For example, a video link may be from a F/O transmitter to a video Multiplexer (MUX).

Main Distribution Frame Room (MDF room): The room inside the TMC which contains the FDF and other distribution hardware.

Mux/Demux: Multiplexer/Demultiplexer.

Optical Time Domain Reflectometer (OTDR): Fiber optic test equipment used to measure total amount of power loss between 2 points and the corresponding distance. It provides a visual and printed display of the relative location of system components such as fiber sections, splices and connectors and as losses attributable to each component or defect in fiber.

Patchcord: A short jumper.

Pigtail: A short length of fiber optic cable with a connector installed on one end.

Power Meter: A portable fiber optic test equipment used to perform end-to-end attenuation testing in conjunction with a light source, containing a detector that is sensitive to light at the designed wavelength of the system under test. Its display indicates the amount of power injected by the light source that arrives at the receiving end of the link.

Segment: A section of F/O cable not connected to an active device which may or may not have splices per the design.

Splice Closure: An environmentally sealed container used to organize and protect splice trays, normally installed in a splice vault that allows splitting or routing of fiber cables from multiple locations.

Splice Module Housing (SMH): A housing for storage of splice trays, pigtails and short cable lengths.

Splice Tray: A container used to organize and protect spliced fibers.

Splice Vault: A vault used to house splice closures.

T-1 Line: A dedicated phone connection supporting data rates of 1.544Mbits per second.

14-1.01 FIELD WELDING RAIL

GENERAL

Summary

This section consists of the Contractor performing field welding of Continuous Welded Rail (CWR) strings using the flash butt welding process or approved thermite-welding method. References to rail or top of rail as shown on the plans must be considered running rail as defined in these specifications.

The Contractor must make assessment as to the number of welds, including the method of welding for each weld, to be performed under this contract.

The work of this section consists of welding rails for use in track construction, in accordance with AREMA Manual, Chapter 4, Rail, and AREMA portfolio, except as modified in these special specifications.

Submittals

Procedure: Submit proposed materials, methods and procedures to be used for mobile flash butt field welding of CWR, including:

1. Manufacturer's trade name and technical data for the welding process, including welding machine performance standards:
 - 1.1. Method of welding high strength rail if different from requirements for standard rail.
 - 1.2. Methods of transporting material and mobile equipment to the site and duration of welding operations.
 - 1.3. Method used for cutting and cleaning to parent metal of the rail ends.
 - 1.4. Minimum and maximum spacing between rail ends.
 - 1.5. Method used for maintaining the rails in alignment during welding.
 - 1.6. Method used for grinding and contouring rail removing weld upset following the welding process.
 - 1.7. Manufacturer's trade name and technical data for the welding process.
 - 1.8. Method used for cutting and cleaning of the rail ends.
 - 1.9. Minimum and maximum spacing between rail ends.
 - 1.10. Method used for maintaining the rails in alignment during welding.
 - 1.11. Method used for preheating the rail ends including time and temperature.
 - 1.12. Tapping procedure including the minimum time required to cool the weld under the mold insulation.
 - 1.13. Method used, including a description of special tools and equipment for removing the gates and risers and finishing the weld to the final contour.
2. Procedure: Submit rail end hardening procedure.
3. Testing: Submit testing company qualified in use of the Ultrasonic testing method in accordance with ASTM E164
4. Field Weld Record: Submit as specified herein.

Quality Control and Assurance

Provide qualified personnel for supervision and performance of work.

Perform certification testing of welds to ensure that work is performed in accordance with the contract documents, and within the tolerances provided herein.

MATERIALS

For electric flash butt welding, materials, equipment and process shall be as provided by Holland L.P. or other approved equivalent.

For thermite welding, Materials and equipment shall be as manufactured by "Boutet," "Orgotherm," "Elektro-Thermite," or other approved equivalent for standard or high strength (alloy or heat treated) rail, as appropriate.

CONSTRUCTION

Electric flash butt welding, methods and procedures shall comply with the AREMA Manual, Volume 1, Chapter 4, Section 2.3, Specification for the Quality Assurance of Electric-Flash Butt Welding of Rail.

Thermite welding, methods and procedures shall comply with the AREMA Manual, Volume 1, Chapter 4, Section 2.5 Specification for the Quality Assurance of Thermite Welding Rail, with the welding kit manufacturer's recommendations, and as specified herein.

Rail ends for thermite welding shall be prepared in accordance with the recommendations of the welding kit manufacturer.

For thermite welding, the rail ends shall be preheated prior to welding to a sufficient temperature and for sufficient time to ensure full fusion of the weld metal to the rail ends without cracking of the rail or weld.

The completed weld shall be finished by mechanically controlled grinding to conform to the same requirements specified for shop welding.

1. Thermite welds shall not be made at the following locations:
 - 1.1. Within 5 inches of the edge of any bolt hole in the rail.
 - 1.2. Within 2 inches of a Cadweld or copper bond wire (If this type of bond exists, remove any presence of copper by grinding. The rail ends must be inspected and cleaned after grinding is complete).
 - 1.3. Closer than 2 feet from an existing plant weld.
 - 1.4. Closer than 6 feet to an existing thermite weld.
 - 1.5. On both ends of a rail plug simultaneously unless the rail is 15 feet or longer on tangent track and 24 feet long or longer on curved track.
2. Follow Manufacturer recommendations for compromise welds.
3. Follow recommendations of rail manufacturer for welding high strength (alloy or heat-treated) rails.
4. Thermite welds shall be located in cribs between ties. The edge of the weld must be no closer than 3 inches from the edge of the nearest tie.
5. Electric Flash Butt welds with the base of the rail smoothly ground may be located anywhere.
6. Field welding record shall be continuously maintained and furnished to the Engineer within 7 working days of completing the weld. The record shall include the following minimum details, noting that a different recording and marking procedure will be required for free end welds or for distress welds used to close up openings in rail:
 - 6.1. Date and time of welds.
 - 6.2. Location by station, specifying track and rail.
 - 6.3. Contractor foreman initials.
 - 6.4. Weather, air and rail temperature for distress welds (welds made to close up rail).
 - 6.5. Track condition, anchorage and rail stress for distress welds, or the word "FREE" for free end welds.
7. Rail shall be permanently marked on the web of rail in legible characters at least 1-1/2 inches high at each field weld with the above information in accordance with Section 3.1.19, Marking Thermite Welds of the SCRRA Track Maintenance and Engineering Instructions. If an existing distress weld is located within 400 feet of a new distress weld, lines shall be marked through the old weld's marking and an arrow marked indicating the direction towards the new distressed weld.
8. A straight edge 36 inches in length, applied to finished welded joint area shall be used to check for the following maximum variations (measurements shall be taken with a 6 inch steel taper gauge):
 - 8.1. Rail Head:
 - 8.2. Vertical Offset: 0.020 inch.
 - 8.3. Horizontal Offset: 0.040 inch.
 - 8.4. Vertical Crown: 0.030 - 0.045 inch.
 - 8.5. Horizontal Kink: 0.020 inch.
 - 8.6. Rail Base:
 - 8.7. Horizontal Offset: 0.060 inch.
 - 8.8. Offset Bending: 0.010 inch per inch.

Sharp edges and burrs shall be removed, including chimneys from thermite welds. Top of base of rail shall be ground smooth at chimney locations.

Weld joints shall be smooth on top and sides of head and straight in line. No over grinding is permitted. Web of rail at thermite welds shall not be ground. Mold residue shall be removed from the weld area and properly discarded.

Finishing of welds shall be sufficient to allow testing using the Ultrasonic test method as described below. Welds rejected because of insufficient or unsatisfactory finishing of welds shall be refinished, repaired, or replaced at the Contractor's expense until the weld meets the testing criteria.

Rail welds must be tested by the Contractor through the use of an SCRRA approved testing agency using the Ultrasonic testing method in accordance with ASTM E164.

Each completed weld shall have full penetration and complete fusion and be entirely free of cracks. Total area of internal defects such as porosity and slag inclusions shall not exceed 0.060 square inch and the largest single porosity or slag defect permitted shall not exceed 1/8 inch diameter.

Other causes for rejection of welds shall be Welded joints not meeting these Specifications and tolerances will be replaced at no cost to the SCRRA or the State. The defective weld shall be cut out, and a new section of rail shall be inserted, welded into place as described in this Section, and retested.

A short section of rail shall be cut in the CWR, when required by the Engineer, for the following reasons:

1. To repair defective rails.
2. To repair defective welds.
3. To destress rail.
4. To make a connection between rail strings or adjust rail to meet a specific point (for example to connect CWR to stock rail or frog).

The short section of rail to be cut in shall be at least 19 feet-6 inches long on tangents and curves less than 2 degrees; and 30 feet long on curves 2 degrees or greater and rail to be cut in shall be of the same weight, size, section, and class of rail being replaced or joined.

Before cutting out rail in CWR and inadvertently losing thermal control, prevent remaining CWR from further movement by applying full box anchors for at least 200 feet each way from the proposed cut. After cutting CWR, a rail expander/puller or other means shall be used to prevent rail movement until a weld or temporary joint is installed.

The ends of the short rail section and the CWR shall be saw cut.

Follow manufacturer's recommended procedures specified for completing field welding by thermite process.

Repair of rail due to damage by the Contractor shall be at Contractor's expense.

When repairing a defective rail or weld, the new rail shall be the same length as rail being replaced, or as required to achieve thermal adjustment.

When performing field welding, rail temperature adjustments shall be made in accordance with the railroad special provision for trackwork, using either heating of rail or mechanical rail pullers. The first weld of a replacement plug may be at ambient temperature, but the second (destress weld or rail closure weld) shall be installed in accordance with the railroad special provision for trackwork.

MEASUREMENT AND PAYMENT

The contract price paid per track foot for running rail includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in field welding rail, as shown on the plans, as specified in these special provisions, and as directed by the Engineer. Plans references to rail, top of rail or bridge guard rail shall be include in the cost for running rail.

14-1.02 BALLAST

GENERAL

Summary

This section specifies the material requirements for ballast to be furnished by the Contractor and placed or stockpiled in accordance with the contract documents or required by the Engineer.

This section also includes furnishing all labor, material and equipment necessary and incidental to furnishing walkway rock as required by the Engineer.

Submittals

Submit the Compliance Report prior to ordering material: Submit certified results of the tests required to demonstrate conformance with these specifications prior to any material being shipped.

Quality Control and Assurance

Testing shall be performed by the Contractor's independent certified testing laboratory approved by the Engineer.

The Contractor must provide laboratory certification that ballast material meets the Specifications of this Section.

If the Contractor observes ballast material not suitable for work, or not in compliance with this part, the Engineer must be notified within 3 hours of discovery of condition.

The product delivered shall be from the same source from which samples were tested and found to conform to the Specification and shall be of the same type and quality of that which was tested.

Testing shall be performed by the Contractor's independent certified testing laboratory approved by the Engineer.

The Contractor must provide laboratory certification that ballast material meets the specifications of this Section.

Blending, stockpiling, and other production and handling operations must be managed by the Contractor.

Stockpiling operations shall minimize breakage or excessive fall in stockpiling operations.

The movement of wheeled or tracked machines over stockpiled or installed materials shall be limited.

MATERIALS

Material Grading Requirements

Ballast gradation shall conform to SCRRR ES 2007-02 and AREMA Volume 1, Chapter 1, Section 2.4.4, Table 1-2-2, Standard No. 4A ballast unless otherwise noted.

Gradation test shall be determined in accordance to ASTM C136, utilizing square opening sieves conforming to ASTM E11.

The percentage passing each sieve shall fall within the following limits:

SIEVE SIZE	SIEVE OPENING	PERCENT PASSING BY WEIGHT
2 1/2 INCH	2.50 INCH	100
2 INCH	2.0 INCH	90-100
1 1/2 INCH	1.50 INCH	60-90
1 INCH	1.0 INCH	10-35
3/4 INCH	0.75 INCH	0-10
1/2 INCH	0.50 INCH	-
3/8 INCH	0.375 INCH	0-3
No. 4	0.187 INCH	-

The percent passing each sieve shall fall within the following limits:

Table Title

SIEVE SIZE	SIEVE OPENING	PERCENT PASSING BY WEIGHT
2 1/2 INCH	2.50 INCH	100
2 INCH	2.0 INCH	100
1 1/2 INCH	1.50 INCH	100
1 INCH	1.0 INCH	90-100
3/4 INCH	0.75 INCH	40-75
1/2 INCH	0.50 INCH	15-35
3/8 INCH	0.375 INCH	0-15
No. 4	0.187 INCH	0-5

Ballast shall consist of crushed stone comprised of angular fragments resulting from crushing by mechanical means, the following types of rocks quarried from undisturbed, consolidated deposits:

1. Granite and similar, phanero-crystalline igneous rock, extrusive igneous rock, or massive metamorphic quartzite or similar rock.
2. Furnish prepared ballast that is hard, strong, angular, durable particles of crushed rock containing no carbonates of slag and free from injurious amounts of deleterious substances and conforming to the following requirements of these Specifications:

2.1. Material qualities shall be as follows:

PROPERTY	MINIMUM	MAXIMUM	TEST METHOD
Percent material passing No. 200	--	1.0 percent	ASTM C 136 ASTM C 117
Bulk specific Gravity – Rock	2.60	--	ASTM C 127
Absorption - Rock	--	1.0 percent	ASTM C 127
Clay lumps and friable particles	--	0.5 percent	ASTM C 142
Degradation	--	As Noted for Material Type	ASTM C 535 or ASTM C 131 (Note 1)
Granite	--	35 percent	
Traprock	--	25 percent	
Quartzite	--	30 percent	
Soundness – (Sodium Sulfate) – 5 cycles	--	2.5 percent	ASTM C 88
Flat or elongated particles (length is equal to or greater than three times the average thickness)	--	5 percent	ASTM D 4791
Durability Test – Procedure A	65	--	ASTM D 3744
Magnesium Carbonate	--	0	ASTM D 3042
Sand Equivalent	50	—	California 217

Note 1: Materials having gradations containing particles on the 1 inch sieve shall be tested by ASTM C 535. Materials having gradations with 100% passing the 1 inch sieve shall be tested by ASTM C131. Use ASTM C 535 for Ballast Standard Type 4A and ASTM C131 for Ballast Standard Type 5.

2.2. Particles of the ballast shall have been broken by the crusher and must have at least two fractured surfaces.

Contractor's testing laboratory shall take and perform gradation and other tests on representative samples of ballast, of not less than 150 pounds, from each source of ballast:

1. Perform tests to ensure compliance with these specifications.
2. Each shipment of ballast shall be accompanied by a certification as specified.

CONSTRUCTION

Ballast shall be delivered to the project site to specific locations identified in the contract documents, required for completion of the work, or as directed by the Engineer, and installed in accordance with the railroad special provisions for trackwork or track shifting, relocation, and resurfacing.

Reference of trackwork implies Ballast for track on bridge, at-grade, and in turn-out.

PAYMENT

The contract price paid per cubic yard for ballast includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in ballast, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

14-1.03 SUB-BALLAST AND AGGREGATE BASE

GENERAL

Summary

This section specifies the material requirements for sub-ballast and aggregate base to be furnished and placed to the lines, grades, and dimensions in accordance with the railroad plans, railroad specifications, and directions of the Engineer.

Submittals

Submit the following items prior to ordering materials:

1. Compliance: Supplier's certification that material delivered to the site is in compliance with the Specifications.
2. Samples: As required by the Engineer samples of not less than 150 pounds. Samples shall be furnished by the Contractor or may be obtained independently by the Engineer's representative for testing to determine whether the material delivered to the site is in compliance with the Specifications.
3. Equipment: A list of equipment used for placing and compacting sub-ballast.

CONSTRUCTION

Sub-ballast and aggregate base shall not be spread until the Engineer has approved the subgrade.

Spread and compact sub-ballast and aggregate base in conformance with the requirements of the Standard Specifications Section 26-1.03: Subgrade; Section 26-1.035: Adding Water; Section 26-104: Spreading; Section 26-105: Compacting. Compaction shall be to a minimum of 95 percent relative density of modified proctor ASTM D1557. Maximum lift shall be 6 inches.

The surface of the sub-ballast and aggregate base shall be stable to permit follow-on stages of construction without rutting.

Sub-ballast and aggregate base shall be finished to within 0.05 feet of the lines and grades indicated on the railroad plans.

Sub-ballast and aggregate base shall be maintained during construction free of deformation, rutting, or inclusion of fines and within lines and grades listed above in a condition acceptable to the Engineer until ballast or paving material has been placed and approved at no cost to SCRRRA or the State.

MEASUREMENT AND PAYMENT

Full compensation for sub-ballast will be considered as included in the various contract items of work under "Trackwork" and no additional payment will be made therefor.

14-1.04 CONCRETE RAILROAD TIE

GENERAL

Summary

This Section specifies the material requirements and performance criteria for production and inspection of monoblock, pretensioned, prestressed concrete ties for standard gage track (4 feet-8-1/2 inch) to be furnished in accordance with the specifications and SCRRRA Engineering Standards (ES) ES 2402, ES 2403, ES 2406 or ES 2407 as appropriate.

Definitions

The word "**Inspector**": in this Specification shall mean the duly authorized representative of SCRRA.

The word "**manufacturer**": in this Specification shall mean the manufacturer of concrete ties.

The word "**supplier**": in this Specification shall mean a supplier of materials or components for use in the concrete ties.

The word "**source**": in this Specification shall mean a plant where a material or component used in the concrete ties, is produced. For aggregates, the word "source" shall mean the strata or quarry face from which the aggregate is obtained.

The word "**bed**": in this Specification shall mean a prestressing bed with forms placed end to end. Each bed is only one form wide.

The word "**form**": in this Specification shall mean a battery form, one tie long, with 5 to 8 cavities in which ties are cast upside down.

The word "**line**": in this Specification shall mean a series of ties end to end on a prestressing bed. Each line is only one tie wide.

The words "**long line process**": in this Specification shall mean ties being, made on a bed with at least ten forms end to end and on which the prestressing wires are tensioned between fixed abutments, independent of the forms, and prior to placing concrete.

The words "**outside testing laboratory**": in this Specification shall mean a testing laboratory, independent of the manufacturer, which conforms to ASTM E994 and is approved by the Engineer.

Submittals

Compliance: Manufacturer's certification that the materials delivered are in compliance with the specification.

Certification that the proposed concrete tie and shoulder inserts will satisfy test requirements as specified herein.

Certification shall include qualified laboratory test results, calculations and performance reports from a proven fastener design with 5 years of operational service.

Certified test results, as required to demonstrate compliance of materials specified herein shall be submitted to the Engineer. The test results for the following items shall be supplied:

1. Cement.
2. Aggregates.
3. Water.
4. Concrete.
5. Rail Seat Pads.
6. Fasteners.
7. Electrical Properties.
8. Tie Testing.

A complete design analysis of the proposed tie and associated hardware, verifying the tie's capability to pass the test requirements contained in the Specifications and verifying the adequacy of the materials for their intended use.

Design submission shall include:

- A. Structural detail Drawings of the proposed tie and fastening assembly.
- B. The Drawing shall include tie configuration, prestressed strand size and location, and details of the shoulders with their fabrication tolerances.
- C. Structural calculations shall be based upon current industry standards for prestressed concrete design and the American Concrete Institute (ACI) standard requirements applied as follows:
- D. Calculations shall include moment analysis for the tie under no-cracking conditions and shall consider long-term permanent prestress losses.
- E. Concrete batch compositions.
- F. Submission shall include physical and chemical composition of the batch; including, type and source of cement admixtures used, source and gradation of aggregates, source and quality assurance of water, curing, procedure, including concrete strength at prestress transfer, and separation of the tie from the form.
- G. It is the Contractors responsibility to ensure that the concrete composition and quality is suitable for its intended purpose.
- H. Specifications for pretensioning tendons.
- I. Documentation confirming the quality of material used in these elements

Cure time:

- A. The length of cure time necessary for the tie to reach 7,000 pounds per square inch strength prior to delivery for placement in track.
- B. Submit Shop Drawings prepared by the manufacturer for the standard "Fastclip" concrete ties and the guardrail equipped "Fastclip" concrete ties both with and without neoprene pads, if required.
- C. Submit to the Engineer Shop Drawings prepared by the manufacturer for the forms and for the gages.
- D. Forms and gages shall not be used until the Drawings have been approved by the Engineer.
- E. Before production commences, submit a Quality Control Manual prepared by the manufacturers for approval by the Engineer.

This Manual shall include the following details:

- A. Management organization.
- B. Responsibilities of production and quality control personnel.
- C. Plant Standards.
- D. Checks to be carried out by production personnel.
- E. Inspection and testing to be carried out by quality control personnel.
- F. Procedures for approving sources of materials and for order in materials.
- G. Procedures to insure that only materials complying with these Specifications are used.
- H. Procedures to insure measuring equipment is properly calibrated.
- I. Procedures to insure that ties are not shipped until acceptance load testing is complete and that rejected ties are clearly marked and segregated from good ties.

The Manual shall be revised or amended whenever there are changes in personnel, responsibilities, or other items contained in it.

Submit the Quality Control Program and the Production Program specified under "Quality Assurance and Quality Control" herein.

Submit written reports to the Engineer prepared by the manufacturer documenting strict adherence to the Quality Control Program and the Production Program.

Quality Control and Assurance

The manufacturer shall have a minimum of 5 years experience, in a fixed location, of the large-scale manufacture of pretensioned prestressed concrete railroad crossties by the long line process.

The manufacturer's existing plants in the USA shall have been certified under the PCI Plant Certification Program.

If the manufacturer's existing plants are outside the USA, they shall have been certified by the equivalent National Certification Organization for that country.

The manufacturer shall show to the satisfaction of the Engineer that he has, or can obtain, the necessary and proper equipment, tools, facilities and means, and that he has the experience, ability and financial resources to perform the work within the time specified and to the quantity standards required.

Ties shall be manufactured by the long line process with 5 to 8 lines per bed.

If the manufacturer produces the ties in a new plant, that plant shall be certified under the PCI Plant Certification Program within 6 months from the start of production.

The requirements of ACI 301 and PCI MNL 116 shall apply except where other requirements are stated in these Specifications.

Concrete ties shall be shipped in open-top cars or flat bed truck trailers.

Ties shall be securely braced for transportation to prevent any movement that will cause damage.

Ties shall be shipped in a horizontal position and braced with spacer blocks in such a manner that the top surface or cast-in-place hardware does not contact ties loaded above.

Ties shall not be loaded higher than the top of the cars and not more than six layers deep.

Ties must be delivered, unloaded, and neatly stockpiled as necessary on the project site by the Contractor.

When handling ties in the plant, yard or at the delivery site, ties must not be dropped or damaged.

Ties must be stacked on firm level ground, not more than 10 ties high and supported on dunnage at the rail seats only.

MATERIALS

General

The manufacturer shall only use materials from sources approved by the Engineer.

For cement, the source of clinker and the source of the ground cement will be approved by the Engineer.

Tests for cement and aggregate shall be completed in accordance with this Specification before approval of materials is requested from the Engineer.

Adequate time shall be allowed for the Engineer to approve new sources.

Trial concrete mixes shall be cast at least 90 days prior to approval being requested.

For aggregates to be supplied from a new source that has not been previously tested, a minimum period of 224 days shall be required for testing to ASTM C227 prior to approval being requested.

Alternatively, 70 days shall be allowed for the Osmotic Cell Test. SCRRA will accept previous test results on these aggregates from a qualified laboratory performing these tests as required to the standards of the appropriate ASTM which has been supervised, signed and sealed by a California Registered PE or Geologist.

The minimum 28-day-design compressive strength of concrete used for concrete ties shall be 7000 pounds per square inch as determined in accordance with ASTM C39. The test cylinders shall be made and stored as specified in ASTM C31.

Batching and Mixing:

- A. Aggregates and cement shall be measured by weight.
- B. The weight of aggregate shall be based on a saturated surface dry condition corrected for free moisture.
- C. Water shall be measured by weight or volume and admixtures shall be measured by volume.
- D. Each batch of concrete shall be mixed separately in a pan mixer or approved horizontal drum mixer located at the site of the concrete tie manufacturing, process.
- E. No water shall be added to concrete after discharge from the mixer.
- F. The quantity of each material used in each batch of concrete shall be automatically recorded.

Proportioning:

- A. Mix proportions shall be developed using the method in ACI 301, Section 3.9. The cement content shall be not less than 600 pounds per cubic yard.
- B. Temperature: The temperature of freshly mixed concrete shall not exceed 90° F.

Curing:

- A. Immediately after placing and consolidating, the concrete, the exposed surface shall be covered with impermeable sheeting.
- B. Concrete shall not be placed in forms whose temperature is less than 40° F and the concrete temperature shall not be allowed to fall below 50° F between casting, and transfer of prestress.
- C. If heat curing is used, the forms may be preheated to avoid cooling of the concrete after placing but the temperature of concrete shall not rise above 100° F until initial set (ASTM C403) has occurred.
- D. The rate of temperature rise in the concrete shall not exceed 35° F per hour and the maximum concrete temperature shall not exceed 140° F,
- E. Transfer of prestress shall not be carried out at a concrete temperature above 135° F.
- F. The heating method used shall ensure that ties in a bed are at a similar temperature.
- G. During curing, the temperature at the center of the rail seat cross section of one tie in each bed shall be automatically recorded.

Testing Fresh Concrete

The first batch on any bed shall be tested in accordance with this Specification and if this requires no adjustment to the mix, a further test shall be made after approximately 25 cubic yard has been poured.

If the first batch requires adjustment to the mix each subsequent batch shall be tested until no further adjustment is necessary and then a further batch shall be tested after approximately 25 cubic yard has been poured.

Slump

When measured in accordance with ASTM C143, the slump shall not exceed 2" when concrete is placed in the forms.

A minimum of two measurements of slump shall be made, on separate batches of concrete, for each bed cast or each 50 cubic yard concrete whichever is less volume of concrete.

Air Content

Air entrainment of the concrete shall comply with the following table:

PERCENT AIR ENTRAINMENT STAGE	AIR CONTENT
Plastic Concrete	4.5% ±0.7%
Cured Concrete	3.5% ±0.5%

Testing Hardened Concrete

Compressive Strength

When measured on 4 inch x 8 inch cylinders capped in accordance with ASTM C617 and tested in accordance with ASTM C39, the minimum compressive strength shall be:

- A. At transfer of prestress: 4500 pounds per square inch.
- B. At 28 days: 7000 pounds per square inch.
- C. The minimum number of test cylinders per bed shall be:
- D, For transfer strength: 4.
- E. For 28 day strength: 3.
- F. The cylinders shall be made from one batch of concrete and the slump and air content shall be measured on the same batch.
- G. The cylinders shall be cured with the ties until transfer of prestress, so the temperature of the cylinders is with +0°-15° For the temperature of the ties.
- H. After transfer of prestress, the 28-day cylinders shall be cured in accordance with ASTM C192.

Four inch cubes may be used to measure the compressive strength at transfer of prestress.

Two cylinders shall be tested for transfer strength.

- A. If either result is less than 4500 pounds per square inch, curing shall be continued for at least a further one (1) hour.
- B. No bed shall be detensioned until at least two cylinders achieve a strength of 4500 pounds per square inch.
- C. If transfer cylinders are tested without conforming to this requirement the bed may be detensioned if at least one cylinder achieves 4500 pounds per square inch.
- D. An additional set of ties from one form shall then be acceptance load tested.
- E. If no transfer cylinders achieve 4500 pounds per square inch, the bed may be detensioned, providing ties are acceptance load tested.

The strength at 28 days shall be satisfactory if the average of three cylinders is not less than 7000 pounds per square inch and no individual result is less than 6500 pounds per square inch.

Durability

One tie shall be selected at the start of production and thereafter every three months, for air void content and durability factor tests by an outside testing laboratory.

The air void content shall be measured in accordance with ASTM C457 on the top, center and bottom of a cross section slice cut from the rail seat of a tie.

The measured air void content shall be not less than 3.0 percent and the air void spacing factor shall not exceed 0.008 inch.

The durability factor shall be measured in accordance with ASTM C666 on a minimum of 4 prisms of concrete taken adjacent to the samples used for the durability tests as required by this Specification.

The durability factor shall not be less than 90 percent.

The frequency of testing, for durability shall be increased at the Engineer's request if there is evidence that ties do not satisfy the requirements of this Specification.

Chloride

The water-soluble chloride content of the concrete shall not exceed 0.06 percent expressed as chloride ion by weight of cement.

This shall be measured by an outside testing laboratory on fresh concrete or on individual materials in the mix when mix proportions are developed in accordance with Paragraph entitled "Proportioning" in the Article "Concrete" of this Specification and thereafter, by tests at three monthly intervals which include materials from all sources in use.

Alkali - Silica Reactivity

The composition of the cement, fine aggregate shall be analyzed and tested in accordance with ASTM C33, ASTM C227, and the "Duggan" Concrete Expansion Test so as to ensure that the resulting combination does not produce a concrete subject to deleterious expansion resulting from an alkali-silica reaction.

These tests must be repeated every 6 months, from each source, unless otherwise defined in this Specification.

Whenever a component or source is changed, new tests must be performed on these components or sources.

CEMENT

Cement shall conform to ASTM C150, and low alkali.

Cement alkali content of Na₂O equivalent (Na₂O + 0.658 K₂O) shall be as low as possible and not greater than 0.6 percent.

The false set penetration, when tested in accordance with ASTM C359, shall be not less than 50 milometer at intermediate times and 40 milometer after remix.

Separate random samples of cement shall be taken each day to represent the cement used on each bed.

Each sample shall be not less than one gallon and shall be clearly identified with the date and bed number.

Each sample shall be kept in air-tight container until the corresponding 28-day cylinder tests have been carried out and results accepted by the Engineer.

Not more than 2 sources of clinker or ground cement shall be used by the manufacturer during any one-month.

Cement from each source shall be clearly identified and stored in separate weather tight silos.

If 2 sources of cement are used on one bed, the tests in this section shall be performed on the first batch of concrete made with each cement and if no adjustment to either mix is required, testing shall continue as single design as required in this section. Strength tests as required in this section shall be conducted on concrete made with each type of cement.

Cement mill certificates shall be provided weekly by each supplier and shall include the results of the following tests on cement delivered during that week.

Substitution of cement are not be permitted unless it pre-qualified through the tests listed in this special provision.

Requirements

Fineness by air permeability (ASTM C204).

False Set (ASTM C359) - Penetration at 3, 5, 8, and 11 minutes and remix.

Setting Time (ASTM C191).

Compressive Strength (ASTM C109) at 1 day, 3 days, and 7 days.

Chemical Analysis (ASTM C114) - INCLUDING SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, SO₃, K₂O, Na₂O and calculated alkalis as N₂O equivalent, C₃S, C₂S, C₃S, C₄AF.

Residue on 325-mesh sieve (ASTM C430).

At least once during every three months, a randomly chosen sample of cement from each source used shall be analyzed for alkali content in accordance with ASTM C114 by an outside testing laboratory.

Aggregates

Fine and coarse aggregates shall meet the requirements of the AREMA Specifications for Aggregates, Part 1, Section 1.3, Chapter 8 of the AREMA Manual.

Aggregates shall be natural aggregates complying with ASTM C33 Class 4S. The maximum combined coarse aggregate percentage wear shall not exceed 39 percent.

The manufacturer shall provide evidence that concrete containing aggregate from the proposed source with a cement content and alkali burden similar to the job mix, has a satisfactory service history of at least 5 years. This evidence shall include structures requiring a Class 4S aggregate.

The maximum size of aggregate shall be ¾ inch. If the coarse or fine aggregate is supplied in more than one size, each size shall be stored separately.

Washed aggregate shall be allowed to drain, in stockpiles, before use. Aggregates shall be free from ice when used. In addition to the requirements of ASTM C33, the following tests shall be conducted by an outside testing laboratory:

- A. Petrographic examination to ASTM C295. Examination shall be repeated on aggregate from each new source.
- B. Evaluation of potential alkali reactivity to ASTM C227 or ASTM C1293.

A separate test shall be conducted with each job cement and the results shall conform with ASTM C33 at three and six months.

This shall be repeated every 6 months for each source.

When there is insufficient time for testing, to ASTM C227 or ASTM C1293, potential alkali reactivity may be evaluated by the Osmotic Cell Test* developed by PCA. The flow rate at 30 days shall not exceed 1.5 milimeter per day.

Evaluation of potential alkali carbonate reactivity:

Aggregates containing carbonate shall be tested in accordance with ASTM C586.

Water

Water in mixing concrete and washing aggregates shall be potable and free of injurious amounts of oil, acid, alkali, inorganic matter, or other deleterious substances, that may be harmful to concrete or steel as specified in AASHTO T-26.

The mixing water, including that portion of the mixing water contributed in the form of free moisture on the aggregates, shall not contain a chloride ion content greater than 400 ppm.

Admixtures

Chemical admixtures for concrete shall conform to ASTM C494.

Additives containing chlorides shall not be used.

Only liquid admixtures shall be used.

Air-entraining, admixtures shall conform to ASTM C260 and contain neutralized Vinsol resin or other approved natural resins as the active ingredient.

Water reducing admixtures shall only be used with the approval of the Engineer. They shall conform to ASTM C494, Types A, B, D, E.

Water-reducing admixtures, retarding admixtures, accelerating admixtures, water reducing and retarding admixtures, water-reducing and accelerating admixtures, and high range water reducing admixtures, when authorized by the Engineer, shall conform to ASTM C494 or ASTM C1017 in the case of superplasticizers.

Other mineral admixtures shall not be used, except for Class F Flyash as noted below, unless mix and quality control program are specifically approved by the Engineer.

Class F Flyash, if used, shall conform to ASTM C618. The properties shall not exceed the following:

- A. 1.5% available alkalis and 60% loss on ignition.
- B. Mill test certificates shall accompany each lot of Class F Flyash used in tie production in order to ensure consistency.
- C. The combined mix design with admixtures, if used, shall be tested using ASTM C1567 on the proposed job mix to verify alkali-silica reaction (ASR) potential.

Prestressing Tendons

General

Prestressing shall be indented wire strand or stress relieved wire.

The wires shall comply with ASTM A881 or stress relieved wire complying with ASTM A421.

The minimum tensile strength of the wire shall be 225,000 pounds per square inch.

Strands for pretensioning tendons shall conform to ASTM A886.

Tendons shall be thoroughly cleaned of drawing lubricants before shipment.

Tendons from one source only shall be used on each bed.

Tendons shall not be contaminated with mud, oil, grease, or chloride salts.

Loose rust shall be removed during stringing and tendons pitted due to corrosion shall not be used.

Pretensioning

During stringing, tendons shall not become contaminated with form release agent.

Each tendon shall be individually tensioned with the same initial force of between 5 percent and 20 percent of the final force using, a hydraulic jack.

The final force shall then be applied by multiple tensioning with hydraulic jacks.

The force shall be measured by pressure cases located immediately adjacent to each jack and be measured by elongation.

The forces measured by the two methods shall agree to within 5 percent.

Detensioning

Stress transfer shall be performed in a controlled manner with hydraulic jacks.

The forms shall be free to move and the stress in tendons shall be transferred at the same time and the same rate.

No tendon shall be cut until it is completely detensioned.

If any tendons break during curing, ties shall be load tested in Rail Seat Positive in accordance with Paragraph entitled "Acceptance Load Testing" in Article "Testing of Ties", starting with the ties from the form adjacent to the abutment where the tendon broke and moving towards the other abutment, when a point on the bed is reached at which ties from one form pass the test, the remaining ties shall be accepted without further load testing.

Rail Fastening System Components

Rail fastening system shall be resilient, thread-less and adjustable in three steps without dismantling the fastener. The three steps shall be:

- A. Retracted: Permits installation or removal of rail
- B. Intermediate: Permits longitudinal rail movement
- C. Clamped: Provides full rail clamping force.

Fasteners shall be comprised of as few components as economically and technically feasible for ease of assembly, disassembly, and maintenance. The rail clips, rail seat pads, and insulators shall be furnished by rail clip manufacturer and shall be compatible with concrete tie shoulders.

Configure fasteners so rail clip can be installed or replaced in the field by one person using standard readily available track tools. Clips shall be capable of being installed by commercially available automated equipment.

Configure fasteners so that when the rail clips are retracted, the rail may be lifted vertically until it is completely free of the fastener without disturbing the horizontal or vertical alignment of the fastener.

Fasteners shall have, on both sides of the rail base, a positive means of preventing more than 1/8 IN total lateral movement of the rail base relative to the fastener in case of failure or loosening of one or both rail clips. The positive means shall extend at least 3/8-inch above the base of rail in the installed position.

Fasteners shall be Pandrol "Fastclip" or approved equal. Rail clips, insulators and tie pads shall be pre-assembled on cross tie at manufacturer's plant.

Rail Clips

Rail clips shall not be dependent on elastomeric components in torsion. The clips shall be reusable after removal through repeated applications without any effect on the operating performance of the system.

The minimum vertical hold down force for spring clips shall be 2,500 pounds with total minimum force of 5,000 pounds per rail fastener assembly.

Insulators

An insulator shall be used between the rail clip, shoulder insert and the rail to position rail to the proper gauge, provide electrical insulation, reduce abrasion, and transfer the rail loading to the rail clip and shoulder insert.

The insulator shall be capable of withstanding degradation from oxidation, water, alkali, petroleum oils, synthetic lubricants, and sunlight without having detrimental effect on the performance of the insulator.

Insulator dimensions shall be appropriate to provide standard gauge dimension.

Insulators for different uses (adaptive insulators) shall be of different colors or different appearance for ease in identification.

Rail Seat Pads

Provide rail seat pads compatible with the rail fastening system with a shape which provides positive means of preventing movement of the pad parallel to the rail. Pads must comply with SCRRRA Engineering Standard ES 2363.

Alternate designs of rail seat pads shall be considered, provided they have successful history of performance of at least three years service under comparable service conditions.

Alternate design must be specifically approved by the Engineer.

Submit results of industry standard tests concerning the above properties.

Iron Shoulders

Iron Shoulders shall be Pandrol cast shoulders for "fast clip" or approved equal, sized for 136 pounds, 6 inch base rail dimension, with adaptive insulators, pads, and clips

Ductile iron shoulders shall be obtained by the manufacturer and shall conform to ASTM A536 Grade 60-40-18 or 65-45-12.

They shall be marked with the part number, supplier's identification and pattern number.

At least four Y block specimens shall be cast from each heat, or in continuous casting, from each four-hour period.

Specimens shall be heat treated under the same conditions as the shoulders they represent.

Tension test specimens with a cage length of 2 inch shall be machined from the Y blocks and one tension test shall be made for each heat or each 4-hour pour period.

If the elongation and tension test results do not conform to ASTM A536, a further specimen shall be tested and if this fails the cast shall be reheated or rejected.

The shoulders and test specimens may not be reheated more than once.

After reheating, two test specimens shall be tested.

If either of these fails to conform to ASTM A536, the cast shall be rejected.

The shoulders shall be free from burned-on sand, cracks, cavities, injurious blowholes and other defects.

Fins shall be removed from the vertical faces of the head of each shoulder.

Fins across the top of the head shall not exceed 1/32 inch and below the head, fins shall not exceed 1/16 inch.

At gates, there shall be no cavity in the shoulder more than 1/8 inch below the general surface level.

Go and No Go inspection gages shall be used to check that tolerances conform to the Drawings.

A sampling plan for Acceptable Quality Levels of 1 percent for major dimensions and 4 percent for minor dimensions shall be used.

The manufacturer shall decide which are major and minor dimensions in consultation with the Engineer (through the Contractor).

Iron shoulders shall be free of mud, oil, loose rust and other contamination when cast into ties. They shall be rigidly secured in the forms during casting and shall not move within the concrete when the securing device is released.

Ductile iron shoulders shall conform to the dimensions on the Drawings issued by the fastening clip suppliers.

Guard Rail Inserts

Inserts for guardrail concrete ties shall be as shown on SCRRRA Engineering Standards ES 2406 or ES 2407 or approved equal.

Neoprene Pads

Neoprene Pads cast into the bottom of the tie for use on bridge decks in certain applications as indicated in the Contract Documents shall be as shown on SCRRRA Engineering Standards ES 2403 or ES 2407.

Tie Dimensions, Configuration and Weight

Dimensions, configuration and weight shall conform to the following:

- A. Alternative designs of concrete ties will be considered if they have the same general profile, and length.
- B. Alternative designs must have a successful history of performance of at least five years service under comparable service conditions.

Alternative design must be approved by the Engineer.

Dimensions

Weight	750 pounds maximum
Base Width	10-3/8" ($\pm 1/4$ ")
Height at rail seat	8" (+3/16" -1/8")

Cross Ties

Length	8'-3" ($\pm 1/8$ ")
Height at center of tie	6-1/4" (+3/16" -1/8")
Rail Seat Cant	1 in 40 towards track centerline
Track Gauge	4'-8-1/2"

Flexural Strength

Flexural strength performance and test requirements shall comply with Section 4.4, Chapter 30 of AREMA Manual. Results per Section 4.9, Chapter 30 of the AREMA Manual shall be provided.

The minimum flexural performance requirements for the concrete ties shall be as follows:

- A. Positive rail seat moment of 280 inch kilo-pound static.
- B. Negative rail seat moment of 146 inch kilo-pound static
- C. Static center positive moment of 110 inch kilo-pound.
- D. Static center negative moment of 162 inch kilo-pound.

Longitudinal and Lateral Rail Restraint

The concrete tie and elastic fastener shall provide longitudinal and lateral rail restraint as specified in Section 4.6 and Section 4.7, Chapter 30 of the AREMA Manual.

Electrical Properties

Each concrete tie, together with its elastic fastening, shall comply with Section 4.8, Chapter 30 of the AREMA Manual.

Tie Testing

Prior to approval of the concrete tie design, tests specified in Section 4.9, Chapter 30 of the AREMA Manual, unless otherwise modified by this Section, shall be performed at testing facility approved by the Engineer and results provided to the Engineer.

Surface Finishes

Every tie shall be visually inspected.

Two ties which, in the opinion of the Engineer, show the required bottom surface finish and two ties which in the opinion of the Inspector show the maximum allowable rail seat defects shall be set aside as comparison standards for acceptance of ties.

The bottom surface of each tie shall have a rough struck, leveled surface.

Projections from and indentations into the general level of the surface shall not exceed 3/16 inch.

The indent pattern shall be approved by the Engineer.

The surface of the rail seat shall have a smooth, formed finish not inferior to the comparison standards.

No forms, seams or warpage in the rail seat will be allowed.

The rail seat flatness shall not exceed a 1/32 inch difference across any part of the rail seat.

When referring to voids and rail seat flatness in the rail seat area, the rail seat will be defined as "area between adjacent shoulders and edge of tie to edge of tie" and the area adjacent to the shoulder and 3/8 inch beyond the face of the front face of the shoulder.

Grinding or shaving with a jig is acceptable.

Freehand grinding is not acceptable, unless approved by the Engineer.

Filling of rail seat voids with fillers is not acceptable.

No rubbing, brushing or other treatment shall be used on the rail seat.

Ties require a lateral resistance pattern to be placed on the side of the tie.

The Engineer will review for approval the design, but not provide the design of this pattern.

The tie shall provide a minimum lateral in a single tie push test of 5,000 pounds.

The tested tie must be in track on a major heavy haul railroad with adequate ballast depth.

Proof of the lateral resistance design will be through multiple single tie tests as performed by the AAR.

The tie manufacturer assumes responsibility for maintenance and design of these forms and patterns.

The Engineer will not accept a tie without a proven pattern.

Other formed surfaces shall be smooth and holes shall not exceed 1/4 inch in depth and diameter.

Ties with a limited number of holes up to 3/8 IN DIA but not exceeding 1/4 inch in depth will be accepted providing that holes are filled with a mixture of 3 parts washed sand, 1 part cement and 1 part SBR latex measured by volume or other accepted material.

Holes in tie ends shall not exceed 3/8 inch in diameter and 1/2 inch in depth or 1/4 inch diameter and 1 inch in depth below the general surface level of concrete.

Corner breakage at tie ends shall not exceed 1 inch in depth.

Ties with visible cracks shall be rejected.

Prestressing wire shall not protrude more than 1/8 inch beyond the tie end and shall not have ragged ends, which would be hazardous in handling.

The surfaces where fastening components bear on the iron shoulders shall be 100 percent free from concrete or other foreign materials.

Tie Dimension Inspection

Approved Go and No Go gages shall be used to check the following:

- A. Out to out shoulder spacing.
- B. Adjacent shoulder spacing.
- C. Shoulder height.
- D. Rail seat cant.
- E. Rail seat flatness.
- F. Rail seat wind or warpage.
- G. Wire location.

A "Go and No Go" gage is the basis for acceptance and rejection. No interpretation of a gage is acceptable.

The inspector may gage as often as is required or as the Engineer feels necessary to QC confidence. If a problem is found then it is the responsibility of the Manufacturer to provide inspection as directed by the Engineer (100 percent if necessary) until the extent of the problem has been determined or the rework has been properly confirmed.

When new forms, modified forms or repaired forms are used, the first tie cast in each cavity shall be checked with Go and No Go gages and normal measuring equipment to insure conformity with dimensional tolerances on the tie drawings.

Ties selected for routine acceptance load testing shall be checked as described in this Specification.

Wire pattern shall:

- A. Ensure 3/4 inch minimum concrete cover of prestress tendons.
- B. Be placed accurately to prevent electrical short between embedded fasteners.
- C. Achieve flexural bending strength in Section 2.10.
- D. Wire pattern for ties on both ends shall be visually inspected daily.

Acceptance Load Testing

Acceptance load testing shall be carried out on the day that detensioning is performed. Contractor must provide sufficient notice to the Engineer to allow for SCRRA Inspectors to be present during acceptance load testing.

Production Start-up Testing

From the first bed cast, ties from one form, selected at random, shall be load tested as follows:

- A. Rail seat positive and bond development at one end.
- B. Rail seat negative at the other end.

If the ties meet these test requirements, further beds may be cast.

If any tie fails to meet the test requirements, two further ties shall be taken from the same line and, if either of these ties fails to meet the test requirements, each tie in the line shall be individually tested, excluding the bond development test. One further bed shall then be cast and the test procedure repeated.

When the test ties meet these requirements an additional four ties shall be randomly selected from the bed already cast and tested as follows:

- A. Two ties tested for Tie Center Negative Moment Test.
- B. Two ties tested for Tie Center Positive Moment Test.

If any tie fails to meet test requirements, two further ties shall be taken from the same line.

If either of the ties fail, then the batch is rejected.

When the test ties meet the production startup testing requirements, further beds may be cast.

Routine Production Testing

After initial production acceptance testing routine acceptance testing shall be carried out on beds cast.

Ties from one form, selected at random from each bed cast, shall be load tested as follows:

- A. Rail Seat Positive at one end.
- B. Every 6th tie selected for test shall additionally be tested as follows:
 - 1. Rail Seat Positive at one end to first crack.
 - 2. Rail Seat Negative at other end to first crack.

If any tie fails to comply with the test requirements, 2 additional ties shall be taken from the same line and tests repeated. If either of these ties fails the test, each tie in the line shall be tested.

One tie per day shall be selected at random from ties subject to Rail Seat Positive test and additionally tested for bond development.

If the tie fails to conform to the requirements of this test, two further ties from the same line shall be tested.

If either of these fails the test, one tie shall be tested from each bed cast on the same day as the ties, which failed the test.

No ties from beds with test failure shall be shipped until a test program to identify ties with unsatisfactory bond is agreed with the Engineer and the tests completed.

One tie per day shall be selected at random from ties subject to Rail Seat Positive Test and additionally tested for Tie Center Negative Moment.

If the tie fails to conform to the requirements of this test, two further ties from the same line shall be tested. If either of these ties fails, each tie in the line shall be tested.

Rail Seat Positive Test

The tie shall be supported in a hydraulic testing machine with loading points so arranged that the load is applied at right angles to the base of the tie midway between the supporting pads. Test configuration shall be in accordance with Chapter 30 of the AREMA Manual.

A test load of 52 kilo-pound shall be applied at a rate not exceeding 10 kilo-pound per minute and maintained for at least three minutes to permit proper inspection. Both sides of the tie shall be inspected.

A tie will be considered to have failed the test if at the 52 kilo-pound test load, it contains a structural crack when viewed under 5-power magnification. The illumination at the surface shall be not less than 125 FEET candles.

When a tie is to be tested to first crack loading shall continue, after inspection at the 52 kip load until a crack 1 inch in vertical length is observed. The load shall then be recorded.

Rail Seat Negative Test

The tie shall be supported in a hydraulic testing machine, in accordance with the test configuration in AREMA Manual, Chapter 30.

The testing procedure shall be in accordance with Chapter 30 of the AREMA Manual.

A test load of 29 kilo-pound shall be applied at a rate not exceeding 5 kilo-pound per minute and maintained for at least three minutes to permit proper inspection. Both sides of the tie shall be inspected.

Bond Development Test

The tie shall be supported in a hydraulic testing machine, in accordance with the test configuration in AREMA Manual.

Dial gages reading, to 0.001 inch shall be attached to the tie at the end being tested, to measure any movement relative to the tie of the outermost wire in each of the bottom corners of the tie.

A test load of 78 kilo-pound shall be applied at a rate not exceeding, 5 kilo-pound per minute and maintained for a period of five minutes.

The wire movement shall not exceed 0.001 inch.

If during this test, a structural crack more than 3 inch long occurs, the test tie shall be rejected after completion.

Tie Center Negative Moment Test

The tie shall be supported in a hydraulic testing machine in accordance with the test configuration in the AREMA Manual.

A test load of 12 kilo-pound shall be applied at a rate not to exceed 5 kilo-pound per minute and maintained for at least 3 minutes to permit proper inspection. Both sides of the tie must be inspected.

Tie Center Positive Moment Test

The tie shall be supported in a hydraulic testing machine in accordance with the test configuration in the AREMA Manual.

A test load of 8 kilo-pound shall be applied at a rate not to exceed 5 kilo-pound per minute and maintained for at least three minutes to permit proper inspection. Both sides of the tie shall be inspected.

Electrical Short

Each tie tested in accordance with in accordance with Paragraph entitled "Acceptance Load Testing" in Article "Testing of Ties", herein shall be checked for shoulder to shoulder direct electrical shorts under 10 volts DC using an Ohm Meter.

The resistance shall not be less than 100 ohms.

If a tie fails this test, ties from the same line shall be individually tested.

Test Reports

The Contractor must submit a monthly manufacturer's test report to the Engineer. This shall include:

Number of good ties cast.

Number of reject ties cast and reasons for rejection.

Concrete compressive strength test results at transfer and at 28 days.

Average and standard deviation of the 28-day compressive strength results.

Percentage probability of 28-day compressive strength results failing to meet the minimum specified strength and the actual number of failures.

Tie first structural crack loads, rail seat positive and rail seat negative.

Average and standard deviation of the first crack loads.

Percentage probability of the first crack loads failing to meet the minimum specified load and the number of failures.

The 28-day Compressive Strength results shall also be presented as frequency histogram.

The Average 28 Day Strength results, Average first Crack Loads and Percentage probability of failing figures shall also be plotted on graphs showing, the corresponding results for the previous 12 months or since production started, whichever is the shorter period.

The manufacturer shall retain for a period of 10 years test certificates provided by suppliers and outside testing laboratories.

Results of all inspection and testing by the manufacturer shall be retained for 10 years.

The Engineer shall have access, during working hours, to all parts of the manufacturer's plant involved in tie production and to those parts of suppliers plants engaged in producing materials or components for use in the ties.

The Engineer shall access to the results of tests carried out by the manufacturer, suppliers and outside testing laboratories.

Plant Yard and Handling

When handling ties in the plant or yard, they shall not be dropped or damaged.

Ties shall be stacked on firm level ground, not more than 20 ties high and supported on dunnage at the rail seats only.

Identification

Each tie shall be marked with indented or raised letters or numerals to identify the manufacturer, SCRRA designation, form designation and date/month/year of manufacture as detailed on the SCRRA Engineering Standard drawings ES 2402, ES 2403, ES 2406 or ES 2407 as appropriate.

CONSTRUCTION

Testing and inspection shall conform to AREMA Manual, Volume 1, Chapter 30, Part 2, Evaluation Tests for Tie Systems and Para 5, Section 4.9, Testing of Monoblock ties, unless otherwise modified by these Specifications.

Full compensation for evaluation tests shall be considered as included in the contract unit price paid for concrete ties and no additional compensation will be allowed therefore.

Ties may be inspected by the Engineer at suitable and convenient places either at points of shipment or destination.

The Engineer reserves the right to examine any equipment used for any manufacturing process at any stage of tie production.

Material not meeting the requirements of this Specification shall not be used in the work.

Quality Control Program

Contractor must comply with the following Quality Control Program requirements.

A quality control program under which the manufacturer will perform sufficient inspection and tests of items of work, including those by suppliers or subcontractors in order to ensure conformance to applicable standards, Specifications or plans with respect to materials, workmanship, fabrication, and identification.

The control plan shall provide for:

- A. Manufacturer's surveillance (e.g. but not limited to shoulder inserts, wire).
- B. Drawing- control (changes).
- C. Mold Certification.
- D. Document control.
- E. Inspection procedures - in process and final.
- F. Production test requirements.
- G. Segregation and disposition of defective material and products.
- H. Material and process control in plant identifying critical control points.
- I. Production equipment and instrumentation calibration, maintenance, and data recording.
- J. Work procedures and instruction.
- K. Failure reporting analysis and corrective action.
- L. Sample plans and quality levels shall conform to Military Standard 105D, AQL Level H unless otherwise stated or approved.
- M. Raw materials standards and controls.
- N. Records of test and inspections.
- O. Time and temperature control.
- P. Strength testing.
- Q. Storage handling and shipment controls.
- R. Procedures or tests for determining within 24 HOURS that the conditions necessary to achieve the 28-day strength have been met, with a margin of safety.
- S. Quality budget in percentage of contract price.
- T. Assurance that the plant will meet and continue to meet PCI certification.
- U. Quality control organization chart showing QC personnel and their corresponding contact level at SCRRA. QC organization must report independently from Production to Project Manager level or above.

The person responsible for quality control shall be independent of production management and shall report functionally to the manufacturing, company's senior management.

Production Program

Contractor must comply with the following Production Program requirements. A complete production program shall include:

- A. Plant layout.
- B. Form design with tolerances.
- C. Raw material requirements.
- D. Primary and alternate sources.
- E. Material handling.
- F. Material placement with tolerances.
- G. Curing method.
- H. Bond release method.
- I. Method of vibration.
- J. Pretensioning and detensioning method for strand or wire.
- K. Daily production capability.
- L. Finished tie inventory plan.
- M. Plan for handling ties from finished product to assigned rail cars or alternate transportation arrangements.
- N. Flow chart of production process indicating points of control for significant operations.

MEASUREMENT AND PAYMENT

The contract unit price paid for Concrete Ties includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in Concrete Railroad Tie, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

14-1.05 WOOD RAILROAD TIE

GENERAL

Summary

This Section specifies the Material requirements and performance criteria for the production and inspection of the wood railroad ties to be furnished and installed in accordance with the Contract Documents.

Work included in this Section encompasses work necessary for the manufacturing, production and handling of wood switch ties, crossties, and grade crossing ties. Requirement for the placement of these wood ties and the measurement and payment provisions are specified in the applicable trackwork sections of these Specifications.

Submittals

Compliance

Manufacturer or Supplier's certification that the materials delivered to the site are in compliance with the Specification.

Tests

Certified test results, as required to demonstrate compliance of materials specified herein must be submitted to the Engineer before any wood ties are used in the Work.

On-Site Storage and Handling

Ties shall be stored to avoid contamination of water and soil by the ties.

Long-term ties storage shall not be located within 250 feet of an open road crossing on residences.

Ties temporarily located within 250 feet of a public road crossings or residences shall be covered by an impervious sheet material to control odor and vapor emitted by the crossties.

Quality Control and Assurance

Testing and inspection of tie manufacture shall be performed by Contractor in conformance with AREMA Manual, RTA and AWPA.

Ties may be inspected by the Engineer, at suitable and convenient times and places including points of manufacture, shipment, or destination.

The Engineer reserves the right to examine any equipment used for any process or method of treatment at any stage of tie production.

Materials not meeting the requirements of this Specification shall not be used in the Work.

The Engineer shall have access to Manufacturers' plant during normal working hours and Project related procurement and production records for inspection during the Contract period of performance.

MATERIALS

Products

The following hardwood species can be used for crossties, and grade crossing ties:

Oaks, Elms, Hickories, Cherries, Walnuts, Oak-Hickory Group: Red Oak, White Oak and Hickories.

Mixed Hardwoods Group: Gums, Ashes, Cherry, Walnuts, Birches, Maples, Beech, Locusts, Sycamore, Elms And Cypress.

The following species are not acceptable:

Douglas Fir, Hem-Fir, Ponderosa Pine, Lodge pole, Pine, Larch, Oak-Hickory Group: Live Oak and Blackjack Oak.

Mixed Hardwoods & Softwoods: Douglas Fir, Hem-Fir, Ponderosa Pine, Lodge Pole, Pine, Larch, Cottonwood, Willow, Basswood, Hackberry And Poplar.

Oak and elm ties shall be of compact wood throughout the top fourth of the tie.

Crossties shall be the full length specified, double end trimmed, and must have full body and full face.

Ties with greater than 1 inch of wane within the 20 inch and 40 inch rail-bearing sections, when measured from the center of the tie, are not acceptable.

Thickness and width tolerance shall be not more than ¼ inch thinner or narrower than the specified size.

Contractor must provide a maximum of 50 percent of the ties from oak species and the remaining 50 percent from mixed hardwoods from list of ties specified in this specification.

Oak ties must be air seasoned Unless otherwise directed by the Engineer and preapproved and specified in writing.

Mixed Hardwoods may be either air seasoned unless otherwise directed by the Engineer and preapproved and specified in writing.

General Tie Requirements

Wooden ties shall be made from sound, straight, live timber and shall be free from defects that may impair their strength or durability, such as bark, splits, shakes, large or numerous holes or knots, pitch seams, pitch rings, slanting grain or other imperfections.

Decay or insect damage in any form is not acceptable.

Ties shall be well sawn on sides and cut square at the end to the full dimensions specified.

Ties shall be straight and opposite faces shall be true and parallel, and with bark entirely removed.

Ties shall be straight.

A tie shall be considered straight when:

- A. Timber Cross Tie: When a straight line from a point on one end to a corresponding point in the other end is no more than 1- ½ inch from surface at all points.
- B. Timber Switch Ties: When straight line from a point on one end to a corresponding point on the other end is no more than 2 inch from the surface at all points.

A tie is not well sawn when its surfaces are cut with score marks more than 1/2 inch deep, or when its surfaces are not even.

The top and bottom of a tie shall be considered parallel, if any difference in the thickness at the sides or ends does not exceed 1/8 inch.

For proper seating of nail plates, tie ends must be flat and will be considered square with a sloped end of up to 1/2 inch, which equals a 1 in 20 cant.

Ties must be marked with saw kerf mark on the sap side, line end of the tie, not to exceed 1/4 inch in depth and 1/4 inch in width.

The kerf mark will indicate heart side down when tie is installed.

If no end plate is installed, the tie must be stamped or branded "SCRRA" and the manufacturer followed by the year of manufacture on the sap side on the end of tie.

The stamp or brand must be applied so the lettering and date are right side up when the tie is properly installed.

Anti-Splitting Devices

Anti-splitting devices are required.

Anti-splitting devices (end plates) shall be multi-nail plates as specified in AREMA Manual, Volume 1, Chapter 30, Part 3.1.6, Specifications for Devices to Control the Splitting of Wood Ties.

Structural type, Grade "C", 18 gauge galvanized steel, ASTM A653 or better with ultimate strength of 55,000 pounds per square inch and yield strength of 40,000 pounds per square inch.

Galvanizing per ASTM A653, G60 coating.

4-5 teeth per square inch.

½ inch to 9/16 inch length of tooth.

This application must enable the plate to hold both vertical and horizontal splits.

End plates shall be applied by a mechanical device capable of squeezing any splits; bringing the tie back to its original (cross section) dimensions prior to application.

End plates for 7 inch x 9 inch ties are to measure 6 inch x 7 inch or 6-1/4 inch x 7 inch.

No part of the end plate is to be within 1/4 inch of any side.

Anti-split end plates shall have rounded corners and a smooth perimeter.

Embossed on all end plates will be "SCRRA" and manufacturer followed by the year of manufacture. End plates shall be installed with the letters "SCRRA" upright with the tie oriented with heartwood down.

Dimensions

Crossties shall have a 7 inch x 9 inch cross-section and shall be double end trimmed, unless otherwise ordered.

Length of ties shall be as ordered in each shipping release.

Ties will be ordered as 9 feet or in one foot increments from 9 feet to 24 feet

The length, thickness, and width specified are minimum.

Ties over 1 inch longer, thicker or wider shall be rejected.

Tie dimensions shall not be averaged.

Preservative

The preservative shall consist of a mixture of 50 percent by volume of P-1 creosote oil conforming to AWWA Specifications (AWPA P3 and AWWA P4), and 50 percent by volume of an approved petroleum residuum oil.

The creosote and oil shall be thoroughly mixed in the working tank until the mixture is of uniform composition. (Note: use of treatment with P-2, 7 pounds per cubic foot is an approved equal).

The residuum oil shall be approved asphalt base petroleum residuum oil.

It shall be free from water and any foreign substance that might interfere with its penetrating qualities.

The flash point of the residuum oil shall not be less than 210° Fas determined in the Cleveland Open Cup.

The viscosity of the residuum oil shall be such that a blend of 50 percent residuum oil and 50 percent creosote shall have a viscosity exceeding 50 seconds Saybolt Universal 180° F.

BS&W shall not exceed 1 percent and the creosote oil mixture shall show no sludge formation upon standing. (Note: AWWA P4 is acceptable as an approved equal for residuum oil).

Approvals and Rejections

Ties with any type of decay will be rejected.

Rejection of ties for holes and knots. Holes and knots will be allowed if they occur outside the sections of the tie between 20 inch and 40 inch from its middle.

A large hole is a hole more than 1/2 inch in diameter and 3 inch in depth within the rail bearing area, or more than 1 inch diameter and 3 inches deep outside the sections of the tie between the 20 inch and 40 inch rail bearing area measured from the center of the tie.

"Numerous holes" are any number of holes equaling a large hole in damaging effect. Such holes, whether caused in manufacture or otherwise, will be cause for rejection.

A "large knot" within the rail bearing area is one whose average diameter is more than 1/3 the width of the surface on which it appears. "Numerous knots" are any number, which, in total, equal a large knot in damaging effect. A cluster of knots will be judged as if it were a large knot in damaging effect.

Ties with shake wide or more than 1/3 the width of the tie, and nearer than 1 inch to any surface, will be rejected.

Fire scar will be considered as shake.

Except in woods with interlocking grain, ties with a slant grain in excess of 1 in 15 will be rejected.

Ties with continuous checks whose depth in a fully seasoned or treated tie is greater than 1/4 the tie thickness and longer than 1/2 the length of tie will be rejected.

Do not count the end as a surface.

Any other imperfections that are within the limits of current AREMA and RTA Specifications will be allowed.

A split is a separation of the wood extending from one surface to an opposite or adjacent surface.

A split 1/8 inch wide and 4 inch long in an unseasoned crosstie is acceptable.

A split more than 1/4 inch wide or 9 inch long on the face on which it occurs in a seasoned crosstie will be rejected.

Stump pull will be graded the same as a split in the end of a tie.

A stump pull that goes into the interior of the tie more than 5 inch will be rejected.

Bark seam or pocket is a patch of bark partially or wholly enclosed in the wood.

Bark seams will be allowed outside the rail bearing area provided they are not more than 2 inch below the surface, 1/4 inch wide, and not more than 5 inch long.

Ties with heart-checks that go into the tie plate area will be rejected if the check is more than a cumulative 1/2 inch wide or if the check causes the plate area to be concave/convex.

Holes

Ties having solid holes on any surface within the rail bearing areas greater than 1/2 inch diameter and greater than 3 inch deep will be rejected.

Ties having solid holes on any surface outside the rail bearing areas greater than 1 inch in diameter or greater than 3 inch deep will be rejected.

Stump pull will be graded the same as a split in the end of a tie.

A stump that goes into the interior of the tie more than 5 inch will be rejected.

Numerous holes are defined as having any number equaling a large hole in damaging effect. Such holes may be caused in manufacture or otherwise.

Mechanically damaged ties shall be replaced by the party that damages the tie.

CONSTRUCTION

Treating plant shall be equipped with the thermometers and gauges necessary to indicate and record accurately the condition of stages of treatment, and equipment shall be maintained in acceptable, proper working condition.

Some green gross ties must be checked periodically for moisture content prior to going in the cylinder. Green ties must be checked periodically for moisture content prior to going in the cylinder.

Several borings shall be taken from crossties, so that the moisture content level can be measured, to determine the amount of water that is to be removed from the crossties. Twenty borings per charge shall be taken from crossties, so that the moisture content level can be measured, to determine the amount of water that must be removed from the crossties.

Material shall be conditioned by air seasoning.

Material, either under vacuum or at atmospheric pressure, must be handled in a manner that will not cause injuries, checking splitting, warping or render it unfit for the service intended.

When air seasoning is used, material shall be treated before it begins to deteriorate. Air seasoned material may also be given a preliminary heating in the preservative for not more than 6 hours at a temperature of not more than 210° F, just before the regular treating operation.

Oak/Hickory ties will be seasoned for approximately 10 months to obtain moisture content not to exceed 45 percent on 2 inch cores.

Mixed Hardwood ties will be seasoned for approximately five months to obtain a moisture contents not to exceed 40 percent on 2 inch cores.

Boultonizing

Ties shall only be Boultonized as directed by the Director System Maintenance and Rehabilitation of Metrolink or his designated representative. Crossties and switch ties scheduled for Boultonizing shall be separated by size and species, incised, and forwarded to taming station for handling prior to initiation of the drying process. Hickory ties must be Boultonized with oaks. Each layer of ties on the tram shall be separated with one 3/4 inch steel cable, steel rod, or 1/4 inch Grade 30 steel chain placed on alternate ends as the layers are built. Switch ties will require two cables, rods, or chains per layer for 9 feet – 12 feet, and three cables, rods, or chains per layer for 13 feet – 16 feet +lengths. Steel or wooden stickers must be removed prior to shipment to Metrolink.

When boultonizing, the oil shall cover the material in the cylinder.

The temperature of the oil during the conditioning period shall not exceed 210° F.

If a vacuum is then drawn, it shall be of sufficient intensity to evaporate water from the material at the temperature of the oil.

The intensity of the vacuum or the temperature of the oil, or both, shall be adjusted so as to regulate the evaporation of the water satisfactorily.

The conditioning shall continue until the material is sufficiently heated and enough water removed from the cylinder before an empty-cell process is applied.

The Boulton process used is to conform to AWPA section C1-00 Section 1.3.3, most recent version.

Maximum moisture content is to be 50 percent for oak-hickory and 40 percent in mixed Hardwoods before press cycle begins.

Manner of Treatment

Following the conditioning period, material shall be treated by an empty-cell process to obtain as deep and uniform penetration as possible with the retention of preservative stipulated.

The range of pressure, temperature and time duration shall be controlled so as to get the maximum penetration by the quantity of preservative injected.

Empty Cell Process (Lowry and Rueping)

Treatment shall be by the empty cell method with a creosote/coal tar solution or creosote/petroleum (50 percent – 50 percent) solution in accordance with AWPA Standard P-2, P-3, AND P-4. The preservative solutions shall be tested monthly according to AWPA Standard A-1 with a copy of the results forwarded to the Metrolink representative. In no case shall treatment be less than that required for AWPA U1, UC4B.

Material shall be subjected to atmospheric air pressure or to higher initial air pressure of the necessary intensity and duration.

The preservative shall be introduced until the cylinder is filled while the air pressure is being maintained during the filling operation.

The Pressure shall be raised to not more than 250 pounds per square inch.

Material shall be held under pressure until there is adequate preservative injected to meet specified retention.

The temperature of the preservative during the entire pressure period shall not be more than 210° F but shall average at least 180° F.

After pressure is completed, the cylinder shall be emptied speedily of preservative, and a vacuum of not less than 22 inch at sea level created promptly and maintained until the wood can be removed from the cylinder free of dripping preservative, or;

After pressure is completed, and before removal of preservative from the cylinder, the preservative surrounding the material may be preheated to a maximum of 215° F, either at an atmospheric pressure or under vacuum; the steam to be turned off the heating coils and the leader lines opened immediately after the minimum temperature is reached.

The cylinder shall then be emptied speedily of preservative and a vacuum of not less than 22 inch at sea level created promptly and maintained until the wood can be removed from the cylinder free of dripping preservative.

At the completion of treatment, material may be cleaned by final steaming, when authorized, at not more than 240° F for not more than 30 minutes.

Results of Treatment and Retention

No charge shall contain less than 75 percent nor more than 110 percent of the quantity of preservative specified for the class of material except when the character of the wood in any charge makes these requirements impracticable despite treatment to refusal.

The amount of preservative retained shall be calculated from readings of working tank gages or scales or weights before and after treatment of loaded trams on suitable track scales, with the necessary corrections for changes in moisture content.

The column of oil preservatives shall be calculated on the basis of 100 ° F.

Calculations of volume or weight shall be made by the use of temperature of specific gravity factor contained in the Volume of Specific Gravity Correction Tables of the AWPA.

Penetration

Penetration of ties shall not be less than the following for at least 80% of the pieces bored in each charge.

Thickness (Inches)	Depth (Inches)	Percent of Sapwood (%)
5 and over	1/2	90

Penetration of ties shall be determined by boring not less than 2 ties in each tram in each charge.

Penetration of timber and ties shall be determined by boring approximately midway between ends.

Only material meeting the penetration requirements shall be accepted.

Any charge not conforming to stipulated minimum requirements may be retreated and re-offered for acceptance.

Any holes, which may be bored, shall be filled with tight fitting treated plugs.

Process and preservative to be used on material and retention required shall be as follows, unless otherwise specified, for ties.

Type of Wood	50% Creosote/50% Oil	Process
Hardwood	7-1/2 pounds or ref.	L&R
Oak	7-1/2 pounds or ref.	Bethel or L&R

Retention will be determined by gauge. The amount of preservative solution retained shall be determined from readings of working tank gauges or scales made before and after treatment. The retention of preservative will be calculated after correcting the volume of preservative solution to 100° F.

Care of Treated Wood

In handling treated material, extreme care shall be used to avoid damage to the edges of the timbers or breaking through the portions penetrated by the treatment and exposing untreated wood.

The use of peaveys, timber dogs, picaroons, log hooks, or other pointed tools shall be such as not to break through the treated portion of treated timber.

Plant Storage

The storage yard for seasoning shall be in the open where the air current will circulate freely; shall not be in a low humid situation if it can be avoided; shall have good drainage; and shall be kept free from vegetation and debris, especially from scrap wood already infected with decay.

Treated materials shall be stored in a similar manner to untreated, but must not be piled in same area with untreated Materials.

Unseasoned material must be stacked separately from seasoned or partly seasoned Material.

Stacking

Sawn ties shall be stacked either 1x9 or 2x9 standard stacking method.

If necessary to retard evaporation of moisture, ties may be stacked parallel on edge, using crossties as separators.

Remove bark and inner skin before treatment.

Ties shall be delivered to the project site to locations indicated on the plans, in the Contract Documents or as required by the Engineer.

Banding of ties by length or grade for shipment shall be done by applying bands in a tight manner (2,500 pounds of tension) to prevent warping, splitting, and slipping during storage or shipment. Two steel bands per bundle (T= 5,450 pounds, 1 ¼ inch x 0.029 inch or better) shall be applied within one foot of each end of crossties or switch ties. These bands shall be applied to bundles of switch ties. No more than 9 switch ties shall be bundled together. No more than 25 crossties shall be bundled together.

No steel cables, steel rods, chains, or wooden strips, or any other sticker material shall be shipped in any bundle to Metrolink.

Rejects shall be marked with an "X" on the end. This is to preclude the accidental shipment of less than grade ties to Metrolink. Treated ties not handled directly from tram to car shall be carefully and neatly stored. Different size classifications shall be kept separate, and bundles or stacks shall be marked with Metrolink, grade or length, and treatment date. Ties shall be stacked to ensure that tie straightness is not impaired during temporary storage. Treated stringers shall be placed underneath stacks of treated ties. No loose windrows of Metrolink treated ties will be allowed. Shipments shall be made from the oldest stacks first. If ties become excessively bleached during storage, they shall be retreated or replaced by the supplier. Yard drainage conditions shall provide rapid drainage of water from beneath stacks of treated ties. Storage areas shall be kept free of grass and weeds. The Contractor shall be liable for fire damage. A minimum 10 foot weed-free zone shall be maintained around Metrolink stored inventory. Care shall be exercised in handling of Metrolink ties for storage or shipment to prevent damage.

PAYMENT

The contract unit price paid for Wood Ties includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in Wood Railroad Tie, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

14-1.06 GENERAL SIGNAL REQUIREMENTS

GENERAL

Summary

The work in this Section includes, but is not limited to, general procedures and requirements and incidental to the planning, manufacturing, installation, removal, relocation, modification, testing, placing in service, and documentation of as-built conditions of the various signal systems.

Modify existing equipment and material as shown on the railroad plans to interface with the existing and proposed signal system.

Definitions

Owner-furnished materials for signal systems, if provided, along with delivery points or location of this material for pickup, is listed in the Special Conditions. Refer to Special Provision, State-Furnished Materials, for responsibilities for receiving, accepting, and transporting Owner-furnished materials. Assemble and install this material as shown on the railroad plans.

Provide additional materials and installation services required for complete working signal systems, as described herein, and as shown on the railroad plans, including equipment not designated as being relocated or designated as Owner-furnished or in these specifications.

Materials and equipment for installation and for interconnection of the various signaling systems shall be fabricated, furnished, and installed as indicated on the railroad plans and specified herein.

The railroad plans represent a final design utilizing systems, components, and materials that meet the Contract Specifications. Contractor may provide equivalent systems, components, and materials subject to the approval of the Engineer. If equivalent systems, components and materials are provided, the Contractor shall provide an alternate detailed final design as specified herein under Design Submittals.

Provide systems that are compliant with applicable rules and regulations of CFR 49, parts 234 and 236, and CPUC GO 75D. Refer to Design Submittals herein for Contractor's responsibility to indicate corrections or modifications to the railroad plans final design that the Contractor may determine are required to conform to these rules and regulations.

Be present at design meetings held with the Engineer by a signal engineer qualified in the design and application of the signaling equipment the Contractor proposes for use on this project.

No circuit is considered to have met the requirement of these Specifications for function and safety until it has been tested and verified in the field. Circuit changes made to meet the functional and safety requirements of these Specifications shall be considered as included as part of the work.

Provide continuous train control and highway grade crossing warning during all phases of rail construction. The work of the Contractor must not cause delay to train operations, cause an unsafe signaling condition, or reduce the effectiveness or quality of grade crossing warning systems. The Contractor shall submit, for approval by the Resident Engineer, its proposed plan for providing alternate methods of crossing warning whenever the existing automatic crossing warning devices are deactivated, altered, or modified in order to accommodate construction work. Alternate methods shall conform to CFR 49, Part 234, and all local ordinances.

Refer to Design Submittals herein for requirements for submittal of plans for providing wayside signaling and highway crossing warning systems protection during the work and plans for point protection and fouling when crossovers are installed or removed. Alternate methods shall conform to CFR 49, Part 234, Part 236 and local ordinances.

Provide rail bonding for new, temporary and relocated turnouts as shown on the railroad plans or as required by the Engineer. Provide rail bonding, as necessary, to maintain existing systems during construction of all work including other disciplines.

Protect existing signal cabling and, where necessary, relocate existing cabling in order to prevent damage during track installation and surfacing. In the event that the Contractor damages existing cabling, the Contractor shall be responsible for all repairs, testing and replacement, if necessary, to existing cabling.

Provide all new signals, new foundations, new cabling, and other new equipment as shown on Drawings. The Contractor shall remove and reuse existing signaling equipment as indicated on the Drawings and in these specifications.

Refer to Special Provision, Project Record Documents, and additional requirements specified herein. Record the final As-Built conditions of the signal systems for each system.

Perform and document tests and inspections in accordance with CFR 49 regulations, the AREMA C&S Manual, the "Instructions Governing Installation, Maintenance, Inspection and Testing of Signal Apparatus and Signal Systems", and these special provisions.

Refer to Special Provision, Contractor Qualifications and Requirements, and requirements specified herein. Provide at least one qualified signal person to accompany on-track equipment, and remove, relocate, or disconnect and reconnect signal equipment that could be damaged by on-track equipment.

Coordinate installation, inspection, and testing of new Owner-furnished material with the Engineer. Notify the Engineer in writing 30 days prior to installation, inspection, and testing as part of this coordination.

Perform acceptance testing and commissioning of the signal system as a normal part of the work.

Contractor furnished software and components shall be new and manufacturer certified.

Remove, salvage, retire, relocate, furnish, and install project related devices as indicated in the Contract Documents and as required to complete the Work.

To retire a grade crossing or a control point, first bulletin it as retired and then take temporary measures with the existing equipment, as required, before removing and salvaging it.

Refer to Special Provision, Earthwork, for provisions for excavation and requirements for shoring of excavation as specified in Special Provision, Excavation and Fill Support Systems.

Refer to Special Provision, Earthwork and Special Provision, Coordination with Utility Owners, for requirements in locating and protecting existing utilities. Details of signal cable runs, conduit runs, and pullbox installations including number, size, and type of cable are shown in the signal drawings of the railroad plans. Information regarding new conduit runs and pullbox installations appear elsewhere in the railroad plans. Conduit runs and pullbox locations, as shown, are the preferred locations. In case of conflict between the signal drawings and other railroad plans, the signal drawings take precedence as to detail, and in the event of conflict as to placement of equipment, the Engineer will determine the correct placement.

Make any minor deviations in location, minor meaning within 10 feet of the location as shown on the civil drawings of the railroad plans, as part of the work. Deviations in excess of 10 feet may be subject to the changes provisions of General Conditions.

Underground signal cables shall be in conduit except for the final connection of the twisted 2 conductor number 6 track cable to the twisted flex to the rails.

Components or equipment proposed by the Contractor as an equal to those specified in these specifications, which are not currently in use on the Metrolink system or that do not have spare maintenance parts in SCRRA stocks, will require that the Contractor furnish sufficient spare components equal to 10% of the quantity order or a minimum of 2 additional units, whichever is greater. The Contractor shall arrange for manufacturer provided training for Metrolink maintenance personnel. Spares and training must be furnished by the Contractor at no additional expense to SCRRA.

Provide construction signal support and coordination of all work with other disciplines including but not limited to track installation and removal, bridge construction or reconstruction, rail and track renewal within crossings, installation or change of track switches, clearing and grubbing. Contractor shall coordinate all work with other disciplines that may affect the existing crossings and track circuits in order to prevent train delays or inconvenience to the public.

Fail-Safe Design Requirements

As used in these specifications, the fail-safe principle shall mean that whenever an equipment failure, human error or failure to act, or adverse environmental condition affects the specified operation of a system involved with the safety of life or property, that system shall revert to a state known to be safe.

Failure of a circuit or equipment that results in an indication of a dangerous or restrictive condition, whether or not there is actual danger, shall have met the fail-safe requirements. Conversely, a failure that results in an indication of safe or nonrestrictive condition when, in fact, a dangerous condition may exist shall not have met the fail-safe requirements.

Vital applications, such as detector locking of switches, shall be based on the following principles that permit the attainment of fail-safe operation in known or discovered failure modes:

1. Closed Loops: Fail-safe circuits shall employ the closed loop principle and shall protect against open circuits, shorts, or combination thereof.
2. Vital Relays: Relays used in vital circuits.
3. Vital Circuits: Line circuits which energize a vital relay shall be two-wire, double-break circuits and shall be energized from an ungrounded direct current (dc) power supply.
4. Grounds: Components or wires becoming grounded shall not cause an unsafe condition.
5. Spurious Oscillations: Any amplifier, generator, or device element, active or passive, breaking into spurious oscillations shall not cause an unsafe condition.
6. Filters: Filters used in fail-safe circuits shall be designed to prevent undesired signals from appearing at the filter output at levels which could cause an unsafe condition.

Equipment failures and conditions which shall be considered in producing a fail-safe design shall include the following, at minimum:

1. Relays (non-vital): Open coil, fused contacts, high contact resistance, shorted coil, armature sticking, contacts sticking, or broken spring.
2. Relay (vital as defined by the AREMA C&S Manual): Open coil, shorted coil, or high contact resistance.
3. Transformers: Open primary, open secondary, shorted turns, primary-to-secondary shorts, or combinations thereof.
4. Capacitors: Short, open, or leakage.
5. Resistors: Increase or decrease in resistance.
6. Transistors: Short, open leakage, or loss of Beta.
7. Diodes: Short, open, or reverse leakage.
8. Coils: Open or shorted turns.
9. Loss or degradation of power sources.
10. Appearance of abnormal signal levels, electrical noise levels, frequencies, and delays.
11. Effects of electrical interference.
12. Absent or abnormal input signals.
13. Opens or shorts in internal circuitry at inputs and at outputs.
14. Mechanical vibration or shock.
15. Drift or instability of amplifiers, receivers, transmitters, oscillators, switching circuits, and power supplies.
16. Deterioration of contacts, connectors, terminals, solder connections, printed circuits, circuit adjusting devices, and mechanical devices.

Fail-safe equipment proposed for vital signaling applications shall have been proven with 5 years of successful rail service operation in the United States of America.

Environmental Parameters for Equipment

Contractor provided material and equipment shall be fully operable with no impairment resulting from the effect of the environment throughout the range of worst values indicated below. The general operating environment shall be considered to be in salty atmosphere and in generally sunny weather.

Ambient outdoor temperature range: From minus 40 degrees F to plus 160 degrees F.

Relative humidity range: From zero to 100 percent.

Maximum rainfall: 4 inches in 24 hours and 1.5 inches in 1 hour.

Maximum wind velocity: 100 miles per hour.

Seismic Zone Location of Work Site: Seismic Zone 4 as defined in the Uniform Building Code.

Isokeraunic Level: Five per year.

Submittals

Do not begin any work without the prior submittal to and approval by the Resident Engineer of the relevant personnel, plans and procedures.

Submit résumés of the proposed Signal Engineer(s) and Signal Manager(s) within 14 calendar days after receiving Notice to Proceed.

Submit to the Resident Engineer for approval, proposed design changes, plans, test and inspection procedures, data sheets of proposed material, installation details, shop drawings, mechanical drawings, proofs of compliance with applicable standards, and any other pertinent data required to fully demonstrate the Contractor's proposed plan for the manufacture, installation, testing, and maintenance of the various signaling systems. The Contractor shall provide submittals within 30 calendar days after receiving Notice to Proceed.

Submit to the Resident Engineer 4 sets of application, installation, operating, and maintenance manuals of all new equipment and systems utilized under this Contract a minimum of 30 calendar days prior to placing any system in service.

Submit a detailed test plan for all systems a minimum of 60 days in advance of placing any system in service. These test plans shall reflect the latest revisions and changes approved by the Resident Engineer and made as a result of field checks and conditions. The Contractor shall not proceed with the cutover or in-service testing until the Resident Engineer approves the test plans. Plans shall include, but are not limited to:

1. Proposed plan for providing alternate methods of wayside signaling and highway crossing warning systems protection when signal components are relocated, deactivated, altered, or modified in order to accommodate construction work.
2. Plan for point protection and fouling when crossover or turnouts are installed or removed.

Prepare and submit a Signaling Construction Sequencing Plan for each location where a signal system is to be modified, installed, or removed. The Plan, as a minimum, shall contain the following:

1. A narrative description of the work to be undertaken at the designated location.
2. A step-by-step sequence of work description which identifies those steps during which the existing system will be disabled, and a description of what steps will be taken to assure that the signal system will be tested and returned to full operation without causing a delay to any train movement.
3. An estimate of time to complete the critical steps in the sequence specified in step-by-step sequence of work description.

Manufacturers' warranties and guarantees furnished for materials used in the work, instruction sheets, and part lists supplied with materials shall be delivered to the Resident Engineer prior to acceptance of the project. All equipment, material warranties, and guarantees shall cover parts and labor for two years from the date of final "acceptance".

After a location is placed in service and prior to final acceptance of the project, the Contractor shall submit as-built documentation as follows:

1. Detailed circuit drawings within 3 days.
2. Submit four copies of all as-built documents to the Resident Engineer within 3 business days.
3. Final application logic documentation within 3 business days.
4. Civil Drawings which show the physical location of all signal apparatus and conduits, both along the tracks and perpendicular to it, and heights of all signal structures within 60 calendar days.

Resident Engineer or his/her representative may inspect the Contractor's furnished materials and work procedures during all phases of construction. Materials and procedures that fail to meet the requirements of these specifications, or regulations, shall not be installed or placed in operation.

Ensure that equipment used in the testing of wayside signal and grade crossing warning systems and components shall be in proper calibration. Test meters and other test apparatus shall have been inspected by a recognized facility that performs calibrations for proper calibration a minimum of 6 months prior to performing required tests. A sticker, or other documentation, must be made available for inspection at the request of the Resident Engineer.

Qualifications and Duties of Signaling Personnel

Refer to Special Provision, Contractor Qualifications and Requirements. Key employees of the Contractor engaged in the final adjustment and testing of the various signaling systems shall be qualified and have had experience on an operating railroad in the type and level of signal installation and testing work as required herein.

Signal Engineer as used herein shall be understood to mean Contractor's railroad signal engineer or engineers approved by the Engineer. Signal Manager as used herein shall be understood to mean Contractor's railroad signal manager or managers approved by the Engineer. Signal Electrician, as used herein, shall be understood to mean Contractor's electricians used to perform wiring and installation of railroad signal and grade crossing warning system circuits, component, and control equipment and devices including their primary and backup power supply systems.

Signal construction and installation personnel shall work under the authority of the Signal Engineer. The Contractor's signaling construction forces shall work under the authority of a Signal Engineer.

Signal Engineer shall plan, direct, and oversee the adjustment, installation, and testing of signal related work and shall coordinate signal work with related track construction work and roadway work.

Signal Engineer shall be responsible for work under his charge and must have the authority to remove personnel from the project who are not performing the work in a satisfactory manner. The Signal Engineer shall obtain, review, and maintain documentation of the required minimum experience, a copy of the Electrician's licenses, and a record of wage rate paid for each Signal Electrician that performs Signal or Crossing Warning System work prior to that Electrician starting any Signal related work. This documentation shall be available for review by the Engineer upon request.

Signal Engineer shall be on site whenever signal related work or track construction work is in progress in the vicinity of existing wayside signaling equipment, highway grade crossings, and/or cabling.

The Signal Managers shall report to and work under the direct authority of the Signal Engineer and shall supervise and direct the work of signal construction and installation personnel.

Signal Engineer shall direct and organize the performance of tests on signaling equipment and systems, under direction of the Engineer, prior to releasing the systems for service. The Signal Engineer shall be responsible to ensure that applicable test documentation other than that documentation provided by the Engineer, is completed prior to, or immediately after, in-service testing is completed.

The proposed Signal Engineer shall demonstrate experience in the philosophy, application, and testing requirements of the various signaling systems. The proposed Signal Engineer shall have a minimum of 10 years signal supervisory or management related experience on a Class I railroad, or commuter railroad comparable to SCRRA. The proposed Signal Engineer shall also demonstrate knowledge of the governing General Code of Operating Rules, including CPUC and FRA regulations and procedures. This demonstration shall be by interview of the proposed Signal Engineer by the Engineer prior to commencement of any work that may affect the signal system. The work of this project includes working within tight windows on a live railroad consisting of freight trains, inter-city passenger trains, and Metrolink commuter trains. Candidate shall have a similar level of experience. The Engineer's decision concerning the candidate's qualifications will be final. Begin no signaling related work prior to obtaining Engineer's approval of the Signal Engineer. In addition, obtain the Engineer approval of each Signal Engineer prior to beginning any work that may affect the signal system. Obtain approval of and provide additional Signal Engineers as required depending upon the level and type of work being performed. Propose alternate personnel if the original candidate is found unacceptable.

The proposed Signal Managers shall demonstrate experience in the philosophy, application, and testing requirements of the various signaling systems. The proposed Signal Managers shall have a minimum of 3 years signal supervisory or management related experience on a Class I railroad or commuter railroad comparable to SCRRA. The proposed Signal Managers shall also demonstrate knowledge of the governing General Code of Operating Rules, including CPUC and FRA regulations and procedures. This demonstration shall be by interview of the proposed railroad Signal Managers by the Engineer prior to commencement of any work that may affect the signal system. The work of this project includes working within tight windows on a live railroad consisting of freight trains, inter-city passenger trains, and Metrolink commuter trains. Candidates shall have a similar level of experience. The Engineer's decision concerning the candidate's qualifications will be final. Begin no signaling related work prior to obtaining the Engineer's approval Signal Managers. Obtain approval of and provide additional Signal Managers as required depending upon the level and type of work being performed.

Propose alternate personnel if the original candidate is found unacceptable. Previous qualification as a Signal Engineer or Manager on other Metrolink projects does not constitute qualification as a Signal Engineer or Manager for this Contract.

The Engineer reserves the right to disqualify a Signal Engineer, Signal Manager, or Signal Electrician during the course of the Work at the discretion of the Engineer and is not subject to protest or appeal.

The Signal Electricians shall have a minimum 1,000 hours of experience in the wiring and installation of railroad signal and grade crossing warning system circuits, components, control equipment and associated devices including their primary and backup power supply systems. Signal Electricians shall perform the wiring, labeling and connection/continuity/resistance testing, as appropriate, of railroad signal and grade crossing warning system circuits, components, control equipment and associated devices including their primary and backup power supply systems. Signal Electricians shall be licensed: Journeyman or Inside Electricians or an approved equal. Signal Electricians shall be paid at the prevailing wage rate for the locality of the construction.

Contractor field personnel shall receive safety training in accordance with Special Provisions, Contractor Qualifications and Requirements, SCRRRA Site Safety Requirements, and Worksite Security Requirements.

Quality Control and Assurance

Not Used.

MATERIALS

Deliverables

Submit manufacturers' warranties, instruction sheets, and part lists supplied with materials to the Engineer prior to Final Acceptance.

Operation and Maintenance Data: As specified in Special Provision, Submittal Procedures, for Operations and Maintenance Data Manual requirements. A minimum of 30 days prior to placing a system in-service, submit to the Engineer 10 sets of application, installation, operating, and maintenance manuals of new equipment and systems utilized under this Contract which are provided by the Contractor. Include complete material ordering reference numbers for each type of product.

Warranty

Provide warranties for all equipment and material covering parts and labor for 2 years from the date equipment or material is "placed in service".

Equipment

General

Signaling 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. The materials and equipment shall have shown proven performance in North America for a minimum of 5 years. Materials and equipment shall be delivered to the job-site in unbroken packages, reels, or other forms of containers.

Materials and equipment shall conform to the recommendations of AREMA Signal Manual, except as modified in the Specifications and railroad plans.

Reference to specific equipment and manufacturers is intended to establish quality, overall design, and fit, subject to compliance with criteria specifications. Equipment equal to or exceeding the specifications and requirements may be used subject to the Engineer's written approval. If alternate equipment is accepted, perform necessary work to fit the alternate equipment to these specifications and to revise the railroad plans.

Electrical and Electronic Components

All Contractor provided electrical and electronic component materials furnished under this Contract shall be new. Design and construct fusing of DC power supplies and circuitry according to the following requirements:

1. Circuit breakers and fuses shall be the correct side-band rating for circuit current interruption and shall protect the electrical equipment and circuits from short-term and long-term overloads.
2. Fuses shall be sized to protect the wire.
3. Fuses shall be in the positive leg of the power supply.
4. Fuses shall be of the nonrenewable indicating type.
5. Branch feeds for a circuit shall be from the same fuse.
6. Loads shall be divided so that no normal operating current is more than 75 percent of the fuse rating.
7. Fusing shall be functionally oriented to minimize the equipment affected by a blown fuse (i.e., per track, switch control circuits, etc.)
8. Fuse clips shall be constructed to retain their resilience under installation and service conditions and to ensure a positive contact between the clips and the fuse.

Printed Circuit (PC) Cards and Connectors:

The PC cards shall be mounted in 19-inch card files unless otherwise approved by the Engineer.

The PC wiring shall be organized so that wires serving the same function shall be connected to the same terminal of PC cards. PC cards containing the same circuitry and programming, where applicable, shall be interchangeable between subsystems.

The design and construction of PC cards of the same subsystems shall be the same. Cards of different subsystems shall be of the same design and construction wherever practicable.

PC cards shall be of glass epoxy construction. Card material shall meet the requirements of NEMA, Type FR-4. Cards shall have sufficient thickness to permit easy insertion and removal, and shall be physically keyed to protect against incorrect interchange. Circuits shall be formed by etching. Conductor material shall be copper and shall be protected from exposure to air.

PC cards containing components that may be damaged if a plug connector or plug-in unit is removed while the equipment is energized shall be clearly identified in the equipment maintenance manual. PC cards shall be marked or labeled with a warning note on the individual board, be conspicuously located on the module, or by an alternate means as approved by the Engineer. A means shall be provided to remove power from the module or card file.

Components mounted on the PC card, weighing more than 1/2 ounce or with a displacement of more than 1/2 cubic inch, shall have a mechanical supporting attachment to the card separate from electrical connections.

Do no stacking or piggybacking of PC sections to accomplish changes or modifications to wiring or components on printed circuit cards.

Connectors shall have plating with a minimum thickness of 0.00005 inch.

Printed Circuit Card Files:

There shall be not more than one type of card file for each size of PC card. The card file plug boards shall be registered to agree with the registry of the associated PC card. PC cards shall not project beyond the front of the equipment rack when mounted in the card file.

Card files shall be installed in dust-proof cabinets and protected with dust covers.

Insulated cable clamping devices shall be located on the back of the file in such a way that wires terminating in the files shall be installed in a neat and secure bundle, rigidly supported, and protected to prevent chafing of insulation. Cabling provision on the file shall permit wires to enter or leave the file from both the right and left sides. Such cabling shall not restrict access to the card file when the rear covers of the card files are removed.

Shop Finishes

Factory finish signal equipment with the exception signal system parts which are stipulated as field finished in AREMA C&S Manual, Part 1.5.10, and aluminum alloy and galvanized metal components. If manufacturer typically provides factory painted finish for aluminum alloy and galvanized components, include such information in equipment submittals for Engineer's acceptance.

Finishes shall comply with AREMA C&S Manual, Part 1.5.10, signal equipment manufacturer's standards, and provisions specified herein. It shall be understood that where AREMA C&S Manual, Part 1.5.10, uses the word "should" that the word "shall" shall be substituted except as accepted by the Engineer in writing.

1. Finish terminal boards and interior of shelters with white gloss fire retardant paint.
2. Factory finish signal equipment with aluminum paint except as otherwise specified herein and in AREMA C&S Manual.
3. For signal system parts which AREMA C&S Manual stipulates as shop primed and field finish, shop prime in accordance with requirements specified in Special Provision, Paints and Coatings and Special Provision, Graffiti Resistant Coating.
4. For signal system parts which AREMA C&S Manual stipulates to receive shop prime and finish coats followed by field finish coat, coordinate shop finish coat with field finish as specified in Special Provisions, Paints and Coatings and Graffiti Resistant Coating.

CONSTRUCTION

Field Paint Materials

Field finish as specified in Special Provisions, Paints and Coatings and Graffiti Resistant Coating and AREMA C&S Manual, Part 1.5.10. Exterior surfaces shall receive heavy duty finish system.

Touch-up Paint for Signal Manufacturer Finishes: Touch-up paints recommended by signal manufacturer, including aluminum touch-up paint.

As-Builts Documentation

Refer to special provision, Project Record Documents, for requirements preparation and submittal of Record Documents.

The following as-built documentation requirements augment requirements specified in Special Provision, Project Record Documents. After a location is placed in service, submit as-built documentation as follows:

1. Detailed circuit drawings within 3 days.
2. Submit four copies of as-built corrections to the Engineer within 3 days.
3. Railroad Plans which show the physical location of signal apparatus and conduits, along the tracks and perpendicular to it, and heights of signal structures within 60 days.

Annotate the As-Built drawing sets to show approved circuiting and wiring changes made during installation and testing of the location prior to placing it in service, and approved changes made after placement in service. Clearly identify changes on the drawings using the "Red In"/"Yellow Out" convention. Changes shall be dated and initialed by the Contractor's responsible Signal Engineer. Identify the date that the location was tested and placed in service in the revision block of the drawings.

In addition to the as-built drawings provided to the Engineer, one set shall be bound and shall be kept in the instrument enclosure at a location and manner approved by the Engineer. As-built drawings shall be clean and legible. The as-built drawings shall not be removed from the field location after the location is placed in service without the prior written approval of the Engineer.

The final as-built drawings shall be 11 inches by 17 inches, unless authorized by the Engineer to substitute another size.

Circuits that continue on another drawing shall be annotated with drawing number and routing information for the continuation of the circuit.

The circuit drawings shall show individual circuits. Typical circuits will not be accepted.

The location plans shall show cable installed with the number of conductors, the size of conductors, the type of cable, termination points of conductors, and the circuit on each conductor. Separate cable plans shall be drawn if cable information cannot be shown in a neat and organized manner on the location plans.

The shop drawings shall be detailed equipment drawings for each type of equipment installed.

Track Availability Requirements

Refer to Special Provision, Maintenance and Protection of railroad Traffic for track access and related provisions. Metrolink Commuter Service and any other passenger or freight service may not be interrupted by the Work of this Contract, except as provided in the Contract Documents.

Signal Cutovers may be required under traffic.

Signal Cutovers under traffic will require coordination between the Contractor, Metrolink, other railroad, as applicable, and the Operating railroad of Record to keep train delays to a minimum.

Installation

Contractor shall make necessary modifications to the existing signal system, protect or relocate existing cabling, signals, switches, and signal shelters; and modify associated signal and highway grade crossing systems to ensure the existing signal system operates as intended during construction and installation of the new signal system. Protect operating signal and highway grade crossing systems to ensure train operations are not interrupted and safety is maintained.

Contractor shall take no action which will violate rules or regulations as specified by CFR 49, the General Code of Operating Rules, timetable instructions, general order, bulletin, or special instruction; which will reduce the integrity of the signal system; or endanger railroad personnel, the public, or employees.

Equipment installation shall be in accordance with the SCRRRA Engineering Standards.

Ensure that equipment within the instrument shelters and relay cases is securely anchored or otherwise fastened in enclosure upon completion of enclosure installation. Securing equipment shall not negate the requirements to maintain isolation between ground systems as otherwise called for in these specifications.

An updated, detailed set of the approved signal design drawings shall be kept at the each field location for equipment as it is placed in-service.

FIELD FINISHES AND TOUCH UP

For signal system parts which AREMA C&S Manual, Part 1.5.10, stipulates as shop primed and field painted, field finish as specified in Special Provisions, Paints and Coatings and Graffiti Resistant Coating and AREMA C&S Manual, Part 1.5.10, including requirement to apply one field coat prior to field assembly and one field coat following field assembly. Touch-up signal manufacturer's finishes after installation

COST BREAK-DOWN

The Contractor shall furnish the Engineer a cost break-down for the contract lump sum items of install railroad signaling. Cost break-down tables shall be submitted to the Engineer for approval within 15 working days after the contract has been approved.

Attention is directed to "Time-Related Overhead" of these special provisions regarding compensation for time-related overhead.

Cost break-downs shall be completed and furnished in the format shown in the samples of the cost break-downs included in this section. Line item descriptions of work shown in the samples are the minimum to be submitted. Additional line item descriptions of work may be designated by the Contractor. If the Contractor elects to designate additional line item descriptions of work, the quantity, value and amount for those line items shall be completed in the same manner as for the unit descriptions shown in the samples. The line items and quantities given in the samples are to show the manner of preparing the cost break-downs to be furnished by the Contractor.

The Contractor shall determine the quantities required to complete the work shown on the plans. The quantities and their values shall be included in the cost break-downs submitted to the Engineer for approval. The Contractor shall be responsible for the accuracy of the quantities and values used in the cost break-downs submitted for approval.

The sum of the amounts for the line items of work listed in each cost break-down table for railroad signaling work shall be equal to the contract lump sum price bid for install railroad signaling, respectively. Overhead and profit, except for time-related overhead, shall be included in each individual line item of work listed in a cost break-down table.

No adjustment in compensation will be made in the contract lump sum prices paid for install railroad signaling due to differences between the quantities shown in the cost break-downs furnished by the Contractor and the quantities required to complete the work as shown on the plans and as specified in these special provisions.

Full compensation for general signal requirements shall be included in the lump sum price for install railroad signaling and no additional compensation will be allowed therefor.

SAMPLE INSTALL RAILROAD SIGNALING COST BREAK-DOWN

UNIT DESCRIPTION	UNIT	APPROXIMATE QUANTITY	UNIT PRICE	AMOUNT
Demolition and Removal of Existing Equipment Including Retiring CP Brighton, Buena Vista Street Crossing, Intermediate Signal Locations, Existing Gates, and Cabling	LS	Lump Sum		
Furnish, Install, and Commission Antennas for Communication to Operations Center CP Hollywood	EA	1		
Update and then Retire CP Brighton Communications to Operations Center	LS	Lump Sum		
Furnish and Install 2c # 6 Twisted Track Wire	LF	4900		
Furnish and Install 7c # 6	LF	5900		
Furnish and Install 7c # 14	LF	2200		
Furnish and Install 12c # 14	LF	6700		
Furnish and Install 3c # 6	LF	750		
House Wiring Changes and Cable Hookups in New Houses	EA	729		
House Wiring Changes and Cable Hookups in Existing Houses	EA	235		
Furnish and Install Signals and Foundations on Flyover (VY 12.74)	LS	Lump Sum		
Furnish and Install Signals and Foundations on Shoofly (VY 12.76)	LS	Lump Sum		
Furnish and Install Signals and Foundations between Arvilla St. and Sunland Blvd. (VY 14.40)	LS	Lump Sum		
Furnish and Install Signals and Foundations at CP Hollywood (VY 13.30)	LS	Lump Sum		
Transport, Install, and Test State Furnished Crossing and Signal Shelters	EA	5		
Relocate Case "B" 6'9" Crossing case at Buena Vista Street	LS	Lump Sum		
Transport, Install, and Test State Furnished Switch Machine and Layout	LS	Lump Sum		
Furnish, Install, and Test Track Connections and Bonds	EA	60		
Transport, Install, and Test State Furnished Roadway and Pedestrian Gates	EA	9		
Relocate Roadway and Pedestrian Gates during Buena Vista Staging	EA	2		
Furnish and Install Conduit in Duct Bank	LF	85000		
Furnish and Install Conduit Under Roadway	LF	1900		
Furnish and Install Conduit Under Tracks	LF	280		
Furnish and Install Conduit (General)	LF	8300		
Furnish and Install 4' x 4' Pull Boxes	EA	55		

Furnish, Install, and Test Flasher Unit for Intermediate Staging at Buena Vista Street	EA	1		
Support During Signal Cutovers	LS	Lump Sum		
Furnish, Install, and Test Track and Gate Pull Boxes	EA	16		
Furnish, Install, and Test Miscellaneous Signal Equipment in Houses	LS	Lump Sum		

14-1.07 COORDINATION WITH SCRRRA PROCUREMENT CONTRACTOR

GENERAL

Summary

This Section includes requirements coordinating installation, inspection, and testing of new Owner furnished material with the Engineer and with the Owner's procurement contractor. Notify the Engineer in writing a minimum of 30 days prior to any installation, inspection and testing of such material.

Refer to Special Provision, Owner-Furnished Materials, in the paragraph "Components of railroad signaling equipment".

Definitions

Not Used

Submittals

Submit Acceptance Test Procedure documentation on Owner Furnished Equipment prior to transport of the equipment.

Quality Control and Assurance

Not Used

MATERIALS

Source Quality Control

Test all Owner-furnished equipment before transporting it to the job site. Conduct this acceptance testing for equipment in accordance with the Contractor's Acceptance Test Procedure. Prior to transportation, submit a copy of the documentation of acceptance testing to the Engineer.

Warranty

Because the manufacturer's warranty for Owner-furnished material begins upon transfer of custody of the material, supplement the manufacturer's warranty for the amount of time elapsed between acceptance of the material and final cutover and as required under General Conditions, Warranty of Work. The supplemental warranty shall include costs to repair or replace material which is damaged while in Contractor's care or fails prematurely and as required under General Conditions, Warranty of Work. Make arrangements for and pay costs of such repairs performed by and replacements provided from the original equipment manufacturer.

CONSTRUCTION

Not Used

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefor.

14-1.08 SIGNAL WIRE AND CABLE

GENERAL

Summary

This Section includes requirements for cable and wire required for signal and signal power system wiring to wayside shelters and crossing shelters junction boxes, factory wired mechanisms and other signal equipment.

Definitions

Material and workmanship shall be of the highest quality, assuring durability for minimum life expectancy of 40 years. Cables shall be suitable for use in the environment to be encountered on a railroad signal system, and shall be certified for continuous operation, in wet or dry locations, with no conductor failing in continuity or with loss of insulation to cross or ground less than one mega ohm.

Submittals

Product Data: Manufacturer's catalog cuts, material descriptions, and specifications for each type of wire and cable the Contractor proposes to provide.

Quality Assurance: Submit a list of cable manufacturer's installations complying with the past performance and experience requirements specified herein.

Product Sample: The Contractor shall submit one (1) foot of sample cable when requested by the Resident Engineer. Resident Engineer shall make request in writing prior to approval if deemed necessary to ensure the product data submittal meets the specification.

Quality Control and Assurance

Cable manufacturer's qualifications shall be as follows:

1. Past Performance and Experience: Demonstrated previous successful experience in supplying cable to the railway or transit industry for use as vital signal control cables. A list of such installations shall be provided for each cable manufacturer to be considered.
2. Quality Assurance Program: The manufacture of cables in accordance with the requirements of these specifications shall be accomplished in compliance with a Quality Assurance Program that meets the intent of ISO 9001.
3. All signal wire and cable furnished under this Contract shall be provided as new, and shall not be installed under this Contract if the manufacture date of the cable exceeds 24 months prior to the Notice-To-Proceed date.

MATERIALS

Internal Wire and Cable

Individual cable make-up and conductor sizes shall be as shown on the railroad plans.

Internal wire and cable shall conform to AREMA C&S Manual, Part 10.3.14, and the following requirements:

1. Solid conductors shall be Type I in accordance with AREMA C&S Manual Part 10.3.14.
2. Stranded conductors shall be Type II in accordance with AREMA C&S Manual Part 10.3.14.
3. Internal wire and cable insulation shall conform to AREMA C&S Manual Part 10.3.24 and the following requirements.
4. The minimum insulation rating shall be 600 volts.

External Wire and Cable

General

Individual cable make-up and conductor sizes shall be as shown on the railroad plans.

Conductors shall be soft or annealed copper, coated with tin in accordance with Type I wire as shown in the applicable AREMA C&S Manual Part.

Stranded conductors shall be soft or annealed copper, coated with tin in accordance with Type II wire as shown in the applicable AREMA C&S Manual Part.

Track Wire

Track wire shall be Okonite-Okolene (EP-PE) manufactured by Okonite Co., or approved equal.
Twisted track wire shall meet the requirements of AREMA C&S Manual, Part 10.3.15.

Signal, Switch, and Express Cable

Wire and cable used for signals, switches and express cable shall be Okonite (EP) Armored Underground Signal Cable manufactured by Okonite Co., or approved equal.

Conductors number six (#6AWG) and smaller shall be solid. Conductors number 4 (#4AWG) and larger shall be stranded.

Armored cable shall be furnished with a 10-mil flat bronze tape between the conductors and the outer jacket, helically applied, and adequately cushioned from the conductors.

Armored cable shall meet the requirements of AREMA C&S Manual, Part 10.3.17.

AC Power Cable

AC power shall be Okonite-FMR (EP) Okolon(CSPE) Type TC Cable manufactured by Okonite Co., or an approved equal.

Cable shall meet the requirements of AREMA Signal Manual, Part 10.3.16.

Modem Cable

Modem cables shall be C-L-X Type SP-OS manufactured by Okonite Co., or approved equal.

Modem cable shall be protected by moisture impervious, continuously welded, corrugated, aluminum sheath with an overall EFTE fluoropolymer jacket.

Individual twisted pairs shall be separately shielded with an aluminum polyester tape to provide shield isolation between pairs of 100 megaohms per 1000 ft. minimum.

Modem cable shall meet the requirements of AREMA Signal Manual, Part 10.3.17 except as specified herein.

Source Quality Control

Coordinate with the Engineer for Engineer's inspections and tests at point of production. The Engineer shall have the right to make inspections and tests, as necessary, to determine if the wire or cable meets the requirements of this Specification. The Engineer shall have the right to reject wire or cable that is defective in any respect.

Provide, at the point of production, apparatus and labor for the following tests:

1. Conductor size and physical characteristics.
2. Insulation HV and IR tests.
3. Physical dimension tests.
4. Special tests on materials in coverings.
5. Final HV, IR, and conductor resistance tests on shipping reels.

Delivery, Storage, and Handling

Shipping, storage, and handling shall be in accordance with AREMA Signal Manual, Part 10.4.1.

During storage and handling, prior to final conductor termination, cable ends shall be sealed to prevent the entrance of moisture.

CONSTRUCTION

Installation

General

The installation of wire and cable shall conform to AREMA C&S Manual Parts 10.4.1, 10.4.30, except as specified herein.

External cable runs shall be in conduit in accordance with the Metrolink Standard Drawings, and as called for in the railroad plans.

The signaling cables shall be separated from parallel run of ac feeder cables, where adjacent locations are fed from one ac service location.

Give the Engineer 24 hours notice prior to installing cables.

Provide sufficient slack in cable conductors at terminating posts to enable a minimum of 3 reterminations of the conductor, due to broken eyelets without re-servicing or re-pot heading the cable.

In certain types of installation, the cable cannot be constrained; therefore, ample cable slack shall be provided for additional flexibility due to vibration of such equipment.

Provide and install all cables.

Do not bend cables to a radius less than manufacturer's recommendation.

Distribution cable runs shall be continuous without splices between cable terminating locations. Express cable runs longer than cable lengths shall be spliced together in junction box, instrument case, or other acceptable shelter. Prior to cable or wire splicing, obtain the Engineer's approval. Approval will not be granted for cables damaged by the Contractor or vandalized by others. It is the responsibility of the Contractor to protect cables until final installation acceptance.

Identify individual cable conductors at each cable termination with plastic tags, as specified in Special Provision, Signal Systems Miscellaneous Products. Identify and terminate spare conductors in each cable.

Seal cable entrance openings in equipment enclosures and junction boxes with compression type fitting or pliable sealing compound after the cable is in place. Use sealing compound to seal the area around cable where the cable emerges from the end of a conduit or pipe. Seal and plug spare conduits. Seal around conduits where conduit(s) enter enclosure(s) to prevent entry of vermin and insects.

Wherever multiple conductor cables are terminated, carefully remove the outer sheath of the cable to a minimum point of 3 inches from the cable entrance. At the end of the cable sheath or covering, apply 2 layers of Scotch 88 plastic electrical tape or approved equal.

Terminate cable conductors in number sequence from top to bottom.

Cable shields or sheaths shall be grounded at the entrance to signal shelters and shall float when terminated in field apparatus.

Underground Buried Installation

When crossing underneath tracks, bury conduit(s) to a uniform minimum depth of 36 inches as measured from bottom of tie to top of conduit(s). When paralleling the tracks, bury conduit(s) a minimum depth of 36 inches as measured from the finished grade to top of conduit(s). Provide backfill and compaction as specified in these Specifications. Install cable within four-inch PVC schedule 80 conduit when passing under tracks or crossing a roadway. Install cable within four-inch PVC schedule 40 conduit(s) when paralleling the tracks.

Upon written request from the Contractor and only under extreme circumstances because of installation hardship will installation of conduit(s) be allowed to a depth of less than 36 inches, and is subject to the Resident Engineer's approval. The Contractor shall protect the conduit(s) and cable(s) in a manner acceptable to the Resident Engineer.

Ensure that whenever any signal conduit(s) is to pass under pavement or roadway, and if conduit is not provided by others, the Contractor shall provide and install cable(s) in 4-inch PVC Schedule 80 conduit and extend schedule 80 conduit(s) a minimum of 2 feet beyond the edge of the curb and gutter and/or sidewalk, where applicable. Installation of conduit(s) and pull box(es) shall be in accordance with SCRRA C&S Engineering Standards. Restore pavement and roadway to its original condition including striping and markers, subject to local municipal requirements and the Resident Engineer's acceptance.

Whenever any signal cable is to pass under the hot-mix asphalt concrete (HMAC) underlay installed on the project, provide and install cable(s) in conduit(s) with pull boxes in accordance with the SCRRA Standard Drawings.

Where cable leaves the ground at other than buildings or in foundations, protect cable by a bootleg or other covering extending above the ground line. Fill top of such protective coverings with a sealing compound.

Where underground cables enter a concrete foundation, junction box, shelter or case, leave sufficient slack in each cable in the nearest pull box to allow a minimum of an additional one foot of cable to be pulled into the shelter or junction box.

Ensure that the pot heading of underground cables shall be applied whenever cable is terminated in signal equipment, and such termination is within two feet of the grade level. This neoprene and seal pothead shall be installed in accordance with the manufacturer's instructions.

The Contractor shall ensure that cable(s), track wire, and conduit(s) shall be installed per Drawings and Special Provisions, Earthwork.

Cables shall not cross one another when they are pulled into a conduit or pipe; the conductors shall not be pulled tight or kinked in conduit fittings or boxes. Cables to be installed in a conduit or pipe shall be pulled and installed simultaneously.

Cables except final connection of flex wires to rail shall be installed in a conduit system as shown on the railroad plans.

Special Protection

Provide appropriate special protection for cables in areas where the cables are unavoidably exposed to hazardous conditions, such as vibration or sharp corners on equipment. Replace cable that is installed but subsequently damaged prior to acceptance as a result of the Contractor's failure to provide special protection.

AC Power Cable

Provide and install AC power cable in dedicated conduit from the service meters to the signal shelters and between signal shelters.

CABLE PULLING

1. Provide cable pulling as specified within the conduits installed by the Contractor.
2. Do not use poly rope for any mechanical means of pulling cable. Poly rope stretches when subjected to high tension and can create a hazard. Manual pulling (by hand) using poly rope is allowed. When using a mechanical means to complete a pull, a Samson rope or equivalent, flat line, shall be used, as it does not stretch in the same way that poly rope does, and presents less of a hazard.
3. Provide two-way voice communication and adequate resources at both feeding and pulling ends of the run and at any interim location (e.g. 4 X 4 pull boxes). Apply cable pulling lubricant liberally during the cable pull. To minimize back reel tension accelerate slowly and smoothly from rest to a constant pulling speed. Avoid stopping the pull midway through the installation; the drag due to friction is greatly increased when pulling is restarted.
4. The cable that cannot be pulled in manually shall be installed by means of a cable puller, an electric winch or a winch on a radial boom derrick. In each case, the machine operator shall have access to a means of determining the pulling tensions on the cable (e.g. gauges which indicate direct line pressure or gauges which indicate hydraulic pressure which can be converted to line tension via a conversion table or a dynamometer). Do not exceed the manufacturer's pulling tension for any cable installation. Cable pulling with trucks, backhoes, crane/boom or any other method whereby the amount of pulling tension is not measurable, is unacceptable.
5. Establish the direction of the pull based on safe pulling tensions, sidewall bearing pressure calculations and minimum bending radius for a specific cable to be installed. Do not exceed the minimum bending radius at any time. Follow the manufacturer's instructions for the safe pulling tension and determine if the cable pull requires a basket grip or a pulling eye attached to the conductor. Basket grips or pulling eyes shall be attached to the pulling rope or cable by an appropriate sized swivel head. Rod each conduit with an appropriate size brush and mandrel to ensure conduits are properly fitted and they are clean and free of all dirt, stones, scale, water etc. For installation in conduit, place cable guides wherever necessary to avoid abrasion and/or damage to the cable e.g. when guiding the cable from the reel to the conduit mouth or trench, when passing through or exiting manholes, when exiting a conduit run. Cable guides shall be in the form of large diameter, smooth-surfaced free turning sheaves or rollers. They shall be designed to ensure that cable will not ride off the end of the roller or be pinched into a sheave contour. Guide tubes or chutes shall be used provided they have a smooth burr-free working surface, well flared entrances, largest possible bending radius and are securely fastened so that the cable passes smoothly over them. In any case, equipment shall be installed to ensure the minimum bending radius of the cable is not exceeded. Using suitable reel mounting equipment, locate and position the reels such that cable tension at the feeding end is minimized. Select pulling equipment, which can provide smooth speed control at the anticipated tensions. Ensure the pull rope or flat line has the required tensile rating. Avoid the use of elastic materials.
6. Pre-lubricate conduit with cable manufacturer's recommended cable lubricant. Setup lubrication points along the conduit run (e.g. feed in point, 4 X 4 etc. to reduce pulling tension and abrasion to the cable jacket). For long heavy pulls, pre-lubrication of conduit and pull rope is essential to prevent abrasion at the bends, particularly PVC conduit bends, which can become softened due to frictional heating. In the case of long conduit lengths or excessive curvatures in the conduit the cable may have to be pulled in from two directions. Follow the recommendations of the cable manufacturer as to the amount of lubricant to be applied which is depended on the size and length of the conduit system into which the cable is being pulled.

Repair

Immediately call to the Engineer's attention any instance of damaged cable observed at any time, whether prior to installation, occurring during construction, or discovered by test observation after installation. The method of correction shall be in accordance with the Engineer's written instruction. Promptly repair such damage.

Field Quality Control

Test installed external cable in accordance with the requirements as specified in Special Provision, Signal Systems Testing, and AREMA C&S Manual, Part 10.4.30.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.09 INTERLOCKING CONTROL

GENERAL

Summary

This section includes requirements for installing, testing, and documenting Owner-furnished pre-wired vital microprocessor based interlocking controller racks, custom local control panels that and ATCS compliant data radio that provides the functionality shown on the railroad plans and described herein.

Final application logic programs, including EPROMS will be furnished by the Owner.

Definitions

Not Used

Submittals

Submit a narrative explanation of the electrical and/or mechanical methods of configuration control used to ensure that the application logic software installed is the correct software for the specific location and that it is the latest version. It shall explain Contractor's procedures for handling components of the vital interlocking controller.

Submit certified acceptance reports.

Submit test reports and verification of tests as described herein under testing.

The Contractor shall provide the Resident Engineer with 5 printed copies of all test reports and certify that all applicable tests have been made in accordance with Special Provision, Signal System Testing.

Quality Control and Assurance

Install, program, and test the interlocking controller and custom local control panel (CLCP) so as to conform to and provide applicable requirements of CFR 49, Part 236, and AREMA C&S Manual Part 2.2.10.

Perform operational testing of the equipment in accordance with the requirements specified in Special Provision, Signal System Testing.

MATERIALS

Solid State Microprocessor Interlocking Controller

Controller shall be a Vital Logic Controller (VHLC) manufactured by GETS.

The interlocking controller shall be capable of operating 12 VDC vital and non-vital relays. A minimum of 8 vital inputs and 8 vital outputs shall be grouped on a single I/O module. Each module used exclusively for vital inputs shall accommodate a minimum of 16 inputs.

The vital lamp driver module provided to operate wayside signal lamps shall be capable of directly driving a minimum of 16 each 10 VDC, 18 watt or 25 watt lamps through isolated lamp driver outputs for on, off, and flashing. Flashing shall be at a nominal rate of 55 flashes per minute. Controller shall provide tumble - down indications based upon light out detection using both hot and cold filament checking.

Controller chassis shall be designed to house a minimum of 12 modules. Three slots shall be reserved for modules that control and process vital and non-vital application logic and communications. The remaining slots shall be designed to house any user defined configuration of input/output, lamp driver, and operating modules.

Plug connectors shall be keyed for each module type to ensure only the proper module can be connected. Plug connector cables shall be color-coded. No color code shall be repeated in a single plug connector.

The interlocking controller shall have the capacity to directly connect, via a cable, to a chassis that will generate and receive Electro Code 4 and Electro Code 5 track codes without use of relay interfacing.

The interlocking controller must be capable passing vital data, via a serial connection, to existing VHLC units utilized on SCRRRA properties.

The software associated with assuring the vitality of the system shall be an inherent part of the basic controller system and shall not be accessible for modification by the user. Changes to the application logic installed in the system shall not require re-verification of the software associated with assuring system vitality. The application logic shall be protected so that it is user modifiable by authorized personnel only.

The program compiler used in developing the site-specific application logic software shall be designed to allow the user to construct individual equation logic equations utilizing "ladder-logic" display elements. Reports generated by the compiler shall provide the user with a complete and detailed description of the system configuration including, but not limited to, module location assignments, internal timer settings, auxiliary input/output assignments, vital lamp output assignments, CTC control and indication bit assignments, electronic track code circuit assignments, data recorder equation selection, remote input/output assignments, and module plug-connector pin assignments.

The interlocking controller shall provide event recording. The event recording shall be designed so that the correct time is maintained when the vital logic and/or code system equipment is reset or powered down. The event recording equipment shall have sufficient storage capacity to store a minimum of 72 hours of events, without overwrite, at the interlocking, recording user selected status changes along with diagnostically important internal status changes.

The interlocking controller shall provide mitigation for "processor failure" via a fall back relay.

The interlocking controller shall interface with the solid-state track circuit detailed in Special Provision, Solid -State Coded Track Circuits.

The failure of an output shall not cause loss of functions not associated with those of the failed module.

The interlocking controller shall operate from a standard 12 VDC signal battery supply. Any special power supply filtering devices required for reliable operation shall be provided as part of the system.

The interlocking controller shall, at a minimum, enable a user to generate the following reports:

1. Configuration report that, at a minimum, indicates controller location, revision history, controller/software identification (chassis identification), chassis slot assignments, application software identification (Eprom crc/checksum), each vital and non-vital input/output assignment and nomenclature, each lamp driver vital output assignment and nomenclature, track code input/output assignment and nomenclature, serial and remote input/output assignment and nomenclature, vital timer configuration and time settings, and equation data recorder logging assignments.
2. Logic equation report that displays application logic equations in a ladder-logic format.
3. Cross-reference report that displays status names used in each logic equation.
4. Revision history report.
5. Real-time data logging that displays, on a user furnished computer display, changes in logic equation status.

Custom Local Control Panel (CLCP)

Local Control Panel (LCP) shall be a Custom Local Control Panel (CLCP). CLCP shall be provided by SCRRRA and installed by the Contractor after instrument enclosures have been delivered to the SCRRRA.

Delivery, Storage, and Handling

Package plug in modules for shipment separately from their card cage units using ESD safe packaging. Protect each item from damage or loss during handling and shipment.

Clearly identify each controller unit, LCP, and their associated components on the packing crate, referencing its intended location.

Warranty

Provide warranty from defects arising from improper handling for 2 years from the first date of final "acceptance".

CONSTRUCTION

Preparation

Ensure that test and specialized installation equipment recommended by the manufacturer to make any readings or adjustments is in the Contractor's possession and within the project limits a minimum of 30 days prior to installation.

Software

The Resident Engineer shall provide the vital and non-vital application software for each VHLC and EC5 unit. Resident Engineer shall provide application logic software for Vital Harmon Logic Controllers (VHLC) and Electro Code 5 (EC5) systems as required.

The Contractor's Signal Engineer shall then load the software at its intended installation site and pretest the location to ensure reliable and safe performance and integrity.

Installation

Wire and install the microprocessor-interlocking controller and the LCP in accordance with rack layout provided in the railroad plans.

Load programmable and configurable modules with application software and perform any configuration necessary.

Conduct a complete breakdown and operating test on the units prior to shipment.

Field Quality Control

Conduct tests as specified in AREMA C&S Manual Parts 2.4.1 and 7.4.1 to ensure proper operation of the signal and grade crossing warning systems.

Conduct tests to ensure that the signal system conforms to CFR 49, Part 236.

Conduct tests required under Special Provision, Signal Systems Testing.

Install and perform applicable tests in accordance with 14-1.20, Signal System Testing, to ensure that the interlocking controller software and CLCP has been installed and made operational as part of the operating signal system. Verification of such tests shall be provided to the Resident Engineer.

The Contractor shall conduct all tests as recommended by manufacturer.

Testing, including pre-testing, shall include operating switch machines and lighting signals. The use of lamp simulators in lieu of, or in parallel with, signal lamps will not be allowed in pre-testing. An exception may be authorized by the Resident Engineer where a signal or switch machine is in service and will be reconfigured for final cutover or cannot be installed or wired until final cutover.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.10 SOLID-STATE CODED TRACK CIRCUITS

GENERAL

Summary

This Section includes requirements for furnishing, installing, testing, and documenting solid-state track circuit elements. Final application logic programs will be furnished by the owner.

Definitions

Not Used

Submittals

Submit a narrative explanation of the electrical and/or mechanical methods of configuration control used to ensure that the application logic software installed is the correct software for the specific location and that it is the latest version. It shall explain Contractor's procedures for handling components of the solid-state track circuit equipment.

Submit certified acceptance reports.

Submit test reports and verification of tests as described herein under testing.

The Contractor shall provide the Resident Engineer with 5 printed copies of all test reports and certify that all applicable tests have been made in accordance with this Section and with Special Provision, Signal System Testing.

Quality Control and Assurance

Install and test the solid-state track circuit equipment in accordance with applicable requirements of CFR 49, Part 236 and the AREMA C&S Manual, Part 8.1.2.

Perform operational testing of the equipment in accordance with the requirements specified in Special Provision, Signal Systems Testing.

The Resident Engineer or his/her representative shall have the right to make inspections and tests, as necessary, to determine if the equipment meets the requirements of this Specification.

The Signal Engineer shall demonstrate knowledge and experience in the operation, programming and maintenance of the solid-state coded track system.

MATERIALS

Electronic track circuits shall be compatible with highway grade crossing constant warning devices. Utilization of bi-directional, uni-directional, and auxiliary crossing control functions shall be provided per railroad plans and manufacturer's specifications. Track filters shall be installed in track leads, as shown on the railroad plans.

Where new equipment is to be furnished and installed in existing locations, the equipment furnished shall be the same make as called for in the Contract Documents.

Track circuit shall function to provide continuous train detection throughout the length of the circuit whenever a shunt of 0.06 ohms is applied to the rails, including the turnouts.

Furnish specialized test or calibration instruments, equipment, or tools that may be needed to test and place in-service the equipment installed under this Section, as shown on the railroad plans. Ensure tests and diagnostic equipment are in the Contractor's possession and within the project limits a minimum of 30 days prior to installation.

Install Electro Code 5, with Alternating Code 5, manufactured by GETS.

Provide a solid-state electronic coded track signal system to determine block occupancy and to pass signal aspect information from one interlocking or signal location to the next. The system referenced herein is Electro Code 5 (EC-5).

The electronic coded track circuit shall be user programmable to provide application logic changes as needed. The application program shall be specified on the release. The Contractor shall furnish the program specified with each electronic coded track circuit system.

The electronic coded track circuit unit shall be configurable for transmission/reception of the track circuit and signal codes over track.

The coded track circuit unit shall have available a minimum of 6 discrete code rates for vital signaling indication in addition to a code rate used for train detection. An additional code rate shall be available for reversal of the code transmission/reception signal orientation. Track circuit shall have 2 codes used to convey non-vital block information. Electrocode IV code rates are presently used on Metrolink with Alternating Code 5. Coded Track Circuit must be able to communicate on the rails with existing Electrocode without requiring any interface equipment.

Event recorder modules for electronic track circuits shall be provided as shown on the railroad plans.

Electronic coded track circuits shall conform to the requirements of the AREMA Signal Manual, Section 8.1.2, where these instructions and requisites are applicable and do not conflict with these Specifications.

Conduct an acceptance test on Owner-furnished units prior to loading at the warehouse.

Conduct acceptance testing of components before transporting from the warehouse and installing. Provide certified acceptance reports at time of delivery.

Delivery, Storage, and Handling

Ship the solid-state modules separately from the wired card cages. Package modules individually in ESD safe packaging, in a sturdy carton with the type of module printed on the outside of the carton.

Package plug-in modules for shipment separately from their card cage units using ESD safe packaging. Protect each item from damage or loss during handling and shipment.

Each microprocessor unit and its associated components shall be clearly identified on the packing crate, referencing its intended location.

Application Logic

The Owner will provide the application logic for each programmable module upon demonstration of readiness for pretest. This application logic will provide the functionality as shown in the railroad plans and shall conform to CFR 49, Part 236. Where specified in the Contract Documents, the Contractor shall furnish the program specified to the manufacturer for factory testing and certification.

CONSTRUCTION

Installation

Install solid-state coded track circuits at locations indicated on the railroad plans.

Install the solid-state track circuit equipment in signal instrument shelters or cases as shown on railroad plans.

The solid-state track circuit equipment layouts shall provide for easy access to test points, indicators, and adjustments.

Install equipment in accordance with the manufacturer's installation and adjustment procedures.

Testing

Conduct tests as specified in AREMA C&S Manual Parts 2.4.1, 3.3.1, and 7.4.1 to ensure proper operation of the signal and grade crossing systems.

Conduct tests to ensure that the signal system conforms to CFR 49, Part 236.

Conduct tests required under Special Provision, Signal Systems Testing.

Testing, including pre-testing, shall include operating any hand throw switches and lighting signals. The use of lamp simulators in lieu of, or in parallel with signal lamps will not be allowed in pre-testing.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.11 SIGNAL LAYOUTS, STRUCTURES AND FOUNDATIONS

GENERAL

Summary

The work of this Section shall include disassembling, relocating and installing existing or new signals.

Signal layouts, as specified herein, shall consist of foundations, signal heads and structures including cantilevers, bridges, ground mounted masts, ladders, platforms, and mounting hardware required to construct signals.

Contractor shall furnish and install signals as shown on the railroad plans at existing and new signal locations.

Definitions

Signal Foundation Structure: Provide for the foundation structure type selection and its design. The design of the signal foundation's structure and stability shall be in accordance with the AASHTO LTS-4. Design calculations shall be prepared by a licensed California professional civil engineer with a minimum of 5 years experience in the design of similar foundation structures.

Signal aspect shall be distinct and unmistakable when viewed from a height of 7 to 12 feet above top of rail at a distance of 1,000 feet. Nominal sighting distance shall be 2,000 feet. Where unobstructed sighting distance for a standard signal arrangement is less than 2,000 feet, supply and install color light LED signal and adjust the signal head for the maximum sighting range possible. Provide to the Engineer with written notification with any sighting problems and location of where spread or wide-angle lenses are installed.

Submittals

Submit shop drawings for each type of signal unit and each type of signal layout to the Engineer for approval. Show ladders, masts, bases, arms, and required mounting hardware. Show location and method of mounting the signals to the structure.

Provide necessary dimensions, hardware, method of mounting signal structures, and material specifications for items to be furnished.

Submit shop drawings for each type structure foundation.

Submit Installation Procedure for approval by the Engineer. The procedure shall include a detailed description of installation activity and sufficient detail to allow the Engineer to determine the validity of the installation procedure.

Submit design calculations for the signal cantilever/bridge foundation.

Quality Control and Assurance

Signals, structures, and related hardware shall meet the requirements of AREMA C&S Manual, Section 7, and applicable portions of Manual Part 3.2.5 where they do not conflict with any requirements specified herein.

Inspect each signal layout after it has been installed in the field. This inspection shall conform to the Contractor's Installation Procedure as accepted by the Engineer.

Foundations shall meet requirements of AREMA C&S Manual Parts 14.1.1.A through 14.4.36 inclusive, where requirements of the AREMA Specifications do not conflict with any requirements specified herein.

MATERIALS

Furnish LED color light signals, as indicated in the Contract Documents. Signals shall be in accordance with Metrolink Standard Drawings.

Furnish signal masts, signal cantilevers and signal bridges, as applicable, in accordance with Metrolink Standard Drawings.

Furnish mounting brackets for marker light assemblies, ladders, junction boxes, housings, backgrounds, hoods and any other nuts, bolts, and associated hardware.

Furnish foundations for signal masts, signal cantilevers and signal bridges, as applicable, in accordance with Metrolink Standard Drawings.

Signals

Signal mounting shall conform to the Metrolink Standard Drawings.

Signal LEDs shall be products specified in the Contract Documents or an approved equal.

Contractor furnished signal assemblies shall include a lamp adjusting resistor in the head.

Signal Masts

Mast assemblies for ground mounting shall conform to the railroad plans and Metrolink Standard Drawings.

Signal Bridges and Cantilevers

Refer to the railroad plans for Signal Bridge and Cantilever requirements.

The junction box shall have two terminals with insulated test links, as specified in Special Provision, Signal Systems Miscellaneous Products, for each cable conductor. Provide 10 percent spare terminals. Do not overcrowd terminals.

Cable entry to the junction box shall be direct from the signal structure. External conduit construction is not acceptable. Provide an opening approximately four by six inches near the base of the signal structure under each junction box location to allow access for cable sealing at the foundation. Provide bolt-on access plate which will cover the opening under normal conditions.

Locate junction box either at the base of a main support mast or on a main support mast at a height of between 3 and 5 feet above the finished grade level at the base.

The method of routing cables from the junction box to each signal mounted on the structure shall be to route the cables within the tubular members of the structure to the greatest extent possible. Pull cables entirely through the structure members, mast, and signal mounting brackets, unless otherwise approved by the Engineer. To facilitate this, provide appropriate pull box locations as needed, located a maximum of 5 feet from each signal. Edges shall be smooth and rounded to accommodate cable installation. Provide a means to prevent entry of rodents and insects at the bases of the vertical masts without cable entrances.

Use galvanized rigid steel conduit where wire is to be run external to the structural members, except as noted.

Use flexible armored conduit to make the connection from the pull box to the individual signal heads.

Use 5C #10 signal color coded cable for mast and jct. box wiring, type TC Okonite 202-10-35-05 or an approved equal.

Signal Foundations

Furnish galvanized steel foundations complete with galvanized bolts, washers, nuts, and associated hardware. Galvanizing shall conform to Special Provision; Signal Systems Miscellaneous Products, and AREMA Signal Manual, Part 15.3.1.

Construct galvanized steel foundations 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.

Bolt spacing shall be to manufacturer's standards for the equipment to be supported by the foundation.

Concrete Foundations: Cast-in-place in accordance with Special Provision, Cast-in-Place concrete, or precast concrete as manufactured by Dixie Precast or an approved equal.

Delivery, Storage, and Handling

Ship LED's separately from the signal in which they will be used.

CONSTRUCTION

Installation - Signals

Contractor shall install signal layouts in locations as indicated on the railroad plans and as shown on the accepted shop drawings. No part of any signal layout shall conflict with Metrolink Design Standards, Code of Federal Regulations, Part 49, or CPUC rules and regulations.

Locate signals centered between insulated joint, except where physically not possible. In such instances, submit a recommendation to the Engineer for approval.

Center line of signal mast shall be 15 feet 0 inches from centerline of track unless a deviation from this is approved by the Engineer, as shown on the railroad plans or required to meet CPUC clearance requirements.

Install signal units level and plumb on their foundations. Leveling nuts shall be used as shown on the Metrolink Design Standards.

Install signal layouts in accordance with the applicable requirements of AREMA Signal Manual, Part 7.4.1 and the Metrolink Design Standards.

Install platforms for each signal unit level.

Align signals for maximum viewing distance before placing in service.

Refer to Design Requirements herein regarding signal aspect and sighting distances. Install signals and verify sighting distances. Provide the Engineer with written notification with any sighting problems and location of where spread or wide-angle lenses are installed

Mount signal heads on an offset arm as shown in the Metrolink Design Standards. Signal heads shall also be able to swivel on the offset arm and be adjustable.

Signal nomenclature shall be as shown on the railroad plans.

The underground cable shall be dressed, potheaded, tagged, and terminated in the signal junction box as specified in Special Provision, Signal Systems Miscellaneous Products. The conductor size of the underground cables shall be at least as large as that shown in the railroad plans.

Wiring from the junction box base to the signal heads shall be minimum No. 10 AWG copper stranded wire or larger as shown on the railroad plans.

Install identification tags on each wire. These tags shall bear the nomenclature shown on the accepted Shop Drawings.

Set lamp voltage between 8.8 volts and 9.2 volts measured at the signal lamp.

Install signal cantilevers as shown on railroad plans.

Installation – Signal Bridges and Cantilevers

Signal bridges and cantilevers shall be installed as shown on railroad plans.

Installation – Foundations

Install each foundation in accordance with the approved Contractor's Installation Procedure for each type of foundation, as herein specified, and shown on the railroad plans. The absence of a specific task listing herein does not relieve the Contractor of the responsibility for providing a complete and functional installation.

Refer to Special Provision, Earthwork, for requirements for locating and protecting existing utilities. Advise the Engineer immediately if any utility or cable interferes with the foundation work. After locating interference, allow 72 hours for the Engineer to relocate or mitigate the interference.

Prior to placing steel foundations in the excavations, place and compact a crushed stone base in accordance with Special Provision, Earthwork.

When placing foundations, exercise care and ensure that anchor bolts are not bent or threads damaged. Protect anchor bolt threads, washers, and nuts by applying friction tape or other accepted method satisfactory to the Engineer, until the unit to be supported is installed.

After backfilling foundations, ensure that the foundation is plumb and level. Where galvanized steel foundations are installed, top of final grade shall be no more than 24 inches below top of foundation.

Install foundations to the lines, grades and dimensions required. Mounting bolts shall be of sufficient length to accommodate use of leveling nuts between the base of the equipment to be supported and the top of the foundation.

Painting

Touch up any damaged painted finish.

Field Tests

Make tests for proper operation and setting of lamp operating voltages in accordance with Special Provision, Signal System Testing.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.12 RELAYS

GENERAL

Summary

This section includes requirements for relays. Unless indicated as Owner Furnished in Special Provision, Authority Furnished Labor, Materials, and Equipment, or as relocated on the railroad plans, relays shall be Contractor furnished and relays of each type shall be uniform in design and contact assembly

Definitions

Not Used

Submittals

Contractor shall provide acceptance testing and documentation for each relay when it is transported from the warehouse to the job site.

Complete Test Report Form provided by the Engineer for each vital relay installed under this Contract. Use typewritten characters to fill in information requested on the form.

Quality Control and Assurance

Vital relays shall meet the requirements of AREMA C&S Manual Part 6.2.1, where they do not conflict with any requirements specified herein. Vital Relays shall be of the type as designated in the Metrolink Standard Drawings SCRR ES8110 and ES8120 .

Factory testing of each relay shall be the manufacturer's standard.

Provide relay specifications including drop away, pick up and working values, any special mounting or supporting arrangements, and contact stacking arrangements, for all relay types to be furnished under this Contract. Include any arc suppression where arc suppression is required.

Before any relay is used, obtain the Engineer's written acceptance. Acceptance will be based on the test results and the proper completion of the Test Report Form.

SCRR ES indicates acceptable relays in use. If the Contractor proposes use of alternate relays not listed in the SCRR ES, and those alternate relays have been approved by the Resident Engineer, the Contractor shall submit manuals with comprehensive descriptions and illustrations of each type of alternate relay provided. The Contractor shall provide four relay manuals, four copies of relay specifications, and calibration sheets for each type of alternate relay furnished.

The Contractor shall provide field test reports indicating each relay furnished has conformed to the manufacturer's specifications and the relay conforms to CFR 49 Part 234 and Part 236 requirements. The use of type written characters shall be used to fill in all information requested on the form.

Submit sample relay identification tag, including method of mounting proposed.

MATERIALS

General

Relays shall be in dustproof enclosures, except a provision shall be made for ventilation where required for heat dissipation.

Vital DC Relays

General

Vital Relays shall be Alstom Type B, Safetran Type "ST", or an approved equal. Contractor shall use the specific relays shown on the railroad plans.

Vital dc relays, unless otherwise indicated on the railroad plans, shall be of the plug-in type and rack-mounted. Relays shall have a transparent dust cover made of a nonflammable composition that will not support combustion.

Vital Relays, with a nominal operating voltage of 10 to 16 volts, shall be capable of operating continuously without resultant damage, with a minimum voltage range of 7 to 21 volts inclusive, applied to their operating circuits.

Vital relays shall have a test terminal to allow convenient measurement of the coil voltage.

Design biased neutral vital relays so that gravity alone will prevent the armature from picking up if the permanent magnet is de-energized or if no current is applied to the coil, due to interruption of the normal magnetic circuit.

Front contacts shall be silver-to-metal carbon, meeting the requirements of the AREMA C&S Manual Part 6.2.1.

When 3 dc vital relays, suppressed as specified herein, are connected in parallel and operated as a test load from normal working voltage, a vital relay front or back contact that breaks this load shall be capable of at least five million operations at this load without the contact resistance, measured with ten milliamp current, exceeding five ohms.

Arc suppression for vital relays shall be built into the relay or into its plug board.

Equip vital plug-in relays, except vital time-element relays and special application relays, with front current testing facilities. Where shown on the railroad plans, provide facilities to enable the testing of voltage from the front of the relay, without having to remove the relay or remove adjacent relays.

Equip vital relays with a registration plate to prevent relays of the wrong style, contact arrangement, or operating characteristics, from being inserted into the plug board.

Switch Operating Relays

Vital switch operating relays used for control of switch-and-lock movement shall meet the same requirements as specified for vital biased neutral relays 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. Switch operating relays to be furnished under this Contract shall be identical: one normal and one reverse switch-operating relay shall be provided for each switch-and-lock movement.

Identification

Facilities shall be included for mounting an approved typed or printed relay nametag for each relay, either on the relay cover or on the relay cabinet front plate, as applicable. The nametag shall be easily replaceable, but shall not come off during normal service.

Identification shall be in accordance with Special Provision, Signal Systems Miscellaneous Products.

Delivery, Storage, and Handling

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

Ensure that all vital relays are safely stored and protected from damage during storage, handling and transporting.

Spare Parts and Special Tools

The Contractor shall furnish one (1) e-post wrench for opening and closing the relay test terminals with each shelter where relays are installed. E-post wrench must be in each shelter for final acceptance.

The Contractor shall furnish two (2) insertion/extraction tools for each type of contact at each shelter where relays are installed. Insertion/extraction tools must be in each shelter for final acceptance.

Refer to Special Provisions, Temporary Facilities and Controls, and Quality Requirements for details regarding packaging and delivery of spare parts and special tools.

Warranty

The Contractor shall provide warranty from defects arising from defective parts and workmanship for 2 years from the first date of final "acceptance".

CONSTRUCTION

Installation

Ensure that the relay operating characteristics have not been altered due to damage during shipping procedures.

Ensure that ac and dc power buses are open while installing relays. Do not reconnect buses until relays have been installed.

Install and wire the relays as shown on the railroad plans. Contractor shall refer to SCRRA ES8110 and ES8120 for relay "tab" and coil wiring information.

Identify each relay with nametag(s) as approved by the Resident Engineer.

Field Quality Control

DC vital relays shall be tested and inspected in accordance with AREMA C&S Manual Part 6.4.1.

Perform tests in accordance with Special Provision, Signal System Testing.

Record test measurements on Test Report Form provided by the Engineer.

MEASUREMENT AND PAYMENT

Full compensation for conforming to the requirements of this section shall be considered as included in the contract lump sum price paid for install railroad signaling and no additional compensation will be allowed therefore.

14-1.13 AT-GRADE CROSSINGS

GENERAL

Summary

This section includes constructing new at-grade crossings of SCRRA railroad tracks and removing existing at-grade crossings.

Submittals

Submit product technical data including:

- A. Traffic Detour Plan signed by a Registered Professional Engineer using SCRRA Engineering Standards ES4022 as guidelines and incorporating provisions of the State of California MUTCD and the WATCH Manual.
- B. Material test reports for products purchased and used in this project.
- C. Product Technical Data including:

1. Acknowledgement that products submitted meet requirements of standards referenced.
2. Manufacturer's installation instructions.
3. Shop Drawings detailing dimensions, reinforcement and lifting apparatus for precast crossing panels.

- D. Furnish any required excavation drawings to Engineer for review and approval by SCRRA and jurisdictional authorities.

Verification documentation that Contractor requested DigAlert field location of underground utilities and SCRRA clearance of underground railroad utilities prior to starting any excavation.

Qualifications and experience of installers of precast concrete grade crossings.

Quality Control and Assurance

Employ a skilled foreman for the Installation of grade crossings, having no less than 3 years experience in installation of the type of grade crossing panels used.

Track work shall be performed under the supervision of an FRA Part 213 Track Safety Qualified Foreman in accordance with requirements of the special provision, TRACKWORK.

The Engineer, will review test reports in accordance with the Specifications as applicable for the material item and may require additional testing to confirm requirements with the Specifications.

Prior to commencing Work, Contractor must examine the Contract Documents, inspect the site, obtain and review available Record Drawings of existing work and utilities and note conditions and limitations which may influence work required by this Section.

MATERIALS

Precast Concrete At-grade Crossing Panels shall be designed for use on 10 feet wood track ties and ballast track as shown in the plans.

Precast Concrete At-grade Crossing Panels shall be fabricated in accordance with SCRRA Engineering Standards ES402.

Precast Concrete At-grade Crossing Panels shall have flangeways not less than 2 3/4 inches width and be electrically isolated to prevent shunt currents.

Crossing panels by Omega Industries are pre-approved for use on SCRRA.

Omega Industries
7304 NE St Johns Road
Vancouver, WA 98665
Phone: (360) 694-3221 Fax: (360) 694-3882.

Contractor may submit an alternative crossing panel to the pre-approved panel. Such panel must meet requirements in these specifications and SCRRA Engineering Standards ES4021.

At-grade precast concrete crossing panels shall have a minimum 7-year manufacturer's warranty.

Ties shall be new 10 feet long and conform to the special provision, "Wood Rail Ties".

Ballast shall be new and conform to the special provision, "Ballast".

Rail size shall be 136# CWR.

Rail shall conform to the special provision, "Trackwork".

Rail fastenings shall be new and shall conform to the special provision, "Trackwork".

Geotextile filter fabric used for grade crossings shall be nonwoven fabric. The filaments shall be polypropylene, polyester, or polyethylene. The filaments must be dimensionally stable (i.e., filaments must maintain their relative position with respect to each other) and resistant to delaminating. The filaments must be free from any chemical treatment or coating that might significantly reduce porosity and permeability. Nonwoven fabric may be needle-punched, heat-bonded, resin-bonded, or combinations thereof.

The physical properties for Geotextile shall conform to the following:

Test Method	Property	Requirement
ASTM D3776	Minimum Weight (ounce per square yard)	3.5
ASTM D4632	Minimum Wet Grab Tensile Strength (pounds)	100
ASTM D4632	Minimum Grab Elongation at Break (%)	20
ASTM D4751	Apparent Opening Size(US Sieve)	30

Hot Mix Asphalt for crossing underlayment and roadway approach paving shall conform to Section 39, of the Standard Specifications and these provisions.

Contractor must submit the proposed pavement design to the Engineer for review and acceptance. Roadway approach paving will be reviewed and accepted by SCRRA and the local agency governing the crossing.

Cast-in-Place concrete for new or replacement sidewalks, curbs, gutters and other concrete items shall conform to Section 73, Concrete Curbs and Sidewalks or as shown in the plans.

Perforated drain pipe shall be Schedule 80 PVC pipe in accordance with Section 64, Plastic Pipe and these provisions.

Signal conduits shall be electrical conduit in accordance to Section 86-2.05A, "Material," and 86-2.05B, "Use."

CONSTRUCTION

Coordinate with SCRRA Signal Department forces in accordance with Division 01 requirements.

Demolish and dispose of existing grade crossing material including asphalt concrete pavement, sidewalks, ballasts, curbs and gutters and other items as required in the plans in accordance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way" and special provision, "At-Grade Crossings".

Remove and salvage existing grade crossing panels or other crossing appliances as required in the plans in accordance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way" and special provision, "At-Grade Crossings".

Track subgrade, asphalt underlayment, and ballast shall be constructed to extend at each end, beyond the limits shown for each grade crossing in accordance with SCRRA Engineering Standards ES4021 or as shown in the plans, whichever is greater.

Contractor must execute Work under this Specification in such a manner as to minimize impact to the daily operation of the railroad, vehicular and pedestrian traffic in accordance with these provisions and the approved Traffic Control Plans.

Contractor must maintain vehicular traffic and pedestrian walkways using barricades, warning signs and warning lights in accordance with these contract documents.

Warning lights shall be set so they do not shine into the eyes of locomotive engineers in on-coming trains.

Temporary pedestrian walkways shall meet ADA Standards.

The Contractor must protect against erosion and uncontrolled run-off within and adjacent to right-of-way in accordance with the Storm Water Pollution Prevention Plan (SWPPP) and the approved National Pollutant Discharge Elimination System (NPDES) Permit.

The Contractor must obtain required permits for dewatering and legally dispose of water from dewatering operations.

Contractor must provide for site cleanliness, sweeping and dust control in accordance with the contract documents.

Contractor must provide noise abatement as required by environmental permits or local agency requirements in accordance with the contract documents.

Prepare subgrade in accordance with the Contract Documents, Section 19, Earthwork and SCRRA Engineering Standards ES4021.

Remove existing concrete foundations, curbs, sidewalks, storm drains, pavement and traffic striping as shown in the plans in conformance with Section 7-1.13, "Disposal of Material Outside the Highway Right of Way".

Cut lines for asphalt and concrete shall be straight and neat. Damage to facilities to remain shall be repaired to the approval of the Engineer at no cost to SCRRA or Caltrans.

Drainage and sub drainage work including placement of geotextile wrap of perforated drainage pipe, shall be performed as specified in the Contract Documents and in accordance with SCRRA Standard Plans ES4021 and ES4023.

Hot Mix Asphalt (HMA) paving for crossing underlayment shall be according to Section 39, Asphalt Concrete and as shown in SCRRA Engineering Standards ES4021.

Hot Mix Asphalt (HMA) paved end ramps shall be provided at concrete grade crossing panel installations in accordance with SCRRA Engineering Standards ES4021 if the preapproved crossing panel is used. End ramps shall be per the manufacturer's recommendation of a substitute is approved, but shall not be less than 3 feet in length.

Place new sidewalks, curbs, gutters and other roadway items as shown in the plans, the identified standards of the public agency identified in the plans responsible for the roadway and SCRRA Engineering Standards ES4001 through ES4004.

Highway-Railroad Crossing Crossbuck signs, when called for, shall be installed in accordance with SCRRA Standard Drawing ES 4101.

Private, Pedestrian and Bicycle Railroad Grade Crossing Sign, when called for, shall be installed in accordance with SCRRA Engineering Standards ES4102.

Temporary construction crossing signs, when called for, shall be installed in accordance with SCRRA Engineering Standards ES4023.

Install precast concrete grade crossing panels to the position and location shown in the plans in accordance with manufacturer's recommendations, the approved procedures and SCRRA Engineering Standards ES4021.

Contractor must use SCRRA Engineering Standards ES4021 when using the preapproved crossing plank.

Contractor must clean dirt and debris from the flangeways before releasing the crossing for the passage of trains.

Place and spread ballast in accordance with the details indicated on the plans, SCRRA Engineering Standards ES4021 and the special provision, "Trackwork".

Grade crossing ties shall be spaced per crossing plank manufacturer's recommendations if not the pre-approved crossing plank, and spacing per SCRRA Engineering Standards ES4021 if the pre-approved crossing plank. Other tie location and layout distances shall be per the SCRRA Engineering Standards ES4021.

Tops of ties within the crossing limits shall lie in the same plane. A tie with an irregular surface dimension shall be adzed or replaced.

Construction and fastening of track through grade crossings shall be performed in accordance with details shown on the plans, SCRRA Engineering Standards ES4021 and the special provision, "Trackwork".

Rail joints or thermite welds are not permitted within the limits of the grade crossing trackwork unless approved by the Engineer.

Rail joints consisting of field welds are permitted at the ends of rail strings placed for crossings. Welds shall conform to special provision, "Field Welding Rail".

Contractor must use a dynamic stabilizer after initial tamping and surfacing followed by a second surfacing pass in accordance with the special provision, TRACK SHIFTING, RELOCATION AND RESURFACING, prior to the final installation of the grade crossing panels.

Compaction testing for subgrade, trench backfill and sub-ballast shall conform to Section 19, Earthwork.

Compaction testing for asphalt concrete crossing underlayment shall conform to Section 39, Asphalt Concrete.

Contractor must coordinate with and provide 24 hours advance notice of crossing work to SCRRRA Signal Inspectors and verify that testing of crossing signal work has been completed and accepted by SCRRRA prior to opening crossing to vehicular traffic.

MEASUREMENT AND PAYMENT

The contract price paid per linear foot for Construct Concrete Grade Crossing Panels includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in At-Grade Crossing, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

14-1.14 SIGNAL SHELTERS

GENERAL

Summary

This Section includes requirements for new factory-wired equipment shelters and relocating existing equipment shelters. The Contractor shall refer to State-Furnished Materials, to determine if new factory-wired Signal Shelters are to be furnished by the Authority, or if the Contractor will be the responsible for supplying the new shelters.

When the Signal Shelters are furnished by the Authority they must be in conformance to these specifications. The Contractor shall inspect the supplied Shelters and equipment and notify the Engineer of any major deviation from these requirements prior to acceptance from the Authority.

Installation and field modification of the new factory-wired equipment shelters by the Contractor to meet the requirements of the railroad plans shall meet or exceed the requirements of this Section.

Definitions

Not Used

Submittals

Submit proposed Installation Test Procedures.

Submit load calculations, indicating sizes of load center panel, voltage drops, and other 240/120 Vac equipment.

Submit Contractor's Inspection and Acceptance Procedure.

Submit four copies of shop drawings showing the proposed size and equipment layout including rack, air conditioner, lighting, convenience outlet arrangement, and exhaust fan mounting and location.

Submit four copies of shop drawings of each instrument and entrance rack, showing the arrangement and description of the mounted equipment and wiring if different from those shown on Contract Drawings.

Submit four copies of shop drawings of the complete grounding arrangement.

Factory Test Procedures proposed.

Shop drawings shall be submitted within 30 days of NTP.

Quality Control and Assurance

The systems housed in shelters and cases shall be assembled by a facility normally engaged in such work. The Contractor shall submit documentation that the wiring facility has assembled a minimum of one hundred (100) systems in shelters and cases in the most recently completed calendar year. Certification that the shelters and cases shall be wired and assembled in a facility operated by GE Transportation Systems Global Signaling, Railroad Controls Limited (RCL), or Safetran Systems is acceptable.

The factory test of the shelters, and the functioning of the equipment contained within each, shall be conducted in accordance with the Contractor's approved Factory Test Procedure.

The instrument enclosures shall be assembled and wired to conform to the Drawings. Contractor shall ensure the enclosures are free from defects and that workmanship is of the highest quality.

Each shelter will be inspected after it has been installed and the Contractor shall correct any deficiencies. This inspection will be conducted in conformance with the requirements of the Contractor's accepted Installation Inspection Procedure.

The Contractor shall provide documentation of acceptance "in good condition" before removing and transporting existing shelters to the job site.

The Contractor shall provide documentation of Factory Acceptance Testing before transporting new shelters to the job site.

Each shelter and case will be inspected after they have been installed and the Contractor shall correct any deficiencies. This inspection will be conducted in conformance with the requirements of the Contractor's accepted Inspection and Acceptance Procedure.

Resident Engineer reserves the right to make inspections and tests at the facility where the wiring services are to be performed to determine if the equipment and workmanship meets the requirements of this Specification.

MATERIALS

House General

Furnish and install factory-wired equipment shelters, as described herein and as shown on the railroad plans. These shelters shall be complete with the equipment shown on the railroad plans. Wiring shall conform to the requirements of the AREMA C&S Manual, NEMA Standard ICS-70, or National Electrical Code (NEC), as applicable.

Equipment shelters shall be products manufactured by P.T.M.W., Safetran Systems, GETSGS, or an approved equal.

Equipment shelters shall be the size and layout shown on the railroad plans.

Equipment shelters shall be rain-tight and dust-tight, National Electrical Manufacturers Association (NEMA) 3R, ventilated, and have hinged doors with three point catch and handle and have welded construction throughout. Welds shall be 1-1/2 inch minimum in length with spacing not to exceed 6-inches where panels meet floor and roof. Spacing on panel welds shall not exceed 18-inches.

Equipment shelters shall be constructed of 12-gauge galvanized steel for floors, walls, and doors. Roofs shall be no less than 14-gauge galvanized steel with a minimum of 50 pounds per square foot loading as shown on the railroad plans .

The entire structure shall be powder coated on the outside with TGIC Polyester Powder (or equal polyester powder) with a nominal thickness of four mils, but no less than three mils at any point on the surface of the enclosure in accordance with AREMA C&S Manual Part 1.5.10. The exterior color shall be light gray.

The steel instrument enclosures shall be complete with moveable shelves, wire chase, and backboard.

The equipment shelters shall provide access to underground and aerial cable entrance behind the main terminal rack. The top and sides shall be lined with heat and cold insulating material and constructed to prevent sweating. Provide ventilation openings as required for the size of the shelter proposed. No ventilation opening shall be made in the roof of the shelter. Provide lift rings to facilitate the movement of the shelter.

Provide ventilation openings in each door. The exterior of the ventilation openings shall be hooded to minimize the entrance of precipitation. Equip the interior of ventilation opening with sliding plate to allow the adjustment of airflow and with a replaceable dust filter. The doors shall be hinged and gasketed so that they will provide a dust proof and weatherproof seal. Provide doors with exterior and interior handles, (interior handles not required on cases) welded to a three point locking device to ensure that the door cannot be locked until it is in the fully closed position. Provide doors with a two-position retaining device to secure the door when open.

Door openings shall be 32 inches wide by 86 inches tall unless otherwise specified on the railroad plans.

Provide thermostatically controlled exhaust fans, operated from 120 Vac and fused separately, in each shelter, as shown on the railroad plans. The thermostat that activates the fan control shall be adjustable and operate in the range of 70 degrees to 130 degrees Fahrenheit. Locate fans relative to the fresh air inlets to draw air over the equipment and size to renew the air within the shelter every 3 minutes. Exhaust fans shall have removable dust filters. Dust filters shall be either replaceable or cleanable.

Hinges shall be separate castings securely fastened to the shelter and door. The hinges shall be equipped with bronze hinge pins, shall be lubricated by the manufacturer before the case is shipped, and shall have grease fittings for later lubrication.

Furnish equipment shelters with interior lighting and duplex 120 Vac power receptacles. Equip shelters and cases with double tube fluorescent lights, minimum 40 watts each, as required to provide complete illumination for passages and sides, and operated from a switch conveniently placed near each entrance door. Furnish convenience outlets as part of each switch.

Shelter lighting and receptacle loads shall be fed from a ground fault interrupt circuit breaker used exclusively for these loads. Signaling logic and signal appliance power loads shall be fed from separate circuit breakers. The signal logic power and signal appliance power shall be ungrounded. The Contractor shall size circuit breakers and wiring.

Furnish shelters complete with a 120/240 Vac power distribution panel, circuit protective devices, and appurtenances necessary to supply the ac power required at each site.

Access points in the enclosure shall be sealed for weather protection and against entry of rodents. All interior and exterior seams shall be caulked with RTV silicone.

Enclosure foundations shall be the inner wall type and adjustable from the outside of the enclosure. The range of adjustment shall be from 36-inches to 52-inches in 1/2-inch increments. Located in the wall the foundations shall be galvanized steel, a minimum of 60-inches long, include hardware, and a 12-inch x 12-inch x 1/4-inch footing pad. Galvanizing shall conform to the AREMA Signal Manual, Part 15.3.1

Permanent vendor name plate, or equivalent, complete with vendor name, address, model number, serial number, and date of manufacture or equivalent shall be located on front.

Case General

Case shall have welded construction throughout. Welds shall be 1-1/2 inch minimum in length with spacing not to exceed 6-inches where panels meet floor and roof. Spacing on panel welds shall not exceed 18-inches.

Interior surfaces including top, sides, and shelves shall be finished with primer coat and 2 coats of white latex enamel paint.

Paint shall be fire retardant.

Key slot channels shall be provided on each side and extend to the full inside heights of the case. Keyhole spacing shall be 2-1/2 inch centers. Key slot channels shall be flush with insulation.

Sides, top, and doors shall include 1-inch of fiberglass faced polyisocyanurate insulation. Floor shall include 1/8-inch bi-directional pyramat rubber matting.

Permanent vendor name plate, or equivalent, complete with vendor name, address, model number, serial number, and date of manufacture or equivalent shall be located on front.

Cases shall be equipped with a minimum of 2 lifting/tie down lugs located at roofline on each side.

Cases shall include 4 knockouts with cover plates and gaskets on sides 'A' and 'C' in the upper corners. Internal insulation at entry locations shall be precut for ease of removal and equipment installation.

Access points in the case shall be sealed for weather protection and against entry of rodents. Interior and exterior seams shall be caulked with RTV silicone.

Exterior shell shall be constructed of 12-gauge galvanized steel.

Exterior surfaces, including bottom of floor, shall be powder coated with TGIC polyester, color light gray, nominal thickness of 4 mils but not less than 3 mils thick.

Shelving and backboard shall be constructed of 3/4-inch MDO two-sided plywood and finished on all sides, with primer coat and 2 coats of fire retardant white latex enamel paint, before mounting.

Shelving shall be adjustable vertically in 2-1/2 inch increments and conform to the keyhole specifications.

Shelves shall be 12-inches wide and covered with 1/8-inch bi-directional pyramat rubber matting. The shelf length will be determined by case size or as shown on the railroad plans.

Exposed edges on shelving, including rear edge, shall have a 1-inch facing constructed of 14-gauge sheet metal, designed for this purpose. Facing shall be aluminum or steel with rust preventive paint or plating. Facing shall be attached with screws and be free of burrs or sharp edges.

Surface area of backboards and shelves shall be free of protrusions such as bolt heads. The bottom of the backboards shall be cut level as shown on the railroad plans.

The width of the backboard shall be determined by the size of the case or as shown on the railroad plans.

Door gasket shall be compressed 1/2-inch free height when door is closed and locked. The gasket shall be coated with an approved lubricant to prevent sticking.

Three bolt on hinges, separate castings, with bronze hinge pins and grease-able, (3/16-inch zerk), fittings shall be installed with an anti-theft arrangement.

Doors shall be lubricated before leaving the factory.

Heavy-duty three point locking system shall be furnished with each door. Latch and locking system shall operate smoothly through complete opening and closing cycle. The door handle must accept a large bail padlock. (Polar Hardware brand #7011) or approved equivalent.

Doors shall be provided with rods to hold door open at 90 degrees and near 180 degrees. Door insulation shall be covered by an interior sheeting to protect the insulation and to add rigidity to door.

Louvers shall be provided in doors with adjustable cover plates for winter and summer usage. The door shall accommodate an adjustable air intake sized to accept a 1-inch x 10-inch x 20-inch replaceable filter.

A drip channel (or roof design) shall be incorporated into the design to direct water away from opening. Y. Case shall include six- 4-5/8 inch knockouts in the floor behind the backboard with cover plates. Four cable risers 36-inches long, complete with male adapters, lock nuts, and bushings shall be included. The knockouts shall be equally spaced behind the backboard.

House General Electrical Specifications

Vendor installed electrical products shall be UL listed. Electrical work shall conform to the National Electrical Code (NEC) standards and accepted practices.

Conduit and device box sizes shall conform to NEC Article 370.

The typical Breaker box shall be Square 'D' 100 AMP; Model QO12M100. The breaker box shall be furnished with the following breakers, one QO120 GFI, one QO230, one QO130, and 7 QO120.

Bushings shall be installed on conduits entering or leaving the breaker or device boxes. An SDSA-1175 surge arrestor shall be mounted on the top of the breaker box.

The Breaker box ground buss shall be bonded to the breaker box and the nearest keyway using an ERICO 'VS' welded connection designed for this purpose. The neutral buss shall not be bonded during manufacture. The field shall bond the neutral at the remote (main) disconnect when used.

The neutral bonding screw shall be packaged and shipped in the breaker box for installation in the field if necessary.

Conduits shall be installed above the wire chase and secured to enclosure structure. Flex conduit shall not be used except when used as a drop or attached to equipment that maybe removed. Circuits must be routed in separate conduits. The fluorescent lamp fixtures shall not be used for a junction box, raceway or conduit for circuit other than the one intended for lamp operation.

One separate 20 AMP plug circuit shall be provided on the 'A' and 'C' walls as shown on the railroad plans. The end plugs shall be 8-inches from the 'D' wall and 18-inches from the 'B' wall the remaining plugs shall be centered between them.

Separate 20 AMP circuits (equipment power drops) shall be provided on the 'A' and 'C' walls. The junction boxes shall be located, above the wire chase, as shown on the railroad plans. The wires from the panel shall be terminated (wire nut and taped) in the junction box. One piece of aluminum flexible conduit, 48-inches long shall be supplied for each junction box and installed by the wiring shop. The conduit shall be coiled up and shipped along with other house material.

Bungalows to have provisions for connection of an auxiliary generator as shown on the railroad plans. Provisions for this arrangement to include the following: 1ea. 125/250V 3-pole 4 wire flange male inlet plug NEMA Type L14-30P with exterior spring loaded weather proof outlet cover (Bryant #71430-MBWP). Main breakers to be 100 AMP (Square 'D' #QO2100) for bungalows with 2-pole 30 AMP breaker (Square 'D' #QO230) positioned adjacent to main breaker with mechanical interlock (Square 'D' # QO2DTI). DO NOT SUBSTITUTE.

General color code and wire specifications for AC wiring are as follows. Wiring shall be THHN or THWN solid copper or as required by the NEC.

GFI Breaker to Receptacle/Thermostat	#10 Black
GFI Breaker to Receptacle	#10 White
GFI Receptacle Ground	#10 Green
Thermostat to Vent Fan	#14 Red
Fan Neutral	#14 White
Breaker to Light Switch	#10 Black
Light Switch to Light	#10 Red
Light Neutral	#10 White
Breaker to Receptacle A & C walls	#10 Black
Receptacle Neutral	#10 White
Receptacle Ground	#10 Green

The service entrance shall be a 2-inch EMT conduit, entering the bottom of the breaker box. The conduit shall extend through the floor. Sufficient length shall be left to allow easy coupling. The open end shall be capped and protected while in transit.

One 36-inch piece of 2-inch EMT conduit shall be included along with a compression coupling. The conduit and coupling shall be secured and shipped inside the enclosure.

A single or 3-way light circuit shall be provided based on house size and door arrangement. One 115/120V-20 AMP duplex receptacle shall be mounted with each light switch, near the main enclosure entrance (D and/or B-wall). The fan thermostat control unit shall be mounted to the light switch/duplex receptacle handy box on 'D' wall.

A minimum of 2 double tubes, 4-foot fluorescent fixtures, 40 watts each and tube guards shall be installed in each enclosure. The actual quantity and location of lights shall be based on the enclosure size or as shown on the railroad plans.

An air conditioner, sized for the structure, shall be supplied and located as shown on the typical drawings. A 30 AMP circuit, with a single 30-amp receptacle, shall be provided.

Bushings shall be installed on all conduits entering or leaving the breaker or device boxes. An SDSA-1175 surge arrester shall be mounted on the top of the breaker box.

Case General Electrical Specifications

Vendor installed electrical products shall be UL listed. Electrical work shall conform to the National Electrical Code (NEC) standards and accepted practices.

The breaker box for cases shall typically be a Square 'D' 100 AMP; Model QO6-12L100S mounted as shown on the typical drawings. Circuit breakers supplied with the case shall be Square 'D' QO series as follows, one- QO120 GFI, two- QO120.

Conduit and device box sizes shall conform to NEC Article 370.

Bushings shall be installed on conduits entering or leaving the breaker or device boxes. An SDSA-1175 surge arrester shall be mounted on the top of the breaker box.

The breaker box ground buss shall be bonded to the breaker box and the enclosure frame using an ERICO 'VS' welded connection designed for this purpose. The neutral buss shall not be bonded during manufacture. The field shall bond the neutral at the remote (main) disconnect when used.

The neutral bonding screw shall be packaged and shipped in the breaker box for installation in the field if necessary.

General color code and wire specifications for AC wiring are as follows. Wiring shall be THHN or THWN solid copper or as required by the NEC.

GFI Breaker to Receptacle	#10 Black
GFI Breaker to Receptacle	#10 White
GFI Receptacle Ground	#10 Green
Breaker to Light Switch	#10 Black
Light Switch to Light	#10 Red
Light neutral	#10 White

The service entrance shall be a 2-inch EMT conduit, entering the bottom of the breaker box. The conduit shall extend through the floor. Sufficient length shall be left to allow easy coupling. The open end shall be capped and protected while in transit.

One 36-inch piece of 2-inch EMT conduit shall be included along with a compression coupling. The conduit and coupling shall be secured and shipped inside the case.

Cases must have provisions for connection of an auxiliary generator as shown on the railroad plans. Provisions for this arrangement to include the following: 1ea. 125/250V 3-pole 4 wire flange male inlet plug NEMA Type L14-30P with exterior spring loaded weather proof outlet cover (Bryant #71430-MBWP). Main breakers to be 60 AMP (Square 'D' #QO260) for signal cases with 2-pole 30 AMP breaker (Square 'D' #QO230) positioned adjacent to main breaker with mechanical interlock (Square 'D' # QO2DTI). DO NOT SUBSTITUTE.

6-9 cases shall include one switched incandescent light circuit. The fixture shall be complete with 100 watt equivalent lamp and metal lamp guard.

A GFI protected duplex plug and light switch shall be mounted inside on the end (C) wall as shown on the railroad plans. The light with metal guard shall be mounted in the front at the top-center of the case.

Equipment Mounting

General

Mount equipment as shown in the railroad plans.

Mount equipment so a seismic event within the parameters of Special Provision, General Signal Requirements, will not cause damage or excessive motion.

Relay Plug boards

Design plug boards for insertion of removable type contacts. The method of attaching the wires to the removable contacts shall be solder less connections. Design plug board so that the removable contact will have a direct connection with the contact and coil prongs. The plug boards shall be in accordance with the applicable sections of AREMA C&S Manual, Part 6.2.2.

Wires shall be of sufficient length to permit them to be moved to any contact on the same relay.

Equip the plug boards for vital relays with a registration plate to prevent relays of the wrong type, contact arrangement, or operating characteristics from being inserted.

Identification

Stencil a white identification number at the top of the front and rear frames of each rack or panel.

There shall be an identifying nameplate for each relay or other instrument mounted on the rack or panel.

Equip the back and front of the relay plug boards with a tag, as specified in Special Provision, Signal Systems Miscellaneous Products. This tag shall indicate the nomenclature of the relay.

Identify terminals and both ends of wires with a wraparound tag printed with the circuit nomenclatures and terminal designations as shown on the railroad plans and Special Provision, Signal Systems Miscellaneous Products.

Wire and cable conductor identification tags for terminal board mounting shall be specified in Special Provision, Signal Systems Miscellaneous Products.

Cable Entrance Terminal Boards

Cable Entrance Terminal Boards shall be 3/4-inch Type AB exterior (five ply) plywood mounted on a rack and painted white with a fire retarding paint.

Cable Entrance Terminal Boards shall be located as shown on the railroad plans.

Multiple-unit terminal blocks for wire and cable conductors shall be in accordance with AREMA C&S Drawing 14.1.6. Furnish each binding post with two binding nuts, one clamp nut, and three washers.

Provide Safetran or equal test links on terminal pairs where conductors enter shelters.

Equip binding posts and exposed terminals of other apparatus for circuits exceeding 50 volts or greater (ac or dc) with insulating nuts and sleeves.

Cable entrance facilities shall be located as shown on the railroad plans.

Lightning arresters shall be specified in Special Provision, Signal Systems Miscellaneous Products.

Cable Entrance Pipes

Supply Cable entrance pipes shall be specified in Special Provision, Signal Systems Miscellaneous Products.

Grounding

Shelter shall be fitted with four 48-inch long No. 2 ground wires cadwelded to floor frame of the shelter at each corner. Cadwelding shall take place prior to powder coating the structure. The pigtailed shall be coiled and secured in a manner that prevents damage during construction and while in transit. Cases shall have two 48-inch long No. 2 ground wires cadwelded to floor frame of the shelter at each end.

Supply and install grounding material shall be specified in Special Provision, Signal Grounding.

Internal Wiring

Internal wiring shall be in accordance with Special Provision, Signal Wires and Cables.

Minimum wire conductor sizes shall be as shown on the railroad plans unless otherwise approved by the Engineer.

Adhering to minimum wire size specifications does not relieve the Contractor's responsibility of using wire sized large enough to safely and effectively provide power to the circuit it serves.

Solderless terminals, for stranded wire, shall be in accordance with Section 14-1.22 Signal Systems Miscellaneous Products.

Solid terminal connectors shall be used for short terminal jumpers.

Wire shall conform to the requirements as specified in Special Provision, Signal Wires and Cables.

Painting – Insulation

Instrument enclosures shall be furnished complete with a layer of rigid insulation on the walls, doors, and ceiling. Instrument shelters shall have a minimum 2-inch thick layer of rigid closed cell foam insulation rated R13. Instrument cases shall have a minimum 1/2-inch thick layer of rigid closed cell foam insulation rated R3.3. Insulation shall be suitable for residential installation.

The interior including the ceiling, walls, terminal boards, and shelves shall be finished with a primer and two coats of white latex enamel paint.

Paint shall be fire-retarding type.

Apply typical legend for control point shelters, highway grade crossing shelters and cases as indicated on the Metrolink Standard Drawings. Consult with manufacturer of shelter prior to paint application.

Equipment Racks

Equipment racks shall be the manufacturer's standard for the type of equipment furnished and shall be sized in conformance to the railroad plans.

Equipment racks shall include necessary supports for wire and equipment.

Secure equipment racks by bolts attached to a threaded mounting plate structurally secured to the floor of the shelter. Attach stabilizing straps to the top of the racks as needed. Racks and mounting shall be secure enough to withstand a seismic event as specified in Special Provision, General Signal Requirements.

Other Equipment

Wiring Raceway (Wire Routing): Internal case wiring shall be contained within surface-mounted plastic raceway. Raceway shall be of a polycarbonate, low smoke type with a solid snap-on cover and flexible sidewalls. The sidewalls shall be of "finger" type construction allowing for insertion and removal of wire runs with terminations attached. The manufacturer shall determine sizes. Fill capacity shall not exceed 60 percent.

Panel Board: Furnish a single-phase, three-wire 120/240 VAC, 60 Hz panel board for each shelter furnished under this Contract. Size panel board as shown on the railroad plans. The capacity rating shall be in accordance with the Contractor's load calculations and the railroad plans.

Service meters shall conform to local codes.

Galvanized Shelter Foundations

Houses shall be equipped with telescoping foundations as described in Materials, House General of this Section complete with galvanized bolts, washers, nuts, and associated hardware. Galvanizing shall conform to as specified in Special Provision, Signal Systems Miscellaneous Products, and AREMA C&S Manual, Part 15.3.1.

Galvanized steel foundations for cases 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.

Bolt spacing shall be to manufacturer's standards for the equipment to be supported by the foundation.

Delivery, Storage, and Handling

Properly fasten and brace equipment shipped within shelters and cases to prevent damage during transit. Replace any equipment damaged during transit or prior to in-service operation at no cost to the Owner.

Package vital relays, batteries, and electronic plug-in modules in separate containers for shipment and do not install until the shelter is set at its final location.

CONSTRUCTION

Installation

Mount shelters and cases level and plumb and secure thereon with the hardware provided. Do not use shims, spacers, or other filler devices to level and plumb shelters or cases.

Install cable entrance pipes through the cable knockout holes provided in the floor of the shelter behind the terminal board(s) as shown on railroad plans. Fill pipes with a substance designed for the purpose that prevents entrance of debris, rodents, and other pests.

Ground shelters as specified in Special Provision, Signal Grounding.

Locate shelter as indicated on the railroad plans. If conditions do not allow placement as shown on the railroad plans, submit alternate placement for Engineer's approval.

Install relays on the relay plug boards corresponding to the relay nomenclature and identification plate, and securely fasten in place with the hardware provided by the relay manufacturer.

Place batteries on rubber matting on the floor of the house or bottom shelf of the case. Coat battery posts with approved grease and securely fasten battery connectors to the battery posts. Strap batteries or otherwise secure using a method approved by the manufacturer so that they will not tip or move in the event of an earthquake.

Mark each grade crossing warning device case or shelter with the street name, milepost location, emergency response number, and DOT inventory number per SCRRRA Standards.

Install pull boxes and conduits. Provide slotted pull box covers to accommodate the cable chute at new house locations. Place the house so the chute aligns with the slotted cover.

Make any modifications to the cable chute required to fit the pull box and accommodate the cable installation. If it is necessary to cut the cable chute, ensure no rough edges, sharp edges, burrs, or other surfaces exist which have the potential to injure the cable.

Install foundations, including telescoping foundations, for shelters including Owner-furnished shelters.

AC Power

Wall mount load center as shown on the railroad plans. Mounting height from floor, wire terminations, and clearances shall be in accordance with the NEC.

Install service meters as described in Special Provision, Service Meters.

Field Quality Control

Test the functioning of the equipment contained within the instrument shelter in accordance with the requirements of Special Provisions, Signal System Testing, CFR Title 49, Parts 234 and 236, and AREMA C&S Manual Part 2.4.1.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.15 POWER SWITCH AND LOCK MOVEMENT

GENERAL

Summary

This section includes requirements for dual control switch and lock movement for each interlocked track switch at new switch locations as shown on the drawings. Relocate existing switch machines where indicated on the railroad plans.

Refer to Special Provision, Track Work, for track construction requirements.

Definitions

Not Used

Submittals

Submit installation drawings showing the tie straps and the mounting details of the switch and lock movement, including the connections to the track switch points and target.

Submit Acceptance Test documentation on power switch and lock movement prior to shipment of the movements.

Submit copies of field test reports.

Quality Control and Assurance

Switch and lock movements shall meet the recommendations of AREMA C&S Manual Part 12.2.1, where they do not conflict with requirements specified herein.

MATERIALS

Install all new and complete dual control Power Switch and Lock Movement Layouts, including the switch targets where applicable. Power Switch and Lock Movement shall lock the switch points in power and hand operation. Power Switch and Lock Assembly shall be 110Vdc such as the US&S M23A configuration. The gear ratio shall be 360:1.

Contractor-furnished Junction Box shall be Model N349656 manufactured by U.S. & S. Co. or an approved equal.

Provide and install an insulated front rod per SCRRRA Standards as part of the power switch layout.

Miscellaneous Fittings: The Contractor shall provide all connectors such as threaded nipples, cable clamps, flex wire, tags, terminals and electrical fittings as required for each power switch and lock movement layout including 48-inch-long, 2-inch-diameter liquid tight flexible conduit and connectors from movement to junction box.

Switch targets shall be provided and installed by the Contractor within power switches that the Freight Carrier uses in hand operation during the construction of the project and shall be removed when the power switch is placed in service along with the control point.

Security

Install SCRRRA furnished switch padlocks on trainman's access side of hand-throw levers of power switch when switch has been determined necessary for Freight Carrier to access. Power Switch will be placed in an inoperative mode (all power removed from machine) and hand throw levers padlocked in hand throw position with SCRRRA provided switch locks.

At power switches under construction and not to be used by the Freight Carrier the Contractor shall place the power switch and lock movement in an inoperative mode (all power removed from machine and hand throw lever padlocked in hand position) and switch points secured using a padlockable switch point clamp with Contractor provided padlock. All locks shall be Contractor provided.

Furnish padlocks, with the exception of switches requiring Freight Carrier access, until all systems have been accepted. At final acceptance, the Contractor will remove their padlocks and SCRRRA maintenance will furnish replacement padlocks.

Source Quality Control

Test each switch and lock movement before shipping it to the job site. Conduct this acceptance testing in accordance with the Contractor's Acceptance Test Procedure for switches and lock movements. Submit a copy of documentation of acceptance testing to the Engineer prior to shipping.

Delivery, Storage, and Handling

Protect switch and lock movements and their component layout parts against damage during handling and shipment. During storage, properly lubricate and maintain switch and lock movement layouts on a regular timed program.

CONSTRUCTION

General

Mount and adjust the complete switch and lock movement layout as specified herein and as indicated on the railroad plans.

Wire control and indication circuits for power-operated switches as shown on the railroad plans.

Installation

Prior to installation, coat parts of the switch and lock movement that are not painted, or made of non-corroding material with an approved grease. Suitably plug or cap unused threaded outlets.

Where existing concrete ties are not used, install two 14 foot long timber ties for mounting the switch mechanisms where shown on the railroad plans. If a helper assembly is required, one of the switch mounting ties shall be 16 foot long.

Prior to mounting the switch mechanism on either concrete or timber ties, align the switch head block ties at right angles to the straight stock rail, and space the ties in accordance with the switch shop drawings, and condition the switch points to move without binding.

Provide and install all required components needed including but not limited to bolts, ties, gauge plates, universal plates, rods, switch point rollers and the power switch and lock movements at the locations shown on the Drawings in order to produce a complete power switch installation.

Secure power switch and lock movement to the switch ties using galvanized or cadmium plated bolts of the proper diameter. Bolts are required to have a six sided or square head and a head bolt lock must be used on the underside of the wood tie. All thread threaded rod is unacceptable.

Install the switch and lock movements at the locations shown on the railroad plans.

Secure switch and lock movement to the switch ties using (8) eight 7/8-inch bolts.

Remove any ballast necessary for the installation of each switch and lock movement layout and replace and tamp ballast after the installation has been completed. Spread excess ballast evenly between ties in the vicinity of the switch and lock movement layout. Remove ballast from between ties to allow unrestricted movement of switch rods.

Make a preliminary adjustment of switch and lock layout at the time of installation and a final adjustment when placing it in service, which shall result in the adjusting nuts being centered on the threads plus or minus 30 percent of the thread length. Make final adjustment at the time of the functional test. Make final adjustments in conformance with the requirements of AREMA C&S Manual Parts 12.2.1 and 2.4.1, and the SCRRRA Instructions Governing Installation, Maintenance, Inspection and Testing of Signal Apparatus and Signal Systems.

Do not apply power to the motor until the switch machine has been fully lubricated, thrown, and adjusted in hand throw. There shall be no rubbing or binding of switch rods or points on gauge plates, rails or ties. Follow manufacturer's adjustment and installation procedure.

During storage and after installation, properly lubricate and maintain switch and lock movement layouts on a regular timed program until accepted by the Engineer.

Exercise care and ensure that the switches, including switch tie plates, are thoroughly lubricated at lubricating points, that machined surfaces susceptible to rusting, both external and internal, are thoroughly coated with grease, as acceptable to the Engineer, and that threaded portions of switch rods and nuts are coated and protected.

Lubricate the switch tie plates with graphite lubricant, as acceptable to the Engineer. Thoroughly steam clean the plates to remove oil or grease prior to application of the graphite. Periodically renew the protective coating until the Owner assumes responsibility for maintenance of the equipment.

Removal of switch targets, if applicable, shall be the responsibility of the Contractor after in-service testing has been completed and control point is placed in service.

Security

Install Owner-furnished switch padlocks on trainman's access side of electric locks, and power and hand throw levers of switch and lock movements.

Touch-up

Touch-up the finish of equipment described in this Section in accordance with the AREMA C&S Manual, Part 1.5.10. Color shall match factory finish.

Field Quality Control

Inspect each switch and lock movement after it has been installed and correct any deficiencies noted. Conduct this inspection in conformance with the requirements of the Contractor's Installation Inspection Procedure as accepted by the Engineer.

Conduct final operational tests of switch and lock movements as described in Special Provision, Signal System Testing.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.16 SWITCH CIRCUIT CONTROLLER

GENERAL

Summary

This Section includes requirements for switch circuit controllers.

Switch circuit controller and layout shall be all new and include the controller unit, junction box, point lug, detector rod, shims, all required bolts, nuts, washers, pins, grease fittings, cotter keys, vent elbows, plates, adjusting brackets, and all hardware to mechanically couple the switch circuit controller to the track switch points as a stand alone or in conjunction with an electric switch lock and mount it on the ties.

Refer to Special Provision, 34 Transportation, for track construction requirements.

Definitions

Switch circuit controller layouts shall include the controller unit, junction box, point lug, detector rod, shims, required bolts, nuts, washers, pins, grease fittings, cotter keys, plates, adjusting brackets, and hardware to mechanically couple the switch circuit controller to the track switch points and mount it on the ties.

Refer to Special Provision, Track Work, for track construction requirements.

Submittals

Submit installation drawings showing the tie straps and the mounting details of the switch circuit controller, including the connections to the track switch points.

Submit Contractors Acceptance Test Documentation on switch circuit controllers prior to transport.

Submit copies of field-test reports.

Quality Control and Assurance

Switch circuit controllers shall meet the recommendations of AREMA C&S Manual, Part 12.1.1, for a 4 front/back contact configuration where they do not conflict with requirements specified herein. Mounting details shall conform to the Metrolink Design Standards.

Delivery, Storage, and Handling

Protect switch circuit controllers and their component layout parts against damage during handling and shipment. During storage, properly lubricate and maintain switch circuit controller layouts on a regular timed program.

MATERIALS

Furnish Electric Switch Circuit Controller Layout complete with rod, lug, and associated hardware as designated.

The Contractor provided Switch Circuit Controller and layout shall be Model U-5 with return spring, ventilators and wire outlet as manufactured by Ansaldo STS USA (formerly Union Switch and Signal) or approved equal. Switch Circuit Controller provided by Contractor shall be complete with offset crank, operating rod, switch point lug and associated hardware.

Contractor furnished Junction Box shall be Model 091 428-ABX manufactured by Safetran Systems or an approved equal.

Furnish Insulated Vertical No.1 Rod with Basket.

Miscellaneous Fittings: Furnish connectors such as threaded nipples, cable clamps, and electrical fittings as required for each switch and lock movement layout including 24-inch-long, 2-inch-diameter flexible conduit and connectors from movement to junction box.

General

Stranded wire: Furnish insulated No. 10 AWG stranded wire between the pedestal-mounted junction box and the switch circuit controller. Insulated wire shall be in accordance with Special Provision, Signal Wires and Cables.

Miscellaneous Fittings: Furnish connectors such as threaded nipples, cable clamps, and electrical fittings as required for each switch circuit controller layout.

Security

Padlocks will be furnished by the Contractor until final "acceptance".

At new switches under construction that are not to be used by the Freight Carrier the Contractor shall ensure that the switch points are secured using a padlockable switch point clamp with Contractor provided padlock. All locks shall be Contractor provided.

Source Quality Control

Test each switch circuit controller before transporting it to the job site. Conduct this acceptance testing in accordance with the Contractor's Acceptance Test Procedure for switch circuit controllers.

Delivery, Storage, and Handling

Protect switch circuit controllers and their component layout parts against damage during handling and shipment. During storage, properly lubricate and maintain switch circuit controller layouts on a regular timed program.

CONSTRUCTION

General

Mount and adjust the complete switch circuit controller layout as specified herein and as indicated on the railroad plans. Circuits for switch circuit controllers shall be as shown on the railroad plans.

Installation

Prior to installation, coat parts of the switch circuit controller that are not painted or made of non-corroding material with an approved grease. Suitably plug or cap unused threaded outlets.

Install one 10-foot long timber tie or concrete tie for mounting the controllers as shown on the railroad plans.

Mount controllers on new and existing timber or concrete ties in conformance to Metrolink Design Standards.

Dap and drill timber ties to meet the requirements of these Specifications. Limit of cutting or dapping shall not exceed 2 inches.

Secure the switch circuit controller to the wood switch ties, by 3/4 inch by 10 1/2 inch bolts. Secure switch circuit controller to the switch tie using galvanized or cadmium plated bolts. Bolts are required to have a six sided or square head and a head bolt lock must be used on the underside of the wood tie. All thread threaded rod is unacceptable.

Remove any ballast necessary for the installation of each hand throw switch layout and replace and tamp the ballast after the installation has been completed. Spread excess ballast evenly between ties in the vicinity of the switch and lock movement layout.

Make a preliminary adjustment of the controller layout at the time of installation and a final adjustment when placing it in service, which shall result in the adjusting nuts being centered on the threads plus or minus 30 percent of the thread length. Make final adjustment at the time of the functional test. Make final adjustments in conformance with the requirements of AREMA C&S Manual, Parts 12.1.1 and 2.4.1.

Underground cable terminating in the controller junction box shall be dressed and potheaded as specified in Special Provision, Signal Wires and Cables. Fan the individual conductors in a neat workmanlike manner, properly tagged and terminated. Wiring between switch junction box and switch circuit controller shall be No. 10 AWG insulated stranded flex wire. These wires shall also be tagged and terminated. Install the wires between the controller junction box and the controller mechanism in an approved flexible conduit with a minimum length of 10 inches and a maximum length of 21 inches. Fasten this flexible conduit to the switch junction box and switch mechanism with appropriate connectors.

After installation, properly lubricate and maintain switch circuit controller layouts on a regular timed program until accepted by the Engineer.

Exercise care and ensure that the controllers, including switch tie plates, are thoroughly lubricated at lubricating points, that all machined surfaces susceptible to rusting, both external and internal, are thoroughly coated with grease, as acceptable to the Engineer, and that threaded portions of switch rods and nuts are coated and protected.

Lubricate the switch tie plates with graphite lubricant, as acceptable to the Engineer. Thoroughly steam cleaned the plates to remove oil or grease prior to application of the graphite. Periodically renew the protective coating until the Owner assumes responsibility for maintenance of the equipment.

Connect switch circuit controller rods to the normally closed switch point. In cases where the switch circuit controller is being used with a sliding derail with wheel crowder (hand-throw derail application), connect switch circuit controller to the lug provided with the derail.

Switch assemblies connected to the open point sides, or which have a reverse switch indication shall be equipped with an insulated front rod.

Security

Install Owner-furnished signal locks for switch circuit controller.

Touch-Up

Touch-up the finish of equipment described in this Section in accordance with the AREMA C&S Manual, Part 1.5.10. Touch-up shall match factory finish.

Field Quality Control

Inspect each switch circuit controller after it has been installed and correct any deficiencies noted. Conduct this inspection in conformance with the requirements of the Contractor's Installation Inspection Procedure as accepted by the Engineer.

Conduct final operational tests of switch circuit controllers as described in Special Provision, Signal System Testing.

Test functions of each switch and lock movement layout in accordance with Special Provision, Signal System Testing.

PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.17 RECTIFIERS, BATTERIES AND BATTERY CHARGING EQUIPMENT

GENERAL

Summary

This Section includes requirements for rectifiers, batteries, and battery charging equipment.

Calculate the loads based upon the equipment proposed. Size batteries to provide a minimum 48 hours standby capacity for systems based on normal operating conditions. Verify the ampere-hour capacity shown on the railroad plans is adequate to provide a minimum of 48 hours standby capacity.

Size battery to provide a minimum of 48 hours of uninterrupted power to the signal systems at the normal operating load.

Size batteries which provide power for crossing warning devices, such as gates and flashing lights, to provide 12 hours of continuous operation with the gate arms in the horizontal position and lights flashing. This requirement is in addition to the requirement for 48 hours standby capacity in the previous paragraph.

Submittals

Load calculations of each dc and ac load. Submit calculations identifying normal and worst case conditions for each load.

Quality Control and Assurance

Not Used

MATERIALS

Acceptable Materials

Exide ELM IRONCLAD Single Wet Cell low maintenance Lead Acid Batteries conforming to AREMA C & S manual parts 9.1.1 and 9.1.30 such as:

1. Model (ELM 240, 240AH)
2. Model (ELM 340, 340AH)
3. Model (ELM 425, 425AH)

NRS Battery Charger: Charger conforming to the requirements specified herein as manufactured by Exide Corp. or an approved equal.

1. Model ERBC (24/30 1/36V, 30A)
2. Model ERBC 12/401C (12/40 120V, 40A)
3. Model ERBC 12/201C (12/20 120V, 20A)

VMI Battery Charger – shall be all new and as manufactured by Quality Marine, or approved equal.

1. Model 12302

Battery Charger/Power Pack – shall be all new and as manufactured by National Railway Supply, Inc.

1. Model ELC 120/6

Battery Charger/Power Pack

Model ELC 120/6 manufactured by National Railway Supply, Inc.

Equipment Details

Battery charging equipment shall be designed for continuous operation.

Battery charging equipment shall be designed to deliver rated outputs with input voltage of 100 Vac to 130 Vac at 60 Hz, single phase, two wire input.

Battery charging equipment shall have a reserve capacity of at least 25 percent above the calculated high load requirements.

Each charger shall be provided with programmable output voltage adjustment.

Terminal markings for ac and dc terminals shall be permanent.

The charger shall provide a stabilized output voltage, temperature compensated with output current limiting. The capacity of the battery charger shall be determined by the Contractor and approved by the Engineer. The charger shall adjust its output current automatically, according to the load and to the demand on the battery.

Battery charger shall conform to requirements in AREMA C&S Manual Part 9.2.1. The output of the charger shall be sufficiently filtered to be compatible with the input voltage requirements of the solid-state interlocking units, and other electronic equipment for the signaling system.

Battery Cells shall be square tubular type design, flooded lead acid. Individual battery cells shall have handles incorporated into their design to facilitate lifting.

Batteries shall not release gas, fumes, or toxic substances when operated under normal conditions or when charged or discharged at a maximum recommended rate. Each battery cell shall be equipped with a dual action bayonet type flame-arresting vent plug, having an integral electrolyte level gauge.

Batteries shall be capable of a minimum of 1,500 charge-discharge cycles to 80 percent discharge without loss of capacity. Totally discharged batteries, even if polarity has reversed, shall be capable of being recharged to rated capacity with charging voltage of no more than 2.30 volts per cell. Contractor shall warrant that all batteries supplied shall be free from defective workmanship or faulty materials for a period equal to, or greater than, 20 years, 10 full years of coverage plus 10 full years of pro-rata coverage. The Engineer reserves the right to reject a bid that fails to comply with these specifications.

Miscellaneous Materials

Furnish mounting hardware, terminals, and terminators, and similar items for mounting chargers and batteries in wayside cases and signal instrument shelters.

CONSTRUCTION

Installation

Install batteries and battery charging systems as shown on the railroad plans.

Tests

Perform tests as specified in Special Provision, Signal System Testing, ensuring system operation.

Test batteries and battery chargers in accordance with the manufacturer's standard when installed submit copy of battery and charger records.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.18 RAIL BONDING

GENERAL

Summary

This Section includes requirements for rail bonds, fouling bonds, frog bonds, track circuit connections, and other material required for bonding of track circuit joints, track frog and switch bonding, and track circuit connections.

Definitions

Welded Bonds and track connections shall be in accordance with the requirements of Metrolink Standards.

Rail track joints shall be bonded with welded railhead bonds per Metrolink Standards.

Track switch, frog fouling bonds, and track connections shall be stranded bonds.

Crimped sleeves shall not be used for any fouling or frog bonding unless allowed by the Engineer.

Submittals

Product Data: Manufacturer's catalog cuts, material specifications, installation and maintenance instructions, and other data pertinent to the bonding material, staples, and circuit connections, specified herein and as shown on the railroad plans.

Quality Control and Assurance

Not Used

MATERIALS

Rail Head Bonds: Railhead bonds shall be 3/16-inch in diameter with steel terminals welded to the conductors. They shall have a nominal length of 6 1/2 inches.

Web Bonds: Web Bonds shall be 3/16-inch, 12-inch long welded to the web.

Track Circuit Rail Connectors: Track circuit connectors shall be 3/16-inch stranded bronze conductor, 1-inch tap for welded connection on one end and compression sleeve on the other end for a direct crimp type connection to the track wire, and shall have a nominal length of 4 inches. Use no crimped connections on fouling wires or frog bonding unless authorized by the Engineer.

Bond Strand: Bond strand for fouling wires shall be 3/16-inch single strand with 4/16-inch black PVC insulation.

Acceptable Manufacturers:

All electrical connections to rail shall be welded with the CADWELD® copper-based exothermic welding process as manufactured by ERICO Products or approved equal.

CONSTRUCTION

Installation of Welded Bonds

Install welded bonds at non-insulated rail joints within the limits of this Contract that are not equipped with a bond.

Grind clean with a vitrified grinding wheel the surfaces of the rails where the bond is to be applied. After grinding, clean surface with an approved non-toxic solvent to remove grease and dirt. After the surface has been ground and cleaned, weld the bond wire to ensure a thorough mechanical and electrical connection.

Before beginning work on these bonds, weld in the field, under conditions similar to those of the regular installation, not less than 3 complete bond connections, and as many more as the Engineer considers necessary to determine that the welds are being made satisfactorily. Welds shall be subject to inspection and testing by the Engineer and acceptance as to the method and quality of workmanship will depend on the results of these inspections and tests.

Ensure that each bond connection is thoroughly welded to the rail. The Engineer may require a test of each weld by hammer and striker, or other manner, which in the opinion of the Engineer is reasonable.

Remove welded bond installed by the Contractor that is found to be defective prior to acceptance, and install a new bond.

Welded bonds shall be installed per manufacturer's recommended installation procedure.

Installation of Track Circuit Connections

The plug end of the track circuit connector shall be as specified herein, at a maximum 3 inches from the end of the insulated joint. When there are multiple track connections to be applied at an insulated joint the wayside signal track connection shall be the nearest connection to the insulated joint with crossing detection circuits next and crossing shunts lastly installed in this order. The Contractor shall ensure that the insulating quality of the materials used to protect the splice meets FRA 234.241 requirements. The use of compression sleeves for track circuit connections is only acceptable when making a bond strand connection to underground cable inside of the trackside concrete pull box.

Strip back underground cable a sufficient distance for the exposed conductor to be fully inserted into the compression sleeve. Then compress sleeve with the type of compression tool designed for that purpose.

Track wire installation shall conform to the SCRRA Engineering Standards.

Install track circuit connections. Remove defective circuit connections prior to acceptance, and install a new track circuit connection.

Provide and install bond strand retainer clips made of Electroplated Spring Steel on the rail base to hold terminated bond strand in place as specified in the Signal Standards and as recommended by the manufacturer.

Provide and secure the bond strand along the tie by use of PVC cable keeper for wood ties or "Snap-On" Style Stainless Steel Concrete Tie Clips for concrete ties.

Testing

Shunt test track circuits for continuity of circuit and ensure main line track circuit is de-energized with 0.06-ohm shunt at any point within the track block. Hardwire shunt usage for inspection and certification of wayside track circuits and constant warning devices is unacceptable

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.19 SIGNAL GROUNDING

GENERAL

Summary

This Section includes requirements for a grounding system for the equipment shelter and other wayside equipment apparatus.

Definitions

Not Used

Submittals

Submit Schematic Drawings showing the design and detail of the proposed grounding system for the signal and power equipment proposed to be furnished and installed.

Submit catalog cuts or drawings showing the type of components to be used for the proposed grounding system (s).

Submit Installation and Test Procedure proposed for equipment grounding.

Submit test reports to the Resident Engineer upon completion of testing of a location.

Quality Control and Assurance

Materials and equipment furnished and installed under this Section shall conform to applicable State and local ordinances pertaining to electrical power installations and the National Electrical Code (NEC).

MATERIALS

Ground rods: As manufactured by Copperweld Corp. or an approved equal.

Ground wire as specified herein.

Cadweld connections: As manufactured by Erico Corp. or an approved equal.

General

Ground rods shall be copper-clad stainless steel, in accordance with AREMA C&S Manual Part 11.3.4. The rod shall be at least 10 feet in length and at least 3/4-inch diameter.

Ground rod clamps shall be made of a cast bronze clamp body, with non-ferrous set-screws in accordance with AREMA C&S Manual Part 11.3.4.

Internal ground wire, from the equipment to the ground bus, shall be insulated No. 6 AWG standard copper wire in accordance with AREMA C&S Manual Part 11.4.1. Insulated ground wire shall be colored green.

Provide a grounding bus of nickel-plated hard drawn pure copper in the equipment shelters sized appropriately for the connections involved.

Bare Ground Wire: Soft drawn copper, Class A or Class B stranded, shall meet the requirements of ASTM B8. Sizing of ground wire shall be in accordance with the NEC, except where sizes specified herein or shown on the railroad plans are larger than those required by NEC; UL listed, Label A for lightning protection conductors. Grounding cable shall be continuous without joints or splices throughout its length.

Bolted Grounding Connectors: Use connectors made of high strength electrical bronze, with silicon bronze clamping bolts and hardware in accordance with AREMA C&S Manual Part 11.3.4; designed such that bolts, nuts, lock washers, and similar hardware which might nick or otherwise damage the ground wire, shall not make direct contact with the ground wire.

CONSTRUCTION

General

Ground the following as described herein and in accordance with the applicable requirements of the National Electrical Code (NEC) and local city electrical codes: Service equipment, motor frames, switchgear and equipment enclosures, lighting and power panel boards, transformers, raceways, fences and gates, building or structure steel frames, lighting standards, floodlight poles, and power/light pull boxes/maintenance holes.

The grounding system shall preclude any closed loop grounding arrangements.

Do not ground connections to the track rails; do not use the neutral conductors of the ac power supply.

Grounding under these specifications shall conform to AREMA C&S Manual Part 11.4.1. In cases where these instructions differ, the Engineer will make final determination.

Ground wire/cable runs shall be as short and straight as possible and shall not be interrupted by any device, termination or splice.

Exterior: Equipment Shelter Grounding

At equipment shelters, drive four ground rods into the ground, one near each corner of a structure. At equipment cases, drive two ground rods into the ground, at opposite corners of the structure. The ground rods shall be a minimum of 6 feet apart and shall be driven below ground level. Dig a 12 inch deep trench between the ground rods. Electrically connect each of the ground rods connected to the others, using a No. 2 AWG bare stranded copper cable, welded using "Cadweld" or an equivalent thermal process. Coat Cadweld connections with epoxy resin. Place the ground wires in the bottom of the trench. Backfill trench, returning the soils removed during construction of the trench.

Cadweld shelter's copper ground cables to the ground rods.

Ground resistance, as measured by the "Fall-Of Potential" method, shall not exceed 15 ohms.

Where flexible conduit is used, provide a bonding jumper.

Interior: Equipment Grounding

Equip shelters with a prime ground terminal securely attached electrically to the shelter structure and to the made ground network.

Run ground connections from lightning arresters and equipment chassis separately to ground buses in the shelters, as shown on railroad plans. Connect ground buses to the prime ground with green insulated No. 2 AWG stranded wire.

Properly ground equipment that is powered by or switches voltages greater than 35 volts ac or dc.

Properly ground equipment that has conductors that leave the shelter.

Testing and Inspection

Ground Resistance Testing: Verify that resistance between ground buses and absolute earth, as measured by the "Fall-Of Potential" method, does not exceed 15 ohms without benefit of chemical treatment or other artificial means.

Test Reports: Provide test reports to the Engineer upon completion of ground tests that completely describe ground resistance test procedures and test results. Test reports shall be signed by a technician and witnessed by a representative of the Engineer.

Prior to final acceptance by the Engineer, arrange to have the new ac power service inspected by state and local jurisdictional authorities as required.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.20 SIGNAL SYSTEM TESTING

GENERAL

Summary

This Section includes requirements for tests and inspections to demonstrate that systems, subsystems, assemblies, subassemblies, and components supplied and installed under this Contract are in compliance with these Specifications and with applicable regulatory requirements.

Definitions

It shall be understood where this Section states "as authorized by the Metrolink Signal Manager or Metrolink Signal Engineer" or "submit to the Metrolink Signal Manager or Metrolink Signal Engineer" such authorization or submittal shall be through the Engineer.

Tests and inspections shall be made both during the progress of this Contract and after completing installation of equipment, and shall consist of factory tests of Contractor Furnished equipment, circuit breakdown tests, wiring verification tests, continuity tests, resistance tests, voltage and current tests, applicable locking tests, operating tests, simulation tests, and other electrical and mechanical tests and inspections.

The work shall include tests required to ensure proper and safe operation of systems and subsystems, and to prove the adequacy and acceptability of the total installation. Tests to be performed shall cause each system and subsystem to be sequenced through its required operations, including imposition of simulated conditions to prove that the installation complies with specified fail-safe requirements.

Each Contractor furnished component and unit of the wayside signal and highway grade crossing system shall have an inspection performed at its point of manufacture and evidence of this inspection and acceptability shall be indicated on the item where practicable.

Conduct an acceptance test on Owner furnished equipment prior to loading at the warehouse. Provide certified acceptance reports with each unit at time of delivery.

Work shall include costs of the Contractor's personnel and special equipment and assistance required to conduct tests with complete documentation.

Supply test equipment of proper type, capacity, range, and accuracy to perform required tests and inspections.

Test equipment used shall be in good working order and properly calibrated within 6 months of the date of the tests. This equipment shall display a sticker indicating its calibration date and the agency that performed the calibration.

Calibration of each instrument shall be certified by a recognized testing facility. Instruments with out-of-date calibrations will be considered non-certified. Tests conducted with non-certified instruments will be rejected.

In the event that the system does not meet requirements, make necessary corrections and retesting. Complete tests and inspections prior to performing final in-service tests.

Work shall include necessary disconnecting and reconnecting to perform the specified tests.

Signal systems test work specified elsewhere in these Specifications shall be construed as related to an inclusive with the testing described herein.

Field tests shall be coordinated with the Engineer. As many tests and inspections as possible shall be completed prior to the final cutover to avoid train delay, inconvenience to the travel public, and cost to the Owner. Place systems in-service in phases where possible, reducing the actual cutover period.

Tests shall ensure conformance with CFR 49, Parts 234 and 236, and shall be recorded on forms provided by the Engineer and signed by the Contractor's Signal Engineer directing each test and inspection.

Tests and inspections shall conform to the SCRRA Instructions Governing Installation, Maintenance, Inspection and Testing of Signal Apparatus and Signal Systems. Owner will provide 3 copies of this Manual at the Pre-Construction meeting. Refer to Special Provision, Project Management and Coordination, Contract Meetings. Request guidance from the Engineer where the test and inspection requirements written herein conflict with SCRRA Instructions Governing Installation, Maintenance, Inspection and Testing of Signal Apparatus and Signal Systems. In the event that the test or inspection to be provided by the Contractor is not provided in the SCRRA Instructions Governing Installation, Maintenance, Inspection and Testing of Signal Apparatus and Signal Systems the Contractor shall request in writing to the Resident Engineer instructions of the testing required.

Testing, including pre-testing, shall include operating switch machines and lighting signals. The use of lamp simulators in lieu of, or in parallel with signal lamps will not be allowed in pre-testing. An exception may be authorized by the Metrolink Signal Manager or Metrolink Signal Engineer where a signal or switch machine is in service and will be reconfigured for final cutover, or cannot be installed or wired until final cutover.

An appropriate meter shall be used when testing circuits. Visual observation of a relay is only valid when coil voltage or current or contact voltage, as applicable, is also measured.

Test and inspection procedures shall be subject to the Metrolink Signal Manager or Metrolink Signal Engineer's acceptance and shall comply with regulatory requirements and the manufacturer's recommended test procedure.

Notify the Engineer in writing at least 48 hours prior to each field test. No part of the signal system shall be placed in service without an authorized representative of the Engineer being present and witnessing the in-service tests.

Submittals

Submit the following pre-test information to the Resident Engineer for acceptance:

A pre-testing authorization request to the Engineer 15 days in advance of proposed pre-testing for acceptance. The request must include:

- A. Names of Contractor's Signal Engineer in charge of pre-testing.
- B. Other personnel assigned to the pre-test who will be performing the tests or assisting with the tests.
- C. List the assigned locations of the Contractor's personnel and their designated duties during the pre-test.
- D. An outline of the tests to be performed on each type of component, unit, or system, together with samples of the corresponding test records. The outline shall be arranged to indicate the proper sequence of each test to be performed on each component or unit. In addition, the date and time will be shown for each test.
- E. Detailed description of each test to be performed, including the operating parameter to be tested. Test equipment to be used for the test, including the model number, serial number, calibration period, last calibration date and a brief description of the purpose of the test equipment.
- F. Description of equipment to be used for communication between the various individuals involved in the testing.

Schedule of pre-testing Contractor proposes to perform which includes beginning and ending dates, times, and locations in a time-line format.

Identify any test or operation that may disrupt or disarrange the existing signal circuits or systems. Include description of proposed safety provisions and back-up contingency plans.

Submit the following in-service testing information to the Engineer for acceptance:

1. Submit, 60 days in advance of any in-service testing, a detailed cutover and in-service test procedure. This procedure shall indicate the Contractor's personnel involved, their assigned location, and responsibility during the in-service testing. Include the following for Contractor-directed signal cutovers (the following does not apply to Owner-directed signal cutovers): The test procedure shall adequately reflect the test to be performed and the sequence in which the tests shall be performed. A signal aspect chart indicating the appropriate signal aspect to be displayed as train simulation tests are made shall be included. The signal aspect chart shall indicate the progressive down grading of signals and track codes and shall reflect the resulting signal aspect displayed as a result of a light-out condition.
2. The test procedure shall include an outline of the tests to be performed on each type of component, unit, or system, together with corresponding samples of test record forms and cards. The outline shall be arranged to indicate the proper sequence of each test to be performed on each component or unit; the numbers of each type of component or unit to be tested to demonstrate adequacy of design and quality control; and a line diagram showing the grouping and sequencing of system and subsystem.

Contractor's testing procedures and cut-over plan must pass the Metrolink Signal Asst. Director or Metrolink Signal Engineer's and the Operating railroads review. Allow 30 days for this approval process. In the event the Contractor's testing procedures and cutover plan is rejected in any manner, the Contractor shall not be entitled to any claim for delay or compensation from the Owner.

Record the results of each test, as herein specified, and submit copies of the field test reports to the Engineer immediately at the completion of the cut-over testing. Prepare final type-written test reports as indicated herein and submit to the Engineer within 5 days after the completion of each test. Final Type-written test reports shall include complete details of the test results and corrections or adjustments performed or which remain to be completed. The type-written test reports shall be signed and dated by the Contractor's responsible employee. Furnish certified test results for tests performed by any subcontractors, when such tests are required within these specifications.

Where required in this Section, submit test results on completed Metrolink test record forms.

Submit test reports for any additional tests required by the Contractor to ensure the safe operation of the system to the Engineer.

Upon completion of all tests and prior to acceptance, the Contractor shall submit a detailed letter of locations completed and certifying that all tests necessary to comply with all current regulatory requirements of these specifications have been performed at listed locations.

Quality Control and Assurance

The Work and testing shall comply with the following standards and regulatory requirements: AREMA Communications and Signals Manual, Part 2.4.1. and CFR, Title 49, Parts 234 and 236.

MATERIALS

Site Test Instruments and Equipment

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, stands, and similar items necessary to conduct the particular test in a completely professional manner.

Temporary Test Materials

Temporary or interim test related materials, special tools, connections, jumpers, and similar items shall be furnished and available not less than one week in advance of the test need.

Factory Tests and Inspections

Wiring and equipment shall be checked to verify conformance to the railroad plans and the Specifications.

Each control point, intermediate signal, grade crossing warning system shelter or other signal equipment shelter shall be tested to verify that it functions properly before it is shipped to the field for installation. These tests shall involve connecting control systems (excluding signals, switches, and similar equipment) that make up a control point, intermediate signal, grade crossing warning system shelter, or other signal equipment shelter; applying power; and then exercising each function of the system and verify proper result.

Provide confirmation that required factory tests of Systems, sub-systems, assemblies, sub-assemblies and components supplied under this Contract have been performed. Each component and unit shall be inspected at its point of manufacture and evidence of this inspection and acceptability shall be indicated. Certified test reports shall be furnished.

CONSTRUCTION

Field Test Procedures

Perform as many pre-tests as possible in advance of in-service testing. Include, at a minimum, the adjustment of tunable joint couplers, microprocessor based coded track circuits, verify signal aspects against received and transmitted codes. Verify operation of, calibrate grade crossing prediction units, and adjust grade crossing signal control equipment as required to assure proper operation. In order to have a successful cut-over, it is essential that as much pre-testing and advance wiring be completed on the Main tracks before in-service testing begins.

Condition precedent for in-service testing and cut-over will be the completion of pre-testing and the Metrolink Signal Manager or Metrolink Signal Engineer's acceptance of the results. Complete pre-testing and submit the results to the Engineer not less than one week prior to the proposed cut-over date.

The field tests performed shall cause each installed system and subsystem to be sequenced through its required operations, including the imposition of simulated conditions, to demonstrate that the installation complies with specified fail-safe design requirements and operational functions.

Demonstrate the quality of installation by field tests for continuity, insulation resistance, resistance of ground connections, circuit breakdown, visual inspection, and other tests required by these Specifications. Perform these tests prior to operational testing of systems or subsystems.

The Contractor's test procedures shall consist of preprinted data sheets or inspection forms. Where applicable, results of test results shall be recorded on Metrolink forms. These forms will be provided by the Engineer. When completed by the field test personnel and checked for accuracy and completeness, submit the sheet as the test report.

When tests require specific meter or test instrument readings, the preprinted data sheet shall show the allowable range of values, for each part of the test. The test report shall also contain a check off system for each action and a blank space adjacent to the expected value in which to record the test readings.

Test reports shall be dated and signed by the responsible employee of the Contractor or subcontractor on the day the test is performed. Space shall be provided for the signature of the witnessing inspector.

The report shall show the specific test instruments used on each test, with instruments identified by name, type, serial number, calibration date, and calibration due date.

If an error is discovered during field testing due to field wiring and connections that do not agree with the accepted circuit plans, the Contractor may correct errors without prior acceptance of the Engineer. The Contractor shall not make changes that deviate from the railroad plans without prior written acceptance of the Engineer.

The Engineer will make final determinations if only a part, or the whole test, shall be rerun when a specific field test does not meet the requirements specified for the test.

Any changes made after completion of test procedure shall be re-tested in accordance with the applicable test procedure and regulatory requirement.

General Field Tests and Inspection

Perform general field tests including the tests listed herein.

- A. Ground verification test.
- B. Dielectric Breakdown test of vital circuitry.
- C. Wiring verification of non-vital circuitry.
- D. Vital function tests.
- E. Operating tests.

Applicable tests prescribed by AREMA C&S Manual Part 2.4.1, where the AREMA inspections and tests do not conflict with the requirements of these Specifications

Applicable tests as required to ensure systems comply with CFR 49, Parts 234 and 236.

Specific Field Tests and Inspection

Perform specific field tests listed herein.

Grounds

Ground resistance shall be tested and reported as described in Special Provision, Signal Grounding.

Low voltage dc circuits shall be tested to verify that they are free of grounds.

Contractor shall record test results on the appropriate Metrolink form and submit this completed form to the Engineer to obtain acceptance of this test requirement.

Insulation Resistance

Insulation resistance tests shall be made between conductors and ground, and between conductors in each cable in accordance with FRA rule 236.108. The insulation resistance of wires and cables installed by the Contractor shall provide an "infinite" reading when using a direct reading instrument (megger) having a self-contained source of direct current test voltage. The megger scale shall have a minimum range of zero to 20 mega ohms and be rated at 250 volts minimum and 650 volts maximum.

Insulation tests shall be performed after the equipment and cables are installed in the field.

Contractor shall record test results on the appropriate Metrolink form and submit this completed form to the Engineer to obtain acceptance of this test requirement.

Vital Relays

DC vital relays shall be tested for pick-up and drop-away values. These values shall be in accordance with field requirement values stated in Table I of AREMA C&S manual, Part 6.4.1.

Contractor shall perform tests required to complete the appropriate Metrolink form.

These tests shall be performed at the shelter locations after the shelter has been set.

Record test results on the appropriate Metrolink form and submit this completed form to the Engineer to obtain acceptance of this test requirement.

Energy Distribution: Energy-Off Tests

With power to the signal instrument shelter or wayside case off, the following checks and tests shall be performed. These tests shall include:

- A. Removing fuses.
- B. Verifying that circuit breaker size compares to that of railroad plans.
- C. Comparing wire gages with those called for on the railroad plans. Discrepancies in wire sizes shall be replaced with the proper size wire.
- D. During energy distribution breakdown, a wire count on each terminal, relay contact, etc. shall be taken to ensure that only the number of wires called for on the railroad plans is present at each terminal, relay contact, etc. Any discrepancies found shall be corrected and additional wires, if found, shall be removed.
- E. Verify proper system voltage for each power supply, ac and dc.
- F. Verify power supplies for correct setting quantities.
- G. Verify that no cross, shorts, or grounds exist.
- H. Tags shall be verified for proper nomenclature and terminal location.

Breakdown of Control Circuits:

Circuits shall be tested in their entirety for the correct operation of and response to each contact on each circuit element, such as relays and contactors. Where parallel paths exist, the tests shall validate each path, and circuits shall be opened when required to ensure the proper test.

Each circuit shall be tested by simulating operating conditions to verify that the circuit operates in accordance with the Specifications and accepted plans.

Electric Switch and Lock Movements (when applicable):

Continuity checks of field wires to switch-and-lock movements to verify nomenclature.

Adjust throw bar so that proper tension is placed on switch points in both directions.

Manually operate switch machine normal and adjust lock rods and point detector rods to allow switch machine to lock up with no obstruction. Repeat above for switch machine in reverse position.

Turn on switch machine power, call switch machine normal and observe in field that switch machine corresponds to position called, and observe in wayside instrument shelter that proper switch correspondence relay is energized.

With switch machine called normal, check gaps on circuit controller contacts to see that they meet equipment specifications. Operate machine reverse and repeat.

Break down each contact in switch circuit controller and observe that proper switch correspondence relay drops. Repeat this procedure for both positions of the switch.

Place ammeter in series with motor control energy and adjust clutch such that it causes overload relay to pick up in less than ten seconds with 1/4-inch obstruction in switch point and record current reading. Repeat for opposite position.

Place switch and lock movement in "hand" operation and observe switch mechanism cannot be operated by power. Place back in "motor" and verify that switch mechanism can be powered from wayside instrument shelter.

Operate switch, then shunt detector track circuit and observe that switch machine is stopped in middle of stroke and not allowed to complete movement. Remove shunt and verify switch completes movement.

Contractor shall record test results on the appropriate Metrolink form and submit this completed form to the Engineer in order to obtain acceptance of this test requirement.

Signal Layouts

Tests shall be performed on signal layouts. These tests shall include the following:

- A. Continuity check of field wires and verification of nomenclature.
- B. Apply energy to signal lighting circuits and adjust all lamp voltages to 10 percent less than the lamp rating.
- C. Sight signals for maximum visibility.
- D. Check that light-out feature, where used, complies with FRA Rule 236.23(f).

Line Circuits

This test procedure shall verify the integrity of line circuits between wayside instrument locations. These tests shall include the following:

- A. Nomenclature shall be verified and line circuits tested for continuity.
- B. Each repeater relay shall be tested to determine that it follows the proper track relays de-energized in the signal shelters.
- C. Each line circuit will have a breakdown test performed between wayside instrument locations. Breakdown of the line circuit shall begin at the origination point of the circuit. The positive side of the circuit shall be opened to ensure appropriate relay or input is de-energized in the other instrument shelter. Close circuit and verify that the proper relay returns to its normal position. Repeat for the negative side of the circuit. If circuit breaks through relays within the instrument shelter where circuit originates, drop each relay one at a time, which breaks the circuit in order to verify that the appropriate relay or input is de-energized in the other instrument shelter. Restore relay and verify that the proper relay and/or input returns to its normal position in the other shelter. Each relay and/or input shall be tested to ensure that it follows all the proper breaks in the signal shelters.

Control Office to Wayside Interface (when applicable)

Upon completion of the wayside tests, a system test shall be performed to ensure continuity of operation of wayside equipment by the supervisory control system. This test shall consist of controlling office wayside functions from the supervisory control console, and the transmission back to the control office of indications from the field stations. The functions to be tested shall include the following:

A. Controls from Supervisory Control Console

1. Control of switch machines.
2. Lining of routes.

B. Indications to Supervisory Control Console

1. Switch machine positions both normal and reverse.
2. Track circuit occupancy, all tracks.
3. Signal clear indications, each signal.
4. Power-off and alarm indications.
5. Switch(es) out of correspondence.
6. Auxiliary input indications if applicable.
7. Signal at stop indications, each signal.
8. Signal in time indication for each route.

C. Design changes found necessary to obtain proper operation shall be submitted to the Metrolink Signal Manager or Metrolink Signal Engineer for acceptance.

Local Panel Test (when applicable):

Verify proper operation of controls and indications.

Switch Circuit Controllers (when applicable):

Each switch circuit controller shall be tested to verify wiring, mechanical connectors, point obstruction, and point detection in accordance with AREMA C&S Manual, Part 12.5.1.

Contractor shall record test results on the appropriate Metrolink form and submit this completed form to the Engineer in order to obtain acceptance of this test requirement.

Track Circuits

Each track circuit shall be tested for shunting sensitivity and polarity in accordance with the AREMA C&S Manual, Part 8.6.1.

Insulated joints

Each insulated joint installed by the Contractor shall be tested with one of the following insulated joint testers, the Harmon 1501A1JC, S&C Model 324 Track Circuit Short Finder, or accepted equal, and shall measure no less than 100 ohms across the joint.

Interlocking and Control Point Tests (when applicable):

A detailed list of the tests and complete test procedures shall be provided by the Engineer to establish safe and proper operation of interlockings. The Contractor shall provide the necessary personnel and equipment, along with support functions, as part of the Signal Test Crew. The test sequence shall be designed to test each function for correct performance, in accordance with these Specifications and the accepted plans. Furthermore, the test sequence shall include simulated unusual conditions to determine that the interlocking circuits will respond in a safe and desirable way.

The functions to be tested shall include the following:

- A. Time locking.
- B. Route locking.
- C. Verification of timing of time releases.
- D. Indication locking.
- E. Signal operation in accordance with route and aspect charts.
- F. Interconnection with existing block signal systems.
- G. Interconnection with existing interlockings. With an established direction of traffic, the controlled signal governing entrance to that particular route shall be put to stop. Traffic in the opposite direction shall not be established until a predetermined time has passed. This predetermined time shall be as indicated on the accepted plans. It shall be ascertained that time locking is effective for this test.

With an established direction of traffic, the controlled signal governing entrance to that particular route shall be put to stop. Traffic in the opposite direction shall not be established until a predetermined time has passed. This predetermined time shall be as indicated on the accepted plans. It shall be ascertained that time locking is effective for this test.

Time tests shall be as follows:

- A. Loss of shunt.
- B. Time locking.
- C. Flashing rate time.

Record test results on the appropriate Metrolink forms. Submit these completed forms to the Engineer to obtain acceptance of these test requirements.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.21 TRACKWORK

GENERAL

Summary

This Section consists of removing, salvaging, repairing, modifying, rehabilitating, or constructing trackwork, turnouts, crossings and crossovers.

Work includes ballast, walkways, ties, rail, fastening systems, other track material (OTM), turnouts and other special trackwork.

Quality Control and Assurance

Quality Assurance

Perform track construction under the supervision of Qualified personnel.

Corrections

During the installation and testing period, Contractor must make available personnel, equipment, and materials necessary to make required corrections to the track including replacements, re-ballasting, resurfacing and realigning, or repair of constructed items.

Ties shall be lifted and supported during storage, transportation, and placing.

Ties shall not be dropped to the roadbed.

Wood ties shall be handled in accordance with AREMA Manual Volume 1, Chapter 30, Section 3.5 and Concrete Ties shall be handled in accordance with AREMA Manual Volume 1, Chapter 30, Section 4.11.

Refer to special provisions for Concrete Ties and Wood Ties for on-site storage requirements.

Rail shall be unloaded and distributed to prevent damage to ties, rails and structures. Do not bump or strike rail.

MATERIALS

Track surfacing and alignment equipment shall be laser guided.

As a minimum at least 70 percent of the original surface area of the track surfacing equipment tamping tool pad must be available and these tools must closely match adjacent and opposite tamping tool pads in the amount of wear.

Equipment shall be compatible with and shall be operated within the clearances indicated in SCRRRA Engineering Standards.

Wheel contours of rail-mounted equipment shall conform to the Association of American railroads (AAR) wheel standards or AREMA maintenance of way equipment wheel standards.

All construction loads borne by equipment shall be applied between gage lines of running rails on each track unless approved by the Engineer.

Vibratory compaction equipment for compaction of base ballast shall be specifically manufactured for compaction purposes.

The self-propelled, pneumatic-tired roller shall have a gross weight of 10 to 15 tons, and the vibratory compactor shall have a weight of not less than 10 tons and shall be capable of applying a dynamic load of not less than 18,000 pounds at 1300 to 1500 cycles per minute.

Furnish tools and equipment necessary to construct the track.

Track gages, track levels, and other tools shall conform to the AREMA Volume 1, Chapter 5, Part 6, "Specifications and Plans for Tools."

Tools and equipment shall be maintained in such a condition as not to endanger personnel nor damage the Work and shall be subject to inspection by the Engineer.

Tools not conforming to standard shall be repaired to AREMA standards or shall be replaced.

Substitution of tools other than AREMA standard will be permitted only with approval of the Engineer.

Track levels and gages shall be checked for accuracy at the start of every work shift and at any time the tool is dropped or struck.

Adjustments shall be performed anytime it is found to have more than 0.050 inches deviation from the nominal measurement value.

Sub-Ballast

SubBallast shall conform to the requirements of special provision for Sub-Ballast and Aggregate Base.

Ballast and Walkways

Ballast shall conform to the requirements of the special provision for Ballast.

Walkway rock shall conform to the requirements of the special provision for Ballast.

Wood ties shall conform to the requirements of the special provision for Wood Railroad Ties.

Cross ties and switch ties shall be of the lengths detailed on the Contract Documents or the designated SCRRRA Engineering Standard.

Ties

Concrete ties, shall conform to the requirements of SCRRA Engineering Standard Plan ES2402 and ES2406 for Pre-stressed Concrete Track Tie or ES2403 and ES2407 (for bridge deck locations requiring a neoprene pad). Ties shall be new unless indicated otherwise in the Contract Documents.

Rail

Rail shall be new 136 RE continuous welded rail (CWR) Head Hardened rail conforming to AREMA Volume 1, Chapter 4, Section 2.1, Specifications for Steel Rails, unless otherwise stated in the Contract Documents.

Other Track Material (OTM)

OTM shall be new and conform to SCRRA Engineering Standards and the following requirements:

Bolts, Nuts, and Washers shall conform to AREMA Volume 1, Chapter 4, Section 2.9, "Specifications for Heat-Treated Carbon-Steel Track Bolts and Carbon-Steel Nuts".

Rail Anchors shall be one-piece conforming to the requirements of ES 2363 or approved equivalent, of standard weight.

Anchors shall conform to AREMA Volume 1, Chapter 5, Part 7, "Rail Anchors," may be normally applied with a sledge hammer or manufacturer's application tool, and of a design, size and construction to properly fit the base of rail on which being applied.

Joint bars shall be 6-hole, 36 inches in length and conform to AREMA Volume 1, Chapter 4, Section 2.8, "Specifications for Quenched Carbon-Steel Joint Bars, Micro-alloyed Joint Bars and Forged Compromise Joint Bars".

Bar detail shall conform to SCRRA ES2502, "Rail and Joint Assembly for 136 pounds RE Rail".

Compromise Joints or connections to other rail weights on SCRRA mainline track (track used in passenger revenue service will be considered mainline track for purposes of this section) will be made through the use of transition rails as specified in SCRRA ES2372 or ES2373 as appropriate.

Other rail weight connections or those connections necessary for "Industry Track" or "Other than main line" will be made using Compromise Bars.

Compromise Bars shall be 6-hole conforming to AREMA Volume 1, Chapter 4, Section 2.8, "Specifications for Quenched Carbon-Steel Joint Bars, Micro-alloyed Joint Bars and Forged Compromise Joint Bars" and conform to the requirements of SCRRA ES2503, "Compromise Joints for Various Weights of Rail".

Final configuration of the track shall utilize field welds to join transition rails wherever applicable in mainline track.

Compromise joint bars may be used for interim phases of construction on mainline track provided interim phase duration is expected to be 6 months or less.

Temporary Compromise joint bars as noted above shall use track bolts in the outer 4 holes only.

Joint bars used to temporarily connect rails that will be field welded in the final configuration shall be bolted with the rails ends drilled in the outer 4 holes only.

Resilient Rail Fastening Systems

Resilient fastening system for wood ties shall be a Pandrol rail fastening system per relevant SCRRA Engineering Standards, "Pandrol Rail Clip – Type "e" 2055", consisting of elastic fastener "E-Clip" galvanized, type elastic clips, screw spikes, and elastic fastener tie plates or approved equal or as otherwise indicated in the railroad plans.

Resilient fastening system for concrete ties shall be a Pandrol Rail fastening system consisting of "Fast-Clip" type elastic fasteners pre-installed in the "off" position on concrete ties, or approved equal, unless indicated otherwise on the railroad plans.

Rail seat pads shall be "3-part" with steel interior plate.

Resilient fasteners for Insulated Joints shall be type specified in SCRRA Engineering Standards for the type of resilient fasteners to be used.

The Contractor must provide suitable fasteners in accordance Relevant Engineering Standards requirements.

Screw Spikes shall conform to the requirements specified in SCRRA ES2355.

Tie plates for resilient fastening shall conform to SCRRA ES2454.

Standard Fastening System

Tie plates shall conform to AREMA Volume 1, Chapter 5, Section 1.1, Tie Plates - "Specifications for Steel Tie Plates" and appropriate SCRRA Engineering Standard.

Tie plate dimensions shall conform to SCRRA ES2451, "Standard 14-inch Tie Plate For 6 inches Base Rail".

Track spikes shall conform to SCRRRA ES2355, and shall conform to AREMA Volume 1, Chapter 5, Part 2.1 for "Specifications for Soft-Steel Track Spikes."

Rail anchors shall conform to AREMA Volume 1, Chapter 5, Section 7.1 for "Specifications for Rail Anchors" and SCRRRA Engineering Standards.

Switch Stands

Manual throw switch stands for hand throw switches and derails shall conform to SCRRRA Engineering Standards or approved equal.

Connecting rod shall be type rod in accordance with standard turnout SCRRRA Engineering Standards.

Turnouts shall be as indicated on the railroad plans, fabricated with all new Material, and in conformance with SCRRRA Engineering Standards.

Derails shall be of constructed using new Material and conform to SCRRRA Engineering Standards with type (double switch point derail or sliding derail with crowder) as indicated in the Contract Documents.

Road Crossings shall be of new Material and conform to SCRRRA ES2006 and as indicated on the railroad plans and the special provision for At-Grade Crossings.

Lubricant for special trackwork shall be Whitmore's Railmaster Curve grease except that Dixon L-5550 graphite shall be used for switch plate lubricant. Approved equals shall be submitted for approval by the Engineer.

New insulated joints must be furnished by Contractor and shall conform to SCRRRA ES2504.

Elastic fasteners for ties supporting insulated joints shall be designed to prevent electrical bridging between rails and joint bars.

CONSTRUCTION

Work shall be completed in accordance with SCRRRA Engineering Standard Drawings, SCRRRA Track Maintenance and Engineering Instructions, AREMA Manual for Railway Engineering, and as specified herein.

Each fully completed segment of track, as approved in the Site-Specific Work Plan, placed into operational service shall comply with the requirements of FRA 49 CFR 213 for the specific classification of train operation.

Track must have ballast section full to top of ties, have joints fully bolted or welded, have anchors or elastic fasteners applied, and the rail shall be fully de-stressed.

Bottom of rail, fastener assemblies, and bearing surfaces shall be broom cleaned before laying rail.

The low rail (inside rail of curves) on superelevated track shall be designated as the profile rail.

Install track, OTM, turnouts, derails and road crossings in accordance with the railroad plans, SCRRRA Engineering Standards, Track Maintenance and Engineering Instructions and California Public Utilities Commission requirements.

Sub-Ballast

Sub-ballast construction shall conform to typical cross sections as depicted in SCRRRA Engineering Standards or as shown on railroad plans and must also comply with the requirements of the special provision for Sub-Ballast and Aggregate Base.

Cross Ties

Wood or concrete ties shall be used in special trackwork, grade crossings, turnouts, and crossing diamonds as shown on the railroad plans.

Use of wood ties or concrete cross ties shall be designated on the railroad plans for use in track construction as indicated.

Ties damaged as a result of improper handling or installation by Contractor and rejected by the Engineer must be removed and replaced with new ties at no cost to the SCRRRA or the State.

Installation and placement of wood ties shall be as follows:

- A. Place wood Crossties on 19-1/2" centers for mainline track, except through grade crossings.
- B. Space cross ties for grade crossings in accordance with the applicable SCRRRA Engineering Standard.
- C. Space Crossties for turnouts in accordance with the applicable SCRRRA Engineering Standard and the railroad plans.
- D. Obtain approval for any deviation in crossties spacing from the Engineer prior to Installation of spikes or hold down devices.
- E. Place wood ties with heartwood face down and square to the rail, except as otherwise shown on the railroad plans.
- F. When handling or spacing ties, prevent damaging them with picks or spiking hammers. Tie tongs, lining bars, other suitable tools or tie spacing equipment shall be used.
- G. Do not drive nails or spikes other than those called for into wood ties.
- H. Do not re-spike new wood ties.
- I. Place concrete Crossties as shown in the railroad plans and SCRRRA Engineering Standards.
- J. Ensure that the proper rail cant is established.
- K. Concrete Crosstie spacing shall be 24 inches centers.
- L. Transition ties shall be installed where concrete ties abut timber track in accordance with SCRRRA Track Maintenance and Engineering Instructions and SCRRRA ES2351-03.

Bridge decks with less than 12 inches of ballast under the tie will require use of a concrete tie with embedded neoprene pad (SCRRRA ES2403 or ES2407). When calculating the depth of ballast under the tie, include any HMA underlayment as a part of the ballast depth for determining the requirement for use of the concrete tie with embedded neoprene pad. Bridge decks with 12 inches or more of ballast under the ties will utilize standard concrete ties (SCRRRA ES2402 or ES2406).

Tie Plates

Plates shall be positioned so that the rail will cant inward towards track centerline and the plate shall be centered on tie and applied as to obtain full proper bearing on both the tie and rail.

Tie plates shall be installed as shown on the SCRRRA Engineering Standards, in SCRRRA Track Maintenance and Engineering Standards, and on approved Shop Drawings.

Rail Fastening

OTM shall be installed in accordance with SCRRRA Engineering Standards and where applicable, manufacturer's recommendations.

Installation of screw spikes and specified resilient fasteners shall be in accordance with manufacturer's recommendations, and SCRRRA Engineering Standards and SCRRRA Track Maintenance and Engineering Instructions.

Spiking for standard cut spike fastening systems shall be performed using new cut spikes unless otherwise indicated in the railroad plans and as follows:

Spiking pattern shall conform to SCRRRA ES2460.

Spikes shall be started vertically, square to the base of rail and driven straight.

Shank of rail-holding spikes shall have full bearing against base of rail.

Do not strike rail or fastenings when driving spikes.

Bent spikes shall be removed and replaced with a new spike as approved by the Engineer.

Spikes shall not be over-driven.

Holes for the screw spikes shall be pre-drilled and applied perpendicular to the plane of the base of tie plate.

Sufficient torque shall be applied to bring the bearing face of the screw spike into flush bearing contact with the tie plate so no gap exists.

Not more than 2 each cut spikes per plate may be used to hold the elastic fastening system plates until the screw spikes are installed.

Cut spikes used in this manner as temporary fasteners may be salvaged or used material.

Cut spikes used as temporary fasteners in this manner shall not be removed; however 4 screw spikes per plate shall be provided if cut spikes are used in this manner.

Rail Anchors

Rail anchors shall be installed per SCRRRA ES2351-01 through ES2351-04, as applicable.

Rail anchors shall be set with full bearing against the side of the tie.

Anchors shall not be over-driven.

Fractured or spread rail anchors will be rejected.

Rail anchors shall be applied prior to operation of trains.

If, in accordance with the Engineer-approved Site-Specific Work Plan, a slow order will be required, the Contractor must submit proposed anchor pattern to the Engineer for approval prior to commencement of the rail anchor work.

Anchors shall be removed and re-applied when CWR is de-stressed.

Rail anchors shall be applied in accordance with manufacturer's recommendations.

Installing Track

Installation, laying, raising, lining, tamping and dressing of track over ballast shall be performed as follows:

- A. Ballast shall only be installed over sub-ballast, which has been prepared in accordance with the special provision for Sub-Ballast and Aggregate Base and approved by the Engineer.
- B. Place base ballast in lifts not more than 6 inches in thickness before compaction.
- C. Layers shall extend beyond the edge of the ties as shown on the railroad plans before compaction.
- D. Compact ballast thoroughly to form a stable section able to support the subsequent layers and loads.
- E. Compaction of base ballast shall be by means of vibratory compaction equipment.
- F. Each lift of ballast within the initial layer shall be uniformly spread and compacted with not less than 4 passes of either a self-propelled, pneumatic-tired roller or vibratory compactor.
- G. Ballast surface that exhibits ruts or crowns is not acceptable and shall be re-graded and re-compacted prior to the placement of the crossties.

Obtain the Engineer's verification of the compacted ballast prior to the installation of track and appurtenant Work over the ballast.

The track shall be assembled on the compacted ballast to permit placement of additional ballast for subsequent raising and tamping and to provide the full depth under the ties.

The ballast shall be tamped with a 16 tool vibrating squeeze-type mechanical tamper, making a minimum of one full tamping insertion per tie for each inch of raise.

The final track raise shall not exceed 1 inch.

The ballast in the crib areas shall be mechanically stabilized by a ballast stabilizer approved by the Engineer.

The track shall be raised, aligned and tamped to within the specified tolerances.

Ballast shall be thoroughly tamped within a space from 15 inches inside either rail to the ends of the ties.

In tamping ties within the above-described limits, simultaneous tamping shall be performed under each rail.

Tamping is not permitted at the center of the tie except within limits of turnouts and crossings where the center of the ties shall be tamped unless prevented by trackwork components.

Pneumatic or electric tamping tools, either hand held or machine mounted shall be used to perform tamping at portions of turnouts not accessible to a production tamper. Hand tamping with shovels or picks will not be permitted unless authorized by the Engineer.

Two tamping tools shall be used opposite each other on the same tie.

Tampers shall be started from a nearly vertical position and worked downward past the bottom of the tie, after which the tool must be slanted downward to force ballast under the tie.

Double tamp every joint tie.

Ballast shall be mechanically dressed to provide the section as shown on the SCRRA Engineering Standards and the railroad plans.

Excess ballast shall be removed.

Payment will not be made for ballast in excess of dimensions shown on the railroad plans.

Ballast damaged by overwork or excessive tamping or fouled by dirt or other deleterious material as determined by the Engineer must be removed and replaced at no cost to the SCRRA or the State.

Where new track joins existing track, the existing track shall be surfaced for a minimum distance of 500 feet on mainline or siding tracks, or 200 feet on industrial tracks, from the point of connection.

Existing track surfacing may be longer as needed to meet FRA requirements.

After the track has been raised to its final elevation and super-elevation, ballast consolidation of tracks shall be performed before the track is placed in service.

Each segment of track may be placed in full service, as approved in the SSWP, if that segment complies with FRA 49 CFR 213 for specific classification of train operation, has ballast section full to top of ties, has joints fully bolted or welded, has all anchors or elastic fasteners applied, and has the rail fully de-stressed and ballast compacted.

When raising track, a spot board or other approved device shall be used to maintain grade, and a level shall be used to keep track to proper cross level.

Laser guided alignment is required, and horizontal alignment must be maintained during the raising operation.

Use of automated controls on tampers will satisfy this requirement.

Newly constructed mainline and mainline siding tracks, upon completion of final surfacing operations, shall be mechanically stabilized using a Ballast Stabilizer.

Installing Turnouts

Installation of frog plates, switch plates, and plates under the closure rails shall conform to SCRRRA Engineering Standards and AREMA trackwork standards.

Plates shall be secured by screw spikes except rehabilitation of existing turnouts with cut spikes, which shall be fully spiked.

Following the installation of turnouts on the initial layer of ballast, the turnouts shall be lifted, aligned and supported prior to placement of final ballast.

Ballast shall be uniformly placed and spread.

The turnout shall then be raised and the ballast tamped under both sides of each tie for the full length of the tie.

Tamp ballast thoroughly throughout the length of all ties in the turnout or other special trackwork.

Final top of ballast shall conform to the ballast section as indicated except in cribs wherein switch operating rods, locking rods or connecting rods are located and between point of switch and heel of switch where the crib ballast shall be 3 inches below the base of the rail.

When installing the various components of the turnout, attention shall be given to the following:

- A. Check that alignment, gage, and surface meet Specifications.
- B. Verify that bolts, nuts, cotter pins, and other fastenings are in place, in good condition, and properly tightened.
- C. Verify that switch points are properly aligned and fit tightly against rail when switch is thrown in either position.
- D. Verify that connecting rod and switch rod bolts are equipped with cotter pins properly applied.
- E. Test-operate the switches for lost motion, difficult throw, or loose connections and adjust as necessary.
- F. Examine the rod and fastenings that connect the switch point to the switch stand to see that they are in place and in good condition.

Joints within turnouts shall be welded.

Switch stands shall be installed to hold the switch point tightly against the stock rail when stand is in normal position, per the manufacturer's instructions.

Switch rods shall be adjusted to hold the opposite point tightly against the rail when stand is in reverse position.

Switch stands, for both switches and derails, shall be mounted on two 16 foot ties.

Switch stands shall be kept securely fastened to the head block ties, use approved screw spike fasteners.

The head block ties shall be set square with the track and kept firmly tamped.

Correct any walkway deficiencies adjacent to the head block ties that would impact SCRRRA employee or operating personnel access to the operating levers or controls for the switch stand.

Switch stand target colors shall conform to SCRRRA ES2106 for Derail Switch Target or to SCRRRA ES2703 for standard switch target.

During installation, sliding surfaces of special trackwork assemblies shall be lubricated with a dry film graphite lubricant in accordance with the manufacturer's recommendations.

Insulated joints for non-interlocked switches shall be installed as shown on the railroad plans and in accordance with AREMA (Former AAR) Signal Manual.

Install joint using manufacturer's recommended procedure.

Signal System Point Protection

No switch point shall be installed in the main track unless it has the proper signal system point protection in place and tested.

No switch protection shall be removed from a normally closed signaled switch point unless the switch point is replaced by a straight rail and signal circuits have been corrected and tested.

Rail bonding and fouling circuit protection must be intact at all times on signaled switches.

SCRRRA will perform installation and testing of signal devices.

Contractor must coordinate installation or removal of turnout with SCRRRA Engineer for required signal testing.

Installing Derails

Install derails per manufacturer's instructions at locations designated in railroad plans and in accordance with SCRRA Engineering Standards.

Drilling

Rail ends for bolted joints shall be drilled in accordance with SCRRA Track Maintenance and Engineering Instructions Section 2.1.15.

Additional holes in rail will be sufficient cause for rejection.

A variation of 1/32" in size and location of bolt holes will be allowed.

Holes shall be located with the proper size rail-drilling template and marked with a center punch prior to drilling.

Drilling through joint bars is prohibited.

Rail Ends

Rail shall be cut with rail saw to a tolerance of 1/32" from square.

Burrs shall be removed and ends made smooth.

Torch cut rails will be rejected.

Battered or mismatched ends shall be built up or ground off to conform to minimum tolerance of 1/16" on top and gage side to adjoining rail.

Rail End Hardening

At all rail end locations not eliminated by field welding, rail ends shall be field end hardened in accordance with the AREMA Manual, Volume 1, Chapter 4, Section 2.1.17.1, "Supplementary Requirements" including all insulated joints.

Placing Continuous Welded Rail

Rail shall be laid or adjusted to the Preferred Rail Laying Temperature in accordance with SCRRA Track Maintenance and Engineering Instructions Section 2.2.2, Preferred Rail Laying Temperatures.

Tie cribs shall be filled with ballast immediately after laying rails and after each track raise.

Track shall be surfaced, stabilized, and lined and all ties tamped and anchored, prior to returning track to full service.

If the rail temperature exceeds 120 °F, the Engineer may suspend rail-laying operations, or direct that the rail be cooled.

These actions shall not entitle Contractor to additional compensation or time.

Welded rails shall be positioned for installing to minimize handling and to prevent buckling.

The rail base and tie plate or concrete tie rail seat area shall be cleaned to remove foreign material that may interfere with the full bearing contact with the base of the rail.

Rails shall be placed base down, parallel with track, avoiding excessive bending or damage, using suitable mechanical equipment.

Do not place rails on signal equipment, manhole covers, electrical connections, or near any other installation that could be susceptible to damage.

An approved rail thermometer shall be used to determine rail temperature.

The thermometer shall be placed on the web or base of rail shaded from the sun and left long enough to record the rail temperature accurately.

The temperature shall be checked frequently.

Rail thermometers shall be calibrated.

Tools used for field cutting rails shall be approved rail saws.

Torch-cut rails shall not be installed in the track.

Rail damaged by torches shall be rejected and removed before Installation in the track.

Rail shall be de-stressed in accordance with SCRRA Track Maintenance and Engineering Instructions Section 8.3 only after final track line and grade has been achieved and ballast stabilized, or as required by the Engineer.

Rail shall be re-anchored after de-stressing has been achieved.

Rail shall have adequate anchor patterns installed at all stages of construction.

Anchoring Continuous Welded Rail

The term "rail anchor" also refers to elastic rail fasteners. Install rail-anchoring devices when the rail is within the permissible anchoring temperature.

Anchor opposite rail only when its temperature is within 5 °F of the previously anchored rail's temperature at the time of its anchoring.

Temperatures shall be measured in accordance with SCRRRA Track Maintenance and Engineering Instructions Section 2.2.3, Instructions for Taking Rail Temperatures.

No train operation is permitted over rail that does not have a full complement of anchors per SCRRRA ES2351-01 through ES2351-04.

If it is necessary to operate trains before de-stressing rail, following the movement of trains, anchors shall be removed for the de-stressing procedure and re-applied.

Prior to joining CWR strings, adjust the CWR strings to the Preferred Rail Laying temperature, vibrate to relieve internal rail stresses, and fully anchor.

Join CWR strings when the rail gap is at the specified gap.

If the rail gap is not within the recommended tolerances for joining CWR strings, and the remainder of the string has been adjusted, un-anchor the CWR strings for 400 feet on each side of the rail gap and readjust each CWR string to within the Preferred Rail Laying Temperature.

Re-anchor the CWR strings before installing the rail joint or weld.

If the recommended rail gap cannot be obtained in this manner, cut a section of rail from the end of one of the CWR strings and insert a rail plug not less than 19 feet-6 inches long on tangent track and curves less than 2 degrees; and not less than 30 feet long in curves of 2 degrees or greater to provide the recommended rail gaps, or crop the rail as necessary to provide the recommended gap.

If the Contractor elects to use an artificial means of adjusting the rail for anchoring, submit the method and equipment proposed to the Engineer and obtain Engineer's acceptance.

A rail vibrator shall accompany the rail heating process to assure free expansion of the rail in advance of the heated area.

Witness marks shall be made at 4 or more stations on unanchored rail across the base of the rail and tie plates to confirm actual expansion of the rail in accordance with the calculations.

Contractor must not make any joints or welds within the body of a curve unless approved by the Engineer.

Adjustment by Mechanical Heating

Rail shall be adjusted for temperature after it has been laid on tie plates but before it is anchored.

Rail gaps shall be provided at the end of each continuous welded rail equal to the amount of the expansion that is required for that rail.

Heating shall begin at the end of the rail and be steadily applied moving forward and without reversing direction until the required expansion has been obtained for that rail.

Complete anchoring application shall follow heating as closely as possible.

Deviation or delay will require reheating the rail.

Prevent damage to other work during the heating process.

Thermal Adjustment Calculation

When it is necessary to adjust the rail already in track, the required increase or decrease may be found by taking the difference between the Preferred Rail Laying Temperature and recorded rail temperatures at each string of CWR and calculating the amount of adjustment as specified herein.

The number of inches by which a CWR segment shall be increased or decreased to adjust its length for a temperature higher or lower than that at which it was anchored or adjusted may be calculated using the following formula:

Req. Adjustment (inches) = $0.0000065 \times \Delta T (^{\circ}\text{F}) \times L (\text{Feet.}) \times 12$, OR

Req. Adjustment (inches) = $0.000078 \times \Delta T (^{\circ}\text{F}) \times L (\text{Feet.})$.

Example:

To adjust the length (L) of a 400 foot CWR, fastened at a rail temperature of 60 degrees, to correspond to the length of this rail at a temperature of 110 degrees, subtract 60 from 110 to obtain a difference of 50 degrees (ΔT) and multiply as follows:

$0.000078 \times 50 \times 400 = 1.56 \text{ inch.}$

Rail Temperature	Inches of Increase for 400 feet of Rail to 110 Degrees F.
20	2.81
30	2.50
40	2.18
50	1.87
60	1.56
70	1.25
80	0.94
90	0.62
100	0.31
110	0.00

Rail Anchorage Record

Compliance record shall be kept in the format similar to that shown in SCRRA Track Maintenance and Engineering Instructions Section 2.2.3 Instructions for Taking Rail Temperatures and provided to the Engineer in an acceptable, reproducible form.

It shall contain the following data for each end of a CWR and at each 400 foot interval during installation:

- A. Date and time.
- B. Track number and rail (East or West, North or South).
- C. Station location.
- D. Weather, air and base of rail temperature.
- E. Type of fastener.
- F. Length of rail being anchored.

Placing Jointed Rail

This specification covers both the permanent construction and rehabilitation of jointed rail and the temporary use of rail joints in the CWR pending field welding.

When laying jointed rail, each rail shall be carefully placed on the ties with ends square, using standard expansion shims placed between the ends of adjoining rails to ensure proper opening of joint.

Shims shall be removed after all joint bolts are tightened.

Using temperatures taken on the rails when they are being laid or adjusted; the thickness of the shim to be used for 39 feet rails will be determined by the following table:

Ranges (Deg F)	Shim (Inches)
-20 – 0	3/8
0 – 25	1/4
25 – 50	3/16
50 – 75	1/8
75 – 100	1/16
Over 100	Laid Tight

Joint Bars shall be well oiled and with full number and correct size of bolts, nuts and spring washers.

Joint bolts shall be tightened before spiking rail and the two center bolts shall be tightened in advance of the end bolts.

Bolts shall be placed with the nuts alternatively on the inside and outside of the rail.

Nuts shall be placed with the flat side toward the rail.

Track bolts, joint bars and finishing surfaces of rails at joint bars shall be swabbed with oil.

Use outer four bolt holes only when installing bolted joints that will be eliminated by field welding.

Do not drill inside holes (holes closest to rail ends) at future field weld locations.

Track Criteria and Tolerances

Track shall be constructed to the alignment and grade prescribed.

Gage shall be 4'-8-1/2".

Deviation from established gage and cross-level shall not exceed 1/8 inches, and profile grade and horizontal alignment variation shall not exceed 1/8 inches measured at the center of a 62 foot chord.

Provide vertical and horizontal control stakes every 50 feet on curves and every 100 feet on tangents.

Tangent track shall be level and superelevation and runoff spirals shall be provided on all curves in conformance with SCRRA ES2201 through ES2204 unless otherwise indicated in the railroad plans.

Contractor must not cut rail strings except as required to fit rail to turnouts, crossings or limits of work.

A thermometer designed to measure rail temperature shall be used in accordance with SCRRA Track Maintenance and Engineering Instructions during rail Installation to assure compliance with the SCRRA Preferred Rail Laying Temperature.

Final installed or Adjusted Rail Temperature shall be within 10 degrees below or 10 degrees over the Preferred Rail Laying Temperature.

Welding Continuous Welded Rail

Rail welding shall be in accordance with the approved procedure and the special provision for Field Welding Rail.

Walkways

CPUC walkways shall be provided within track work limits in accordance with the railroad plans, SCRRA ES2105, SCRRA Track Maintenance and Engineering Instructions, CPUC General Order No. 118.

Insulated Joints

Each insulated joint installed by the Contractor must be tested with an insulated joint tester, either the Harmon 1501A1JC or equal approved by the Engineer.

Test shall measure no less than 100 ohms across the joint.

Test results shall be uniquely identified with a specific joint and submitted to the Engineer in Compliance Record.

The rail ends at each insulated joint shall be beveled and hardened in accordance with the manufacturer's procedures as approved by the Engineer.

Contractor must comply with rail end hardening and beveling requirements specified in this Section.

Inner Guard Rails

Inner Guard Rails will be required:

- A. For all bridge spans where exposed structural steel is present above the top of rail.
- B. Where individual spans are over 100 feet in length
- C. Where entire structure is over 800 feet in length and at least one span crosses over a waterway that normally contains water which is at least 15 feet deep.
- D. On any bridge as directed by SCRRA or the Contract Documents.

Inner Guard Rails shall extend 50 feet beyond the span or spans to be protected as required above. SCRRA ES2302 and ES2304 indicate details for construction of Inner Guard Rails. Inner Guard Rails require use of special Concrete Ties as shown in ES2406 and ES2407.

Salvaging Material

Salvaged material shall be taken to a location within a 75 mile radius of the jobsite designated by the Engineer.

MEASUREMENT AND PAYMENT

Trackwork will be measured by the individual unit constructed in accordance with the Contract Documents and as measured by the Engineer.

All work must be complete prior to payment being made, including but not limited to welding, distressing, final surfacing, and completion of punch list items related to track work.

The contract price paid per track foot for Remove Existing Track, Ties and Ballast, and Install Bumping Post includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in remove existing track, ties and ballast and install bumping post, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per track foot for Remove Grade Crossing (Shoofly and Mainline) includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in remove grade crossing (shoofly and mainline), as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract unit price paid for Remove Turn-out and Return to Metrolink includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in remove turn-out and return to Metrolink, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per cubic yard for Salvage, Haul off and Re-use of Ballast includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in salvage, haul off and re-use of ballast, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per track foot for Salvage, Test and Store Existing Rails and Ties for Re-use includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in salvage, test and store existing rails and ties for re-use, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The lump sum price paid for Remove Existing Railroad Bridges Over San Fernando includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in remove existing railroad bridges over San Fernando, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per track foot for Running Rail includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in running rail, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract unit price paid for Concrete Tie includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in concrete tie, complete in place, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract unit price paid for Wood Tie includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in wood tie, complete in place, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per linear foot for Construct concrete grade crossing panels includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in construct concrete grade crossing panels, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The lump sum price paid for Cutover Track from Mainline to shoofly and reverse includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in cutover track from mainline to shoofly and reverse, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per track foot for Install Ballasted Track includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in install ballasted track, as shown on the plans either at grade, in transition, on a bridge, as specified in these special provisions, and as directed by the Engineer.

The lump sum price paid for Construct Ballasted Turnout includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in construct ballasted turnout, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

The contract price paid per track foot for Construct Track on Bridge includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals for doing all work involved in construct track on bridge, as shown on the plans, as specified in these special provisions, and as directed by the Engineer.

14-1.22 SIGNAL SYSTEM MISCELLANEOUS PRODUCTS

GENERAL

Summary

This Section includes requirements for miscellaneous components and products for signal systems that the Contractor shall provide and install. All materials provided by the Contractor shall be new unless designated on the railroad plans or approved by the Resident Engineer.

Definitions

Not Used

Submittals

Product Data: Submit manufacturer's catalog cuts, material descriptions, specifications, and other data pertinent to the miscellaneous products required.

Submit samples of solderless crimp-on type terminals to be used in this Contract as well as samples of solderless crimp-on type terminals from vendors performing house wiring.

Quality Control and Assurance

Not Used

MATERIALS

General

Electrical components shall be rated to operate at power, voltage, current, and temperature levels exceeding by 20 percent those which the components will be subject to in service, unless otherwise specified herein.

Miscellaneous components and products shall be clearly and permanently labeled with value or type identification.

Circuit Breakers and Fuses

Circuit breakers and fuses shall be of suitable capacity to protect the various pieces of signal apparatus from the effects of short circuits or overloads. Circuit breakers and fuses required for the equipment and systems shall be in accordance with these Specifications.

Circuit fuses shall be non-renewable, and shall be of the fiber-case, time lag, fusion type.

The circuit breakers and fuses shall be the correct size and rating for circuit current interruption and shall protect the electrical equipment and circuits from short-term and long-term overloads.

Circuit breakers and fuses shall be centrally located on the power distribution panel, power racks and shown in the railroad plans.

Fuse clips shall be constructed so that they shall retain their resilience under installation and service conditions, to ensure a positive contact between the clips and the fuse.

Diodes

Diodes to be furnished under this Contract shall carry a JEDEC number or shall be available from more than one manufacturer, and shall be used within the published specifications for such number. Diodes shall be silicon type, unless otherwise accepted by the Engineer.

Resistors

Resistors, other than those required for electronic circuits, shall be in accordance with AREMA C&S Manual Part 14.2.15.

Reactors

Reactors, other than those required for electronic circuits, shall be in accordance with AREMA C&S Manual Part 14.2.20.

Signal Terminal Blocks

Signal system terminal blocks shall be in accordance with the applicable requirements of AREMA C&S Manual Part 14.1.5.

Terminal Binding Posts

Signal system terminal binding posts shall be in accordance with the applicable requirements of AREMA C&S Manual Part 14.1.10.

Terminal binding posts for interface with plug-coupled wires to rack mounted electronic equipment shall be in accordance with the AREMA C&S Manual, Part 14.1.2.

Terminal Post Insulators

Terminal posts, located on terminal boards in the wayside cases, signal instrument shelters used to terminate 50V, or greater, ac or dc circuits shall be provided with a protective insulator.

The type of insulator shall be individual for each terminal post and shall be fire-resistant.

Insulated Test Link

Type 024620-1X as manufactured by Safetran, Inc., or an approved equal.

Lighting Arresters and Equalizers

Safetran Clear view No. 022485-28X, Equalizer No. 022700-1X, or an approved equal. Lightning arresters and equalizers shall be mounted on accepted type base and shall be in accordance with AREMA C&S Manual Part 11.3.1.

Surge Protectors

Safetran SP-17, SP-18, SP-19, SP-20, or an approved equal. Surge Protectors shall be in accordance with AREMA C&S Manual Part 11.3.3.

Terminals for Wires and Cables

Solderless terminals shall be in accordance with the AREMA C&S Manual, Part 14.1.1, unless otherwise specified herein.

Terminals shall be of the solderless crimp-on type. Samples of solderless terminals shall be submitted for approval.

Stranded copper wire shall be fitted with an approved type of terminal at points where the wires are to be terminated on terminal binding posts.

The terminating means shall be of four types:

1. A lug for terminating heavy wires or signal power wires.
2. A solderless type of terminal as manufactured by American Pamcor, Inc., under the trade name of "Pre-Insulated Flags" with translucent insulation similar to Catalog No. 322313, or an approved equal, for terminating No. 16 and No. 14, American Wire Gauge (AWG) stranded wires.
3. An AMP Solistrand "Ring Tongue-Flat" terminal, similar to that shown on the AMP Drawing P64044, together with slip-on nylon post insulator, similar to that shown on AMP Drawing P64-0264, or an approved equal, for terminating wires larger than No. 14 AWG to a maximum diameter over the insulation of 0.40 inch.
4. An AMP preinsulated; diamond grip ring nylon insulated wire terminal shall be used for terminating other stranded wires, No. 20 and No. 18 AWG, having maximum diameter of 0.125 inch. AMP Catalog No. 320554, or an approved equal, shall be furnished for No. 8 studs and AMP Catalog No. 320571, or an approved equal, shall be furnished for 1/4-inch studs.

Terminals shall be for attaching to the ends of the conductor in such a manner that the flexibility of the conductor will not be destroyed and the possibility of breakage at the terminal will be reduced to a minimum.

Terminals shall be for attaching to the wire with a tool made by the manufacturer of the terminal and recommended by the manufacturer for the terminals being furnished.

The tool shall be equipped with a ratchet device to ensure proper indentation of the terminal, which will not release until proper indentation is complete.

Tagging for Cables, Wires and Equipment

Except as otherwise specified in this Section, permanently identify with a tag both ends of each cable, each cable wire, and single wires that terminate in the junction boxes, switch mechanisms, signal instrument shelters, on equipment racks, relay bases, shelter 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. Each conductor of the cable shall be rung out and identified before applying the tag. Tagging shall follow the three-line convention with the termination in the first line, nomenclature in the second line, and termination of the other end of the wire in the third line. (From-To)

Tags for wire and cable identification and for identification of transformers, resistors, reactors and other components shall meet the following requirements and shall be subject to Engineer's acceptance:

Sleeve Type Tags

Tags for identifying individual cable conductors and field-installed wires within the signal instrument shelters, wayside cases, switch mechanisms, switch layout junction boxes, base of signal junction boxes, and similar applications, shall be the sleeve type as manufactured by Raychem Corporation, Thermofit Marker System (TMS), or an approved equal. 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.

Flat Plastic Tags

Tags for identification of vital relay plug boards, individual transformers, resistors, reactors, terminals, and other miscellaneous components within the signal instrument shelters, wayside cases, and outside terminal cases, shall be the flat plastic laminated type.

Tags shall be 1-1/2 inches long by 1/2-inch-wide. The untreated tag shall be milk white "vinylite", or an approved equal.

The identifying nomenclature space shall allow for two rows of lettering, and the tag material shall be capable of receiving typed-on characters by conventional means. The height of the lettering shall not be less than 1/8 inch.

After lettering, both the face and backside of the tag shall be covered with a clear plastic coating, "vinylite", or an approved equal.

Hardware

Mounting hardware exposed to the elements and used for signal equipment, cases, conduit, hangers, brackets, clamps, and the like, shall be hot-dip galvanized in accordance with AREMA C&S Manual Part 15.3.1, except as otherwise accepted by the Engineer.

Galvanizing

The hot-dip process of galvanizing shall be used. Parts shall be picked so scale and adhering impurities are removed. The zinc coating shall be of commercially pure zinc, and shall be continuous and thorough. It shall not scale, blister, or be removable by handling or installation. The finished surface shall be free from fine line cracks, holes, or other indications of faulty galvanizing. It shall be smooth and free from adhering flux and other impurities. The edges and ends of parts shall be free from lumps and globules. Parts shall be coated with at least 2 ounces of zinc per square foot of galvanized surface, after bending, cutting, drilling, and final fabrication.

Cadmium Plating

Nuts, bolts, and washers shall be cadmium plated or stainless.

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 six ten thousandths of an inch and shall withstand the salt spray test for at least 1,000 hours or an equivalent test accepted by the Engineer.

Conduit

Rigid conduit

Steel conduit shall conform to ANSI C80.1 and shall be installed as shown on the railroad plans. Where elbows are used, they shall be long radius type. Steel conduits shall be protected in shipping and handling by approved thread protectors.

Thick wall polyvinyl chloride conduit, high impact schedule 40, herein referred to as PVC conduit, shall be installed as shown in the railroad plans. Where elbows are used, they shall be the long radius type.

Flexible Conduit

Conduit for track circuit leads, switch-and-lock movements, and electric lock layouts shall be Liquid-Tite flexible conduit or an approved equal. The conduit shall be clamped at both ends with stainless steel clamps. Clamps are not required for track wire risers.

Where acceptable to the Engineer, metallic flexible conduit, Type UA, or an approved equal may be used.

Fittings

Approved fittings for flexible conduit shall be used.

Approved fittings for PVC conduit shall be used.

Fittings for rigid steel conduit shall be of cast malleable iron and shall be protected by hot-dip galvanizing.

Padlocks

Switch padlocks will be Owner-furnished.

Signal padlocks will be Owner-furnished. The Contractor shall provide temporary padlocks until such time the equipment is placed in-service.

Switch padlocks for the Freight Carrier's use will be SCRRA furnished. Provide all other padlocks in order to provide security of signal and electrical equipment until such time as the equipment is placed in-service and approved through final "acceptance".

Provide signal equipment padlocks until such time as the project is found to be acceptable and the Owner relieves the Contractor of maintenance responsibility. The Contractor and Owner or SCRRA will schedule a lock change out program directly related to the final "acceptance" of the project. The schedule shall be coordinated through the Resident Engineer. Present a list of equipment locks to be changed out by equipment and locations and the total number of locks that will be required to secure all the signal equipment.

Sealing Compound

Sealing compound for use in sealing cable entrances shall be in accordance with AREMA C&S Manual Part 15.2.15.

Cable Entrance Pipes

Cable entrance pipes for wayside signal shelters shall be 4-inch PVC, Schedule 40, and 3 feet 6 inches long and extend 18 inches below the final grade.

Cable entrance for wayside signals shall be 4 inch Liquid-Tite flexible conduit or an approved equal. Entrance pipe shall extend 18 inches below finished grade around signal.

Cable entrance pipes are not required where a cable chute directly enters a pull box.

Junction Boxes

Junction boxes shall be provided with gaskets to prevent the entrance of moisture and dust, in accordance with AREMA C&S Manual Part 15.2.10.

Junction boxes shall be provided to terminate underground cables at switch and lock movements and switch circuit controllers.

Junction boxes shall be provided with means for applying padlock.

Lubrication

Lubrication for switch tie plates for switch and lock movement layouts installed by the Contractor shall be an accepted graphite lubricant, similar to Dixon's Graphite "railroad 60".

Environmental Protection (Corrosion Preventive Compound)

Protection, as hereinafter specified for machine-finished surfaces, threaded rods, nuts, and other parts that are susceptible to rusting or corroding, shall be a corroding preventive compound, NO-OX-IDE No. 90918, or an approved equal. The product shall have sufficient body to resist weather and rusting for at least 6 months.

DC Track Circuits

Transmitters shall be a 1TC, 2TC, or 3TC manufactured by GETS Global Signaling or an approved equal.

Style C Track Circuits

Transmitter shall be a TD-1A driven by an ACG-2T or TD-4 manufactured by GETS Global Signaling or an approved equal.

Audio Frequency Island Track Circuits

Audio frequency island track circuits shall be AFTAC-II manufactured by GETS Global Signaling, PSO manufactured by Safetran systems, or an approved equal.

OVERLAY TRACK CIRCUITS

Provide and install Overlay track circuits EPIC III manufactured by GETS Global Signaling, or approved equal as designated in the railroad plans.

AC Track Circuits

AC Track Circuits shall be steady energy such as the SE-3 manufactured by Safetran or an approved equal. Vane Relays shall not be used.

Data Radio

Data radio package shall be comprised of Safetran Systems Inc. WCP II Radio, PN A53412; DC/DC Converter, PN A53106; and Wayside Control Unit, PN A53105.

Power off Strobe Light

Power off strobe light and miscellaneous materials shall be packaged and shipped with each shelter to be installed as shown on the railroad plans. Power off strobe light and miscellaneous materials shall be installed in the field by the installation contractor.

Each shelter requiring a power off strobe light and Miscellaneous materials will include the following:

1. 1 ea. Power Off Indication Light – S&C Distribution Company p/n 120-10, or an approved equal.
2. 1 ea. Protective Cage 5" x 5" x 5" – Fumio Fukaya Enterprises p/n UPRR0012, or an approved equal.
3. 1 ea. Rubber Grommet 3/8" x 1/8" – Newark Electronics p/n 32F1353.
4. 4 ea. Bolt, 1/4" – 20 x 2" Hex Head Cap Plated – McMaster Carr p/n 013194-002.
5. 4 ea. Nut, 1/4" – 20 Hex Plated – Grainger Industrial Supply p/n 4P408.
6. 8 ea. Washer, 1/4" Flat Stainless Steel – Grainger Industrial Supply p/n 4P484.
7. 1 ea. Silicone, RTV Sealant (Blue) – Grainger Industrial Supply p/n 5E220.

Enclosure Alarm System

Intrusion alarm system to be supplied and installed inside of enclosure as depicted on the railroad plans. Intrusion alarm system supplied by "ADEMCO No. V20 Pack", or equivalent system approved by the Engineer.

Extra Materials

Furnish two gallons or equivalent volume of corrosion preventive compound, No-Ox-ID A-Special or approved equal. Compound shall be the same product as approved for use in the Work.

CONSTRUCTION

Installation

Material and apparatus specified herein shall be installed in accordance with the details of respective Sections of these Specifications, manufacturer's recommendations, and in accordance with the Contractor's accepted installation drawings.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.23 SERVICE METERS

GENERAL

Summary

This Section includes requirements for 120/240, 100A three-wire, single-phase meter service and upgrading existing meter service to 120/240, 100A, 3-wire, single-phase meter service.

Provide interface with and in conformance to the standards of the Local Power Company (LPC), in order to obtain the commercial metered power service at the locations shown on the railroad plans and as required by the Engineer.

Definitions

Not Used

Submittals

Submit Meter Service Drawings, indicating mounting pole, meter base, breaker box, and grounding.

Submit Peak load calculation for each meter location. Submit load calculation within 90 days of Notice to Proceed.

Submit letter certifying that the installation of the meter service has been approved by the local electrical inspector.

Submit a copy of each service order to the Resident Engineer for approval and to verify that each meter service planned falls within the Owners property.

Quality Control and Assurance

Electrical service shall conform to the provisions in NFPA 70 National Electrical Code and these Specifications.

Materials and equipment furnished and installed under this Section shall conform to applicable State and local ordinances pertaining to electrical power installations and the National Electrical Code (NEC).

MATERIALS

Circuit Breakers

Circuit breakers shall be sized by the Contractor for the projected loads. Circuit breakers for 120 Vac power shall be 2 pole rated for 240 Vac. Panels shall contain 25 percent spare circuit breaker space.

One double pole circuit breaker shall be provided for future use, in addition to the 25 percent space circuit breaker space, specified herein.

Meter Bases shall meet the requirements of LPC.

Ground rods and ground rod clamps shall meet the requirements specified in Special Provision, Signal Grounding, and those of the LPC.

Wood Poles: Shall meet the requirements of LPC.

Meter Pedestals and Bases shall provide and install meter pedestals and bases which meet the requirements of LPC.

CONSTRUCTION

General

Make the necessary arrangements with LPC and pay fees in connection with having the new meter service hooked up at least one month prior to placing signal system in service.

Arrange to obtain the service connection from LPC. Pay LPC charges for this service connection.

Where the Contract Documents specify that the Owner will make arrangements with the LPC, Contractor shall be responsible for installation and coordination with the LPC.

Coordination

Coordinate the connection and interface of new cables and equipment with LPC in accordance with its standards.

Shall be responsible for Local Power Company monthly charges from all new meters installed until "The Commission" accepts full and final maintenance of the project. When final acceptance has been granted, the Contractor shall coordinate with SCRRA and the Local Power Company to transfer all new meter address to SCRRA at:

Southern California Regional Rail Authority
ATTENTION: Venus Sanchez
One Gateway Plaza, Floor # 12
Los Angeles, California 90012

Installation

The installation of the various equipment and materials for the signal power distribution system that are specified herein shall be in accordance with LPC's requirements and the NEC.

The requirements included within this section shall cover incidental installation work necessary to affect an integrated, tested, and operable signal power system for the work as shown on the railroad plans.

Arrange utility power service at equipment shelter locations requiring services. Connections to equipment shelters from meter may be by underground or aerial connection. Where aerial connection is used, maximum aerial length between meter and shelter shall not exceed 125 feet without the Engineer's prior acceptance.

The Contractor, in cooperation with the Engineer, shall meet as necessary with LPC representatives to negotiate for the upgrade, relocation, or addition of required power services needed to complete system operation.

Grounding

Meter service grounding shall be in accordance with Special Provision, Signal Grounding, the NEC, and the LPC's requirements. If there is a conflict between the above specifications, LPC's requirements shall govern.

Testing and Inspection

Simulated load tests, in accordance with approved signal power system test procedure, shall be satisfactorily completed prior to final connection of signal facilities at each equipment location.

Prior to final acceptance by the Engineer, obtain inspection of the new AC power service by state and local jurisdictional authority(s), as required.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.24 HIGHWAY GRADE CROSSING WARNING SYSTEMS

GENERAL

Summary

This Section includes requirements for highway grade crossing warning systems. These requirements shall also apply to pedestrian grade crossing warning systems, as applicable.

Where shown on the railroad plans 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.

Provide continuous operation of the highway grade crossing warning systems in preparation for, and during, track installation and rehabilitation work.

Definitions

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.

Provide continuous highway grade crossing warning during rail construction. Refer to Special Provision, 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.

Provide rail bonding for new or modified rail joints or turnouts as shown on the railroad plans. Provide rail bonding, as necessary, to maintain existing systems during construction.

Protect existing signaling cabling and, where necessary, relocate existing cabling to prevent damage to the cabling during track installation, profiling, or grade crossing work.

Record the final as-built conditions of the crossing warning system for each crossing.

Perform and document tests and inspections in accordance with CFR 49 regulations and these specifications.

Submittals

Provide submittals for highway grade crossing devices, equipment, systems, assemblies, and detailed design in accordance with the requirements of Special Provision, General Signaling Requirements.

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.

Alternative Foundation Design

If the Contractor proposes foundations different from those shown on the railroad plans, 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.

Detailed Work Plan

The following work plan shall be coordinated with and integrated with submittals made under Special Provision, 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. Changeover of control, testing, and temporary-warning procedures shall be coordinated with the Engineer.

Submit for approval of the Engineer a procedure plan for conducting quality assurance, component integrity, circuit continuity, circuit breakdown, and system operation tests.

Submit product data for products furnished under this Section.

Submit documentation of acceptance testing.

Submit test reports within 3 days of testing .

Quality Control and Assurance

Not Used

MATERIALS

Equipment - General

Furnish materials and equipment for installation and for interconnection of the highway crossing warning as indicated on the railroad plans 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.

Only those existing materials and equipment specifically identified on the railroad plans 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.

Furnish trackside equipment, such as tuned joint couplers, narrow band shunts, and wideband shunts, as shown on the railroad plans. Furnish equipment shelters, predictors, track filters, chokes, and other equipment as shown on the railroad plans and as required for complete installation.

Refer to Special Provision, Authority Furnished Material and Equipment, for lists of Owner-furnished equipment. Conduct and document acceptance testing of components prior to transporting them from Owner-designated storage location.

Electrical and Electronic Components - General

Design fusing and furnish fuses and printed circuit cards, connectors, and files in accordance with Special Provision, General Signaling Requirements.

Crossing Warning Train Detection Equipment

Furnish and install constant warning time (CWT) type crossing train detection equipment, terminating shunts, surge panels, and arresters for the crossing configurations shown on the railroad plans.

Furnish and install 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 railroad plans.

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.

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.

Furnish and install 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.

Constant warning time crossing train detection equipment shall be GETSGS (Harmon Electronics') Model HXP-3R2, Safetran GCP 3000-D2, GCP 4000 as shown on the railroad plans, or Approved Equal. Termination shunts shall be the CWT manufacturer's recommended type shunt for the frequency and application used. Furnish multi-frequency selectable termination shunts.

Furnish and install termination shunts, adjustable inductors, filters, code isolation units, and the like, as recommended by the CWT controller equipment manufacturer, as shown on the railroad plans.

Provide solid-state vital "AND" gate or equal as shown on the railroad plans.

The placement of the crossing approach start shunts shown on the railroad plans is based upon the maximum authorized train speed of 79 MPH and a crossing warning time of 30 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.

Furnish and install an internal 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.

Furnish and install a separate solid state data recorder and crossing monitor, which shall be capable of being integrated into the Metrolink Railway Works crossing monitor and alarm system, and capable of remote interrogation. The North American Signal Micro Data Analyzer II with data radio (MDA II) as shown on the railroad plans or Approved Equal shall be used.

Furnish and install a Roof mounted VHF antenna and 7db YAGI antenna and associated antenna cables, on each shelter as shown on the railroad plans. Contact the data recorder manufacturer to coordinate communication links from each data recorder to a data recorder communications controller, which is located within a Communications Shelter.

Provide and install an all new solid-state microprocessor based control system for interface with the traffic signal system for preemption applications. This system shall utilize an isolated RS-422 serial link (two twisted wire pairs) to a separate traffic controller or traffic control communications interface device. The system shall utilize the industry-standard IEEE 1570-2002 communications protocol to establish a serial link with a compatible Advanced Transportation Controller (ATC). The system shall be user configurable via a touch screen LCD user interface panel. The system shall have an output for interface system health, and one for traffic controller health. The system shall be able to provide second train logic via an output to drive a vital relay. This relay may also be used to extend the warning time of the crossing when there is a failure of the traffic signal controller. The Safetran Systems I-SPI unit, or approved equal shall be used.

Crossing Warning Gates and Flashing Lights

Furnish and install each highway grade crossing warning device assembly complete with associated hardware consisting of mast mounted gate mechanism, mast, junction box base, gate arm, flashing light units, bell, signs, and miscellaneous hardware as shown on the railroad plans and as specified herein.

The crossing gate warning device assembly shall conform to the requirements of CPUC GO No. 75D; CFR, Title 49, Part 234; and the relevant sub-parts of the AREMA C&S Manual Part 3.2.

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.

The gate mechanism shall be of the power-up, power-down electro-mechanical type complete with internal relay and adjustable snubbing resistor.

Furnish gate arms lengths required per Metrolink signal standards and site conditions. Arms shall be of the aluminum with fiberglass extensions and fiberglass tip type. Gate arm lamps shall be LED conforming to the AREMA C&S Manual, Part 3.2.40. Provide high intensity lamps when shown on the railroad plans. Fit lamp wiring harness with a five wire pull-apart connector for interconnection to the gate mechanism and securely fasten to the gate arm.

Provide gate arm wind guards conforming to AREMA C&S Manual Part 3.2.22 with each gate assembly.

Provide flashing light crossing signal units as shown on the railroad plans. Light units shall have 12-inch roundels with LED's and be complete with steel backgrounds, steel hoods, junction box, and cross-arm brackets.

Provide a crossing warning bell conforming to the AREMA C&S Manual, Part 3.2.60 with each gate assembly, except that the bell shall be mounted on the cantilever structure when a cantilever is shown.

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.

Exit Gates will default to the vertical position when energy is removed. At a grade crossing, the entrance gates and the exit gates must be provided by the same manufacturer. The Safetran S-40 and S-40EXIT or the US&S Model 95 Entrance Gate and Exit Gate are acceptable.

Exit Gate Systems shall incorporate dynamic vehicular detection utilizing preformed inductive loops with a modular processor assembly incorporating a minimum of 4 inputs and 8 outputs per module. Operating parameters shall be accessible and programmable from the front of the module such as the Reno A & E Model E-1400 or equal. Modules shall be capable of synchronous loop frequency scanning. Loop detector modules shall be integrated within the Exit Gate System

Control of Exit Gate operation shall be by a solid state processing system which is user configurable with permission and password protection. The Exit Gate System shall be configurable to process gate position information for up to 8 individual gate mechanisms selectable to be either Entrance or Exit Gates. The Exit Gate System shall be configurable to process vehicular detection information for vehicle presence and detector health for up to 16 individual inductive loops. User configuration and event analysis must be by a front panel LCD touch screen panel. The front panel LCD shall provide a graphic display depicting collective positions of entrance and exit gates along with occupancy status of entrance, intermediate and exit vehicular loops for both traffic directions. Exit Gate controller shall have an event recording capability and the ability to serially connect with another Exit gate controller of the same manufacturer. The railroad Controls Limited Exit Gate Management System or approved equal shall be used.

Control of Entrance Gates shall be by a solid state microprocessor system which contains a charging system and programmable gate delay. This controller may be a separate unit such as the Safetran SSCCIV or approved equal, or it may be an integrated modular component of the Constant Warning Time system such as the GCP4000 or approved equal.

Foundations

Provide foundations for wayside equipment cases, highway grade crossing gates, flashers, and cantilevers as specified herein.

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 Special Provision, Cast-in-Place Concrete, and Special Provision, Precast Concrete.

Provide precast concrete foundations complete with anchor bolts, nuts, and washers in accordance with the AREMA C&S Manual, Part 14.4.

galvanized steel foundations to be furnished and installed shall be complete with Special Provision, Signal Systems Miscellaneous Products, and AREMA C&S Manual, Part 15.3.1.

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.

Bolts, nuts, and washers shall be galvanized. Nuts and threads shall be in accordance with AREMA Specifications for Bolts, Nuts, and Threads, C&S Manual, Part 14.6.20. Plain washers shall be in accordance with AREMA Specifications for Plain and Spring Lock Washers, C&S Manual, Part 14.6.21. Steel shall be in accordance with AREMA Specifications for Various Types of Steel, C&S Manual, Part 15.1.4, Section 1. Bolts shall be of sufficient length to provide for leveling of the device.

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.

Hardware

Furnish hardware in accordance with Special Provision, Signal Systems Miscellaneous Products.

Conduit

Conduit shall conform to the specifications in Special Provision, Signal Systems Miscellaneous Products.

Delivery, Handling, and Storage

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.

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.

Spare Parts and Special Tools

Refer to Special Provision, Temporary Facilities and Controls, for general requirements for spare parts. Furnish for spare parts:

- A. A constant warning type (CWT) crossing train detection equipment cabinet complete with modules for a -track operation, associated surge panels, and programming keypad.
- B. A Solid State Vital Processing System including a vital modular processor assembly for loop detection for management of the exit gates.

CONSTRUCTION

General

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.

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 railroad plans.

Insulated Joints

Install insulated joints as specified in Special Provision, Track Work (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.

Rail Bonding

Install new, or maintain existing, and test rail bonding for electrical continuity as required for continuous train detection within the approach limits of the crossing(s).

Double bond frog assemblies, switch points, and rail joints as specified in Special Provision, Rail Bonding, with the type of bonds specified in Special Provision, Rail Bonding.

Make signal connection to rails using weld type track circuit connectors per SCRRA Engineering Standards.

Provide and install all required six wire configurations as designated in the railroad plans. The Contractor shall adhere to the installation instructions in place by the manufacturer of the CWT and the installation instructions regarding specialized application of Cadweld® bonding for the six wire configuration.

Crossing Warning System

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

Adjust new crossing warning system components as directed by the Resident Engineer to accommodate revisions to city traffic preemption requirements. This includes, but is not limited to, adjusting the placement of narrow band shunts, adjusting maximum preemption timers and reconfiguring constant warning device parameters.

The Contractor shall provide and install vital vehicle detection loops in accordance with SCRRRA ES4001.

Track Circuits

Install and adjust track circuits in accordance with the requirements of AREMA C&S Manual, Parts 8.6.1, CFR 49, Parts 234 and 236, and as specified herein.

Make track circuit rail connections using weld type connectors.

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.

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

Highway Grade Crossing Equipment

Install grade crossing warning equipment in conformance with CFR, Title 49 Part 234; CPUC G.O. 75D; approved submittals; and as shown on the railroad plans.

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 the AREMA C&S Manual, Parts 3.3.1 and 3.3.5 and CFR 49 Part 234.

Provide new cabling between the wayside gate/flasher and the crossing control shelter except where the railroad plans specifically specify the re-use of the existing cabling.

Furnish and install pedestrian gates in accordance with the railroad plans and installation instructions furnished by the Engineer.

Foundations

Excavate, backfill, compact, and clean-up excavation as specified in Division 31- Earthwork.

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.

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.

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.

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.

Refer to Special Provision, Exposed Finished Concrete, 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.

Provide nonconductive material between the foundations and the mounted apparatus to prevent direct contact between the concrete and metal surfaces.

Conduit

Install conduit where shown on the railroad plans and as specified herein.

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.

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.

Place conduit to a minimum depth of 36 inches below finished grade except where specifically noted otherwise.

Removing, Reinstalling and Salvaging Equipment

Relocate, reuse, modify, and salvage existing equipment as shown on the railroad plans. Refer to Special Provision, Demolition, Cutting and Patching, for salvage requirements. Inventory existing relays and controlling equipment prior to delivering to the Engineer's designated storage location.

Newly re-wire any existing equipment designated to be reused except where noted on the railroad plans.

Removed equipment and materials not designated for reuse or salvage shall become the property of the Contractor and disposed of. Refer to Special Provision, Site Clearing, for disposal requirements.

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.

Field Quality Control

Perform testing in accordance with Special Provision, Signal Systems Testing, including documentation requirements.

Prepare test procedures and perform and document tests on the highway grade crossing components and systems as follows:

1. Include tests herein specified, as specified in the appropriate sections of the AREMA C&S Manual, and the FRA Rules, Standards, Instructions for railroad Signal Systems, CFR 49 Part 234 and 236.
2. Perform pretests on 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.

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 railroad plans and as approved by the Engineer. Verify, by measurement, that the equipment does not violate the train dynamic clearance envelope.

Test each grade crossing warning installation in accordance with Section 34 42 58, Signal Systems Testing, and the AREMA C&S Manual, Parts 3.3.1 and 3.3.5. In addition, perform applicable tests as described in the SCRRA Instructions Governing Installation, Maintenance, Inspection and Testing of Signal Apparatus and Signal Systems, all manufacturer's recommended test and adjustment procedures, and any tests required by regulation.

Disconnect and ground associated signal equipment not under test. Disconnect or unplug electronic devices or signal equipment prior to any testing.

Follow manufacturer's instructions for testing of operation and electronic equipment.

Submit test data and results to the Engineer's information and approval within 24 hours of placing the apparatus or system in operation.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.25 WAYSIDE SIGNAL ASSEMBLIES

GENERAL

Summary

The Section includes the requirements for furnishing and installing wayside signal assemblies.

Wayside signal assemblies shall consist of ground-mounted masts, color-light signal heads with LED lamps, backgrounds, visors, number plates (for automatic signals), ladders, platforms, foundations, and mounting hardware required to construct absolute (interlocking) and automatic signals.

Contractor shall furnish and install signals as specified herein and as shown on the railroad plans.

Definitions

Not Used

Submittals

Contractor shall submit shop drawings for each type of signal unit and each type of signal layout to the Resident Engineer for approval. Show ladders, masts, bases, arms and required mounting hardware. Show location and method of mounting the signals to the structure.

Provide necessary dimensions, hardware, method of mounting signals, and material specifications for items to be furnished.

Submit shop drawings for structure foundations.

Submit Installation procedure for approval by the Engineer. The procedure shall include a detailed description of installation activity and sufficient detail to allow the Engineer to determine the validity of the installation procedure.

Quality Control and Assurance

Wayside signal assemblies shall meet the requirements of AREMA C&S Manual part 7 and applicable portions of Manual Part 3.2.5, where requirements of the AREMA Specifications do not conflict with requirements specified herein.

Inspect each signal assembly after it has been installed in the field. This inspection shall conform to the Contractor's Installation Procedure as accepted by the Engineer.

L.E.D. Lamp Units shall meet the requirements of AREMA C&S Manual Part 7.1.5.

Signal aspect shall be distinct and unmistakable when viewed from a height of 7 to 12 feet above top of rail at a distance of 1,000 feet. Nominal sighting distance shall be 2000 feet. Where unobstructed sighting distance for a standard signal arrangement is less than 2000 feet, provide to the Resident Engineer written notifications of sighting problems and locations.

Foundations shall meet requirements of AREMA Signal Manual Part 14.1.1.A through 14.4.36 inclusive, where requirements of the AREMA Specifications do not conflict with requirements specified herein.

The Engineer reserves the right to make inspections and tests, as necessary, to determine if the equipment meets the requirements of these Specifications.

MATERIALS

Delivery, Storage, and Handling

Ship lamp units separately from the signal head in which they will be used.

Contractor shall ensure that wayside signal assemblies and signal lamp units are safely stored and protected from damage during storage, handling and transporting.

Warranty

Contractor shall provide warranty from defects arising from defective parts, workmanship, and lightning damage for 2 years from the first date of service.

Materials

Contractor shall furnish color-light signal heads as manufactured by Safetran, as specified herein, and as shown on SCRRR ES8525-01

Contractor shall furnish ground signal assemblies in accordance with these Specifications, and SCRRR ES8500-01 and ES8505-01, as appropriate for site-specific requirements.

Signal Heads

Signal head shall be furnished with L.E.D. lamp units, blank out cover plates (if applicable), hoods, background, mounting brackets, and U-bolts to fit 5-inch mast assemblies that Contractor proposes to furnish.

Signal head shall include mounting bracket for 5-inch mast and stainless steel fasteners.

Color-light signal units shall be capable of displaying three aspects: green, yellow and red as shown on SCRRR ES 8525-01

Install blank-out cover plates in unused lamp units.

Signal head shall be designed to allow removal of lamp units from the rear with the exception of the Unilens dwarf signals..

Dwarf signals shall be of the Unilens type as manufactured by Safetran Systems or approved equal and must be able to display three aspects: green, yellow, and red as shown on SCRRR ES 8525-01.

Signal access covers (doors) shall be provided with a means of securing in closed position.

Ground Signal Assemblies

Contractor shall furnish ground signal assemblies in accordance with SCRRA ES 8500-01, as appropriate for site-specific requirements.

Ground signal assemblies shall consist of an aluminum 5-inch mast structure, junction box, liquid-tight flex conduit, platforms, ladder, ladder foundation, grounding pigtail welded to the mast structure, and shall be equipped with mounting hardware to accommodate the required arrangement of signal heads.

Each ground signal assembly must be fully compliant with the latest OSHA and CAL-OSHA fall protection requirements in effect at the advertisement of this Contract. Where a conflict exists between the requirements, the most stringent shall apply.

Signal Masts

Signal masts shall be predrilled for the placement of signal units by the manufacturer at the factory. Nominal signal mast height is between 21 feet and 21 feet 7 inches. A 5-inch cap for top of mast shall also be provided with each mast unit.

The base section shall be designed to accommodate a 5-inch mast. The dimensions of the foundation bolt hold centers in the base shall be as specified on SCRRA ES8500-01 and SCRRA ES8505-01.

Signal mast shall be fitted with one 48-inch long No. 2 ground wire cad-welded to the mast as shown on SCRRA ES8500-01 and ES8505-01. The pigtail shall be coiled and secured in a manner that prevents during construction and while in transit.

Grounding for signal mast shall be as specified in Special Provision, Signal Grounding.

Ladders and Platforms

Platforms and ladder mounting brackets shall be constructed of galvanized steel, and shall be in accordance with AREMA Signal Manual Part 7.2 and SCRRA ES8500-01 and ES8505-01.

Ladders shall be constructed of aluminum having non-slip rungs and capable of supporting the weight of two people. Two hinged flat plates shall be fitted to the ladder to prevent unauthorized access to both sides of the ladder. The covers shall be locked in place by a signal padlock and hasp arrangement intended for this purpose.

Ladder platform cages shall extend a minimum of 42 inches above the top of landing.

Junction Boxes

Junction box shall be in accordance with SCRRA ES8530-01

Junction box shall be mounted as shown in SCRRA ES8500-01 and ES8505-01. Junction box shall be securely fastened to the mast using 5-inch u-bolts. Junction box shall be furnished with a minimum of 28 AAR test (multi-unit) terminals in accordance SCRRA ES8330, and a 4-inch liquid tight flex conduit 8feet. length with liquid-tight flex conduit 8feet. in length with liquid-tight fitting.

Foundations

Furnish foundations for ground signals in accordance with SCRRA ES8255.

Furnish galvanized steel foundations complete with galvanized bolts, washers, nuts and associated hardware. Galvanizing shall conform to Specifications in Special Provision, Signal Systems Miscellaneous Products, and AREMA Signal Manual, Part 15.3.1.

Construct galvanized steel foundations of steel angle and plate welded together. Foundations shall be constructed of 2 ½ inch by 2 ½ inch by ¼ inch steel angle and ¼ inch steel plate.

CONSTRUCTION

Installation - Signals

Contractor shall furnish and install signal layouts in locations as indicated on the railroad plans and as shown on the accepted shop drawings. No part of any signal layout shall conflict with SCRRA Design Standards, Code of Federal Regulations, Part 49, nor installed within the clearance envelope as defined in CPUC G.O. 26-D.

Locate signals centered between insulated joint, except where physically not possible. In such instances, submit a recommendation to the Resident Engineer for approval.

Center line of signal mast shall be 15 feet from centerline of track unless a deviation from this is approved by the Resident Engineer, as shown on the railroad plans or required to meet CPUC clearance requirements.

Install signal units level and plumb on their foundations. Leveling nuts shall be used as shown on SCRRA Engineering Standards.

Install signal layouts in accordance with the applicable requirements of AREMA Signal Manual, Part 7.4.1 and SCRRRA Engineering Standards.

Install platforms for each signal unit level.

Align signals for maximum viewing distance before placing in service.

Refer to Design Requirements herein regarding signal aspect and sighting distances. Install signals and verify sighting distances. Provide the Resident Engineer with written notification with any sighting problems.

Mount signal heads on an offset arm as shown in the SCRRRA Engineering Standards. Signal heads shall also be able to swivel on the offset arm and be adjustable.

Signal nomenclature shall be as shown on the railroad plans.

The underground cable shall be dressed, pot-headed, tagged and terminated in the signal junction box as specified in Special Provision, Signal Systems Miscellaneous Products. The number of conductors and conductor size of the underground cables shall be as shown in the railroad plans.

Wiring from the junction box base to the signal heads shall be No. 10 AWG copper stranded wire as shown on the railroad plans.

Install identification tags on each wire. These tags shall bear the nomenclature shown on the accepted Shop Drawings.

Set lamp voltage between 8.8 volts and 9.2 volts measured at the signal lamp.

Installation – Junction Boxes and Cabling

The junction box shall have two terminals with insulated test links for each cable conductor, as specified in Special Provision, Signal Systems Miscellaneous Products.

Junction box placement and cable entry to the junction box shall be as shown on SCRRRA ES8500-01 and ES8505-01.

The method of routing #10 flex wire from the junction box to each signal mounted on the structure shall be to route the wire within the tubular members of the structure. Pull wires entirely through the structure members, mast and signal mounting brackets, unless otherwise approved by the Resident Engineer.

Provide pull boxes located a maximum of 5 feet from each signal. Edges shall be smooth and rounded to accommodate cable installation.

Installation - Foundations

Install each foundation in accordance with the approved Contractor's Installation Procedure for each type of foundation, as herein specified, and as shown on SCRRRA ES8215-01. The absence of a specific task listing herein does not relieve the Contractor of the responsibility for providing a complete and functional installation.

Refer to Special Provision, Coordination with Utility Owners, for requirements for locating and protecting existing utilities. Advise the Resident Engineer immediately if any utility or cable interferes with foundation work. After locating interference, allow 72 hours for the Resident Engineer to relocate or mitigate the interference.

Prior to placing steel foundations in the excavations, place and compact a crushed stone base in accordance with Special Provision, Earthwork.

When placing foundations, exercise care and ensure that anchor bolts are not bent or threads damaged. Protect anchor bolt threads, washers, and nuts by applying friction tape or other accepted method satisfactory to the Resident Engineer, until the unit to be supported is installed.

After back filling excavation, the Contractor shall ensure that the foundation is plumb and level. Where ground signal foundations are installed, the top of the foundation shall be no higher than the nearest rail and no lower than the top of nearest tie. Under no circumstance shall the top of the foundation be more than 24 inches above final grade.

Foundations shall be installed to the lines, grades and dimensions required as determined by the Contractor and accepted by the Resident Engineer. Mounting bolts shall be of sufficient length to accommodate use of leveling nuts between the base of the equipment to be supported and the top of the foundation.

The Contractor shall provide a means to prevent entry of rodents and insects at the bases of the vertical masts.

Painting

Touch up any damaged painted finish.

Field Tests

Make tests for proper operation and setting of lamp operating voltages in accordance with Special Provision, Signal Systems Testing.

MEASUREMENT AND PAYMENT

No separate measurement will be made for the work in this section.

Payment for the work of this section will be included in the lump sum payment(s) for the applicable building or facility in accordance with the Schedule of Quantities.

14-1.26 TRACK SHIFTING, RELOCATION, AND RESURFACING

GENERAL

Summary

Furnish supervision, labor, materials, equipment, transportation and incidentals necessary to shift, relocate or resurface railroad track as shown on the railroad plans and specified herein. Railroad track as used herein is defined as "an assembly of rails, ties and fastenings over which cars, locomotives and trains are moved." This "track" assembly includes, the rail, ties, special trackwork, other track material (OTM), ballast, and walkways although not an exclusive listing. Special provision for TRACKWORK will govern track construction work associated with this Section.

Perform track shifting, relocation and resurfacing work as shown on the railroad plans, and in accordance with this Section.

Prior to shifting or relocating track, drainage structures and grading, including placement of Sub-Ballast shall be completed and accepted by the Engineer.

Shifted, relocated, and resurfaced track shall be stabilized using a Ballast Stabilizer.

Following shifting, relocating, resurfacing and stabilizing of track, rail shall be distressed in accordance with SCRRRA Track Maintenance and Engineering Instructions Section 8.3.

Track shifting shall include work to shift existing track more than 1 foot and less than 10 feet and providing Ballast per the special provision BALLAST, resurfacing and regulating track in its new location.

Track relocation shall include all work to relocate existing track a distance greater than 10 feet including installation of Ballast per the special provision BALLAST, resurfacing and regulating track in its new location.

Resurfacing, shall include shifting of existing track up to 1 foot, and involves resurfacing indicated track and special trackwork, including lining, raising, tamping, and regulating track in conformance with SCRRRA engineering standards, provisions of this specification, and to the lines and grades shown on the railroad plans. The Ballast per the special provision BALLAST required to fill cribs and provide adequate shoulders must be provided by the Contractor.

Rough and final surfacing of the entire track section shall be performed to provide minimal profile smoothing and adjustment. This surfacing may include providing and placing Ballast per the special provision BALLAST, tamping, stabilizing and regulating ballast.

The Contractor must submit a SSWP for each track segment that requires shifting, relocating, or resurfacing the active track and specification for COORDINATION WITH SCRRRA.

Submittals

Refer to the special provision for COORDINATION WITH SCRRRA, for submittal of applicable SSWP.

Quality Control and Assurance

Contractor must perform track shifting, relocating, and surfacing under supervision of a qualified railroad Construction Project Manager, railroad Track Construction Manager, and Track Foreman. Work shall be performed by personnel experienced in similar railroad track work. The surfacing crew shall include a ground man, with a minimum of six months experience, qualified to check profile and alignment behind the tamper.

Project Conditions

This work may occur on an active railroad track.

The Contractor must coordinate the Work to prevent undue interference with the SCRRRA daily operations, or with other phases of the Project, whether performed by SCRRRA forces or another contractor's forces.

MATERIALS

Products

Materials to be installed under this Contract must be provided by the Contractor unless indicated otherwise in the Contract Documents.

Materials damaged or broken prior to or during installation must be replaced at the Contractor's expense with no cost to SCRRRA.

Labor, material not furnished by SCRRA, or equipment required for track resurfacing but not expressly shown on the railroad plans shall be as if shown on the Drawings and included in the Contractor's bid price.

Material must be new, except as otherwise indicated herein, and meet the requirements stated herein and of the AREMA and SCRRA Standards.

CONSTRUCTION

Contractor personnel and equipment shall meet the requirements set forth in these contract documents.

Contractor must exercise care in his progression of work under this Contract to avoid and prevent damage to the track being shifted, relocated, or resurfaced, adjacent tracks, and structures and facilities, such as existing pavements, pavement bases, drainage structures, light poles, fire hydrants, signal facilities (track wires, bootlegs, signal masts, guy wires, signals, cables, conduits) utilities, signage and buildings. Contractor must repair or replace damaged structures or facilities to satisfaction of the owner at no cost to SCRRA, except that SCRRA will repair and test signal facilities at the Contractor's expense. Track wires, bootlegs, signal masts, guy wires, signals, cables, conduits and other signal facilities identified for removal in the SSWP will not be removed by the Contractor but will be removed by SCRRA. The Contractor must be responsible to coordinate his work with SCRRA to arrange for the timely and orderly removals or relocations of this signal equipment and facilities. Failure of the Contractor to provide reasonable and adequate coordination for timely removal and relocation of signal facilities will not allow for an extension of time or provide grounds for extra cost to SCRRA.

Contractor must perform Work under this Section in accordance with these Specifications and consistent with track resurfacing standard industry practice.

Contractor must periodically review the supply of materials, labor and equipment to ensure a uniform flow of work. Contractor must keep the Engineer informed regarding material shortages or developing problems that require corrective action.

Shifted, relocated, and resurfaced track shall meet the following tolerances as well as the standards for FRA 49CFR213 class 5 track.

Except for pre-existing rail gauge corner rail wear,

Deviation from correct gage of 56-1/2 inch shall not exceed + or - 1/4 inch at any point.

Deviation measured in any section of 20 consecutive crossties shall not exceed 1/8 inches at 75 percent of the crossties, and 1/4 inch at the remaining 25 percent.

Newly installed or re-installed ties will be spiked not to exceed + or - 1/8 inch irrespective of pre-existing rail gauge corner wear.

TRACK SURFACE	TOLERANCE
Runoff in any 31 FEET of rail at the end of a raise may not be more than	1/4 inch
Deviation from uniform profile on either rail at the mid-ordinate of a 62 FEET chord may not be more than	3/8 inch
Deviation from designated elevation on spirals may not be more than	1/4 inch
Variations in cross levels on spirals in any 31 FEET may not be more than	5/8 inch
Deviation from zero cross level at point on tangent or from designated elevation on curves between spirals may not be more than	3/16 inch
Difference in cross level between two points less than 62 FEET apart on tangents and curves between spirals may not be more than	3/8 inch

Alignment - maximum deviation from uniformity measured in conformance FRA Safety Standards Section, 213.55.

Tangent Track 1/4 inch - at mid-ordinate on a 62 feet chord.

Curved Track 1/4 inch - from correct mid-ordinate on a 62 FEET chord.

Elastic clips, rail anchors, and spikes shall be loosened prior to shifting track to prevent skewed ties. Rail, fasteners, or crossties damaged during track shifting must be replaced by the Contractor at Contractor's expense. Rail anchors are not to be slid longitudinally along the base of the rail. They must be removed prior to shifting track and reapplied in the correct location after track is shifted to its final location.

Contractor must perform shifting and resurfacing within the stated project limit station areas as specified to bring the line and surface into compliance within the track geometry tolerances specified.

Contractor must resurface the track to zero crosslevel on tangent track and to the proper crosslevel elevation, with spirals, for the curves as shown on Contract Documents.

Ballast shall be spread and track raised in a series of lifts. No single lift shall be higher than 2 inches except in crossings and turnouts. In raising the track, jacks or equipment shall be regulated to avoid bending of angle bars or straining of joints. When jacks are used they shall be simultaneously used and properly spaced at not more than quarter points of the rail to avoid breaks or bends in the rail when the track is raised. Both rails shall be raised simultaneously and to proper crosslevel by utilizing automatic tampers or standard track level boards with each set of track raising jacks. Each tie shall be tamped from 15 inches inside the rail to the end of the tie. Tamping shall not be permitted at the middle of a tie. Both ends of a tie shall be tamped simultaneously and tamping inside and outside the rail shall be done at the same time.

Ties that become loose during track raise shall be placed in proper position, tie-plates properly placed, holes plugged with "Tight Spike" or approved tie plugs and spiked before tamping. During each track raise, track shall be uniformly tamped.

After ballasting is completed and the track is resurfaced and lined, according to the tolerances, ballast shall be mechanically stabilized using a track stabilizer and ballast shall be trimmed neatly and surplus material shall be spread evenly along the ballast shoulder.

After stabilizing is completed, rail shall be distressed in accordance with SCRRRA Track Maintenance and Engineering Instructions Section 8.3.

Contractor must perform the necessary operations to ensure that ties are at right angles to the track as practical with standard railroad procedures. Cribs between ties shall be fully ballasted and dressed.

Contractor must perform 2 tamping squeezes per tie up to 2 inch of raise with one additional insertion and squeeze for each additional 1 inch of raise. Joint ties shall be given one additional squeeze more than other ties. The Contractor must not cause a center-bound track condition.

Where squeeze tampers cannot fill and compact ballast, such as but not limited at frogs, guard rails, switch portions of turnouts and headblocks, mechanically tamp with approved hand-held air tools or other power tamping tools. Hand tamping shall be done simultaneously from both sides of the tie.

On curves, the high rail shall be used as the line rail and the low rail shall be used as the grade rail.

When surfacing turnouts, the straight side of the turnout shall be used as the line rail.

After ballast regulating in turnouts, cribs for switch points, switch rods, and guardrails shall be pocketed 3 inches and cleared of ballast to permit free operation of the switch and signal rods.

After the ballast is regulated, dressed and consolidated using a track stabilizer, Contractor must ensure that track bolts and rail anchors, or elastic track fasteners are tight and in proper alignment.

For track resurfacing the total track raise will be the minimum amount necessary to smooth the track profile. It shall be the responsibility of the Contractor to provide smooth transitions that meet the required surfacing tolerances as listed above to grade crossings and turnouts, using the ballast stockpiled near the worksite. In addition, the Contractor must maintain vertical overhead clearances under structures by limiting the amount of track raise. Adjustment of turnouts and connecting tracks to match profile and alignment adjustments on adjacent track must be provided by Contractor at no additional expense.

Any temporary surfacing runoffs made to accommodate interim rail traffic prior to completion of track surfacing must meet FRA Track Class 5 Standards.

Walkways shall conform to SCRRRA Engineering Standards ES 2105 and General Order No.118-Public Utilities Commission of the State of California.

MEASUREMENT AND PAYMENT

Work of shifting, relocating and resurfacing existing track will include furnishing all labor, materials, tools, equipment, supplies, supervision, installation of Contractor provided ballast and walkway rock, laser aligned tamping, resurfacing, regulating, stabilizing and de-stressing to SCRRRA standard cross section and any other incidental work necessary for shifting, relocating and resurfacing existing track as described in the Contract Documents.

Full compensation for conforming to the requirements of this section is considered as included in the contract price paid per track foot for running rail, by the unit for concrete and wood ties, linear foot for construct concrete grade crossing panels, lump sum for cutover track from mainline to shoofly and reverse, track foot for install ballasted track, lump sum for construct ballasted turn out, track foot for construct track on bridge and no separate payment will be made therefor.

BID ITEM LIST**07-1218W4**

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
1	070012	PROGRESS SCHEDULE (CRITICAL PATH METHOD)	LS	LUMP SUM	LUMP SUM	
2	024076	CONTRACTOR-FURNISHED RESIDENT ENGINEER'S OFFICE	LS	LUMP SUM	LUMP SUM	
3	071321	TEMPORARY FENCE (TYPE CL-6)	LF	4,710		
4	024077	TEMPORARY DRAINAGE SAN FERNANDO BLVD EXCAVATION	LS	LUMP SUM	LUMP SUM	
5	074016	CONSTRUCTION SITE MANAGEMENT	LS	LUMP SUM	LUMP SUM	
6	074019	PREPARE STORM WATER POLLUTION PREVENTION PLAN	LS	LUMP SUM	LUMP SUM	
7	074026	TEMPORARY MULCH	SQYD	11,400		
8	074027	TEMPORARY EROSION CONTROL BLANKET	SQYD	3,000		
9	074028	TEMPORARY FIBER ROLL	LF	13,500		
10	074029	TEMPORARY SILT FENCE	LF	9,800		
11	074031	TEMPORARY GRAVEL BAG BERM	LF	22,500		
12	074033	TEMPORARY CONSTRUCTION ENTRANCE	EA	30		
13	074034	TEMPORARY COVER	SQYD	5,000		
14	074037	MOVE-IN/MOVE-OUT (TEMPORARY EROSION CONTROL)	EA	24		
15	074038	TEMPORARY DRAINAGE INLET PROTECTION	EA	200		
16	074041	STREET SWEEPING	LS	LUMP SUM	LUMP SUM	
17	074042	TEMPORARY CONCRETE WASHOUT (PORTABLE)	LS	LUMP SUM	LUMP SUM	
18	074051	TEMPORARY HYDRAULIC MULCH	SQYD	4,700		
19	074053	TEMPORARY HYDROSEED	SQYD	8,000		
20	074055	TEMPORARY SOIL BINDER	SQYD	46,000		

BID ITEM LIST**07-1218W4**

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
21	074056	RAIN EVENT ACTION PLAN	EA	82	500	41,000
22	074057	STORM WATER ANNUAL REPORT	EA	4	2,000	8,000
23	074058	STORM WATER SAMPLING AND ANALYSIS DAY	EA	52		
24	090100	TIME-RELATED OVERHEAD (WDAY)	WDAY	900		
25	120090	CONSTRUCTION AREA SIGNS	LS	LUMP SUM	LUMP SUM	
26	120100	TRAFFIC CONTROL SYSTEM	LS	LUMP SUM	LUMP SUM	
27	120120	TYPE III BARRICADE	EA	55		
28	120159	TEMPORARY TRAFFIC STRIPE (PAINT)	LF	112,000		
29	120165	CHANNELIZER (SURFACE MOUNTED)	EA	680		
30	128601	TEMPORARY SIGNAL SYSTEM	LS	LUMP SUM	LUMP SUM	
31	129000	TEMPORARY RAILING (TYPE K)	LF	122,000		
32	129100	TEMPORARY CRASH CUSHION MODULE	EA	820		
33	141103	REMOVE YELLOW THERMOPLASTIC TRAFFIC STRIPE (HAZARDOUS WASTE)	LF	56,400		
34	148005	NOISE MONITORING	LS	LUMP SUM	LUMP SUM	
35	150305	OBLITERATE SURFACING	SQYD	26,700		
36	150608	REMOVE CHAIN LINK FENCE	LF	33,900		
37	150662	REMOVE METAL BEAM GUARD RAILING	LF	4,360		
38	150676	REMOVE CABLE RAILING	LF	1,680		
39	024078	REMOVE HANDRAIL	LF	260		
40	150711	REMOVE PAINTED TRAFFIC STRIPE	LF	388,000		

BID ITEM LIST**07-1218W4**

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
41	150712	REMOVE PAINTED PAVEMENT MARKING	SQFT	1,610		
42	150714	REMOVE THERMOPLASTIC TRAFFIC STRIPE	LF	64,500		
43	150715	REMOVE THERMOPLASTIC PAVEMENT MARKING	SQFT	1,950		
44	150722	REMOVE PAVEMENT MARKER	EA	23,100		
45	150742	REMOVE ROADSIDE SIGN	EA	316		
46	150757	REMOVE SIGN STRUCTURE (EA)	EA	12		
47	024079	REMOVE SLOTTED CORRUGATED STEEL PIPE	LF	1,290		
48	150812	REMOVE PIPE (LF)	LF	750		
49	150820	REMOVE INLET	EA	16		
50	150821	REMOVE HEADWALL	EA	2		
51	150833	REMOVE RETAINING WALL (LF)	LF	3,740		
52	150853	REMOVE CONCRETE PAVEMENT (SQYD)	SQYD	92,900		
53	024080	REPLACE UNDERLYING BASE	CY	400		
54	024081	REMOVE EXISTING TRACK, TIES AND BALLAST AND INSTALL BUMPING POST	TF	27,600		
55	024082	REMOVE GRADE CROSSING (SHOOFLY AND MAINLINE)	TF	370		
56	024083	SALVAGE TURN-OUT	EA	1		
57	152390	RELOCATE ROADSIDE SIGN	EA	5		
58	152430	ADJUST INLET	EA	6		
59	152604	MODIFY INLET	EA	1		
60	153103	COLD PLANE ASPHALT CONCRETE PAVEMENT	SQYD	2,700		

BID ITEM LIST**07-1218W4**

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
61	153130	REMOVE CONCRETE CURB (LF)	LF	60,200		
62	153139	REMOVE CONCRETE SIDEWALK (LF)	LF	9,760		
63	153221	REMOVE CONCRETE BARRIER	LF	18,000		
64	153225	PREPARE CONCRETE BRIDGE DECK SURFACE	SQFT	65,800		
65	153247	REMOVE CONCRETE (MISCELLANEOUS) (CY)	CY	420		
66	153251	REMOVE SOUND WALL (LF)	LF	5,840		
67	153531	ACCESS OPENING, SOFFIT	EA	2		
68	155003	CAP INLET	EA	152		
69	157551	BRIDGE REMOVAL, LOCATION A	LS	LUMP SUM	LUMP SUM	
70	157554	BRIDGE REMOVAL, LOCATION D	LS	LUMP SUM	LUMP SUM	
71	157562	BRIDGE REMOVAL (PORTION), LOCATION B	LS	LUMP SUM	LUMP SUM	
72	157563	BRIDGE REMOVAL (PORTION), LOCATION C	LS	LUMP SUM	LUMP SUM	
73	157565	BRIDGE REMOVAL (PORTION), LOCATION E	LS	LUMP SUM	LUMP SUM	
74	157566	BRIDGE REMOVAL (PORTION), LOCATION F	LS	LUMP SUM	LUMP SUM	
75	157567	BRIDGE REMOVAL (PORTION), LOCATION G	LS	LUMP SUM	LUMP SUM	
76	024086	REMOVE EXISTING RAILROAD BRIDGES OVER SAN FERNANDO	LS	LUMP SUM	LUMP SUM	
77	024087	EMPIRE CENTER RESTORATION	LS	LUMP SUM	LUMP SUM	
78	024088	CLEARING AND DEMOLITION	ACRE	2		
79	024089	ROADWAY EXCAVATION (VOLATILE ORGANIC COMPOUNDS, PETROLEUM HYDROCARBONS AND METALS)	CY	3,170		
80	190101	ROADWAY EXCAVATION	CY	206,000		

BID ITEM LIST**07-1218W4**

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
81	024090	TRACKBED EXCAVATION (PETROLEUM HYDROCARBON COMPOUNDS AND METALS)	CY	21,400		
82	190106	ROADWAY EXCAVATION (TYPE Z-3) (AERIALY DEPOSITED LEAD)	CY	3,390		
83	190107	ROADWAY EXCAVATION (TYPE Y-1) (AERIALY DEPOSITED LEAD)	CY	21,600		
84	190108	ROADWAY EXCAVATION (TYPE Y-2) (AERIALY DEPOSITED LEAD)	CY	2,750		
85	190110	LEAD COMPLIANCE PLAN	LS	LUMP SUM	LUMP SUM	
86	190111	ADL BURIAL LOCATION REPORT	LS	LUMP SUM	LUMP SUM	
87	024091	ROADWAY EXCAVATION (PETROLEUM HYDROCARBON)	CY	25,400		
88	024092	ROADWAY EXCAVATION (PETROLEUM HYDROCARBON AND AERIALY DEPOSITED LEAD)	CY	370		
89	043923 (F)	STRUCTURE EXCAVATION (PETROLEUM HYDROCARBON AND AERIALY DEPOSITED LEAD)	CY	3,048		
90	044017 (F)	STRUCTURE EXCAVATION (PETROLEUM HYRDOCARBON)	CY	548		
91	044018 (F)	STRUCTURE EXCAVATION (VOLATILE ORGANIC COMPOUNDS, PETROLEUM HYDROCARBONS AND METALS)	CY	4,100		
92	192003 (F)	STRUCTURE EXCAVATION (BRIDGE)	CY	31,425		
93	192025 (F)	STRUCTURE EXCAVATION (CULVERT)	CY	1,404		
94	192037 (F)	STRUCTURE EXCAVATION (RETAINING WALL)	CY	89,314		
95	024093 (F)	STRUCTURE EXCAVATION (AUSTIN VAULT)	CY	3,055		
96	192054 (F)	STRUCTURE EXCAVATION (TYPE Z-3) (AERIALY DEPOSITED LEAD)	CY	990		
97	192057 (F)	STRUCTURE EXCAVATION (TYPE Y-1) (AERIALY DEPOSITED LEAD)	CY	6,504		
98	192058 (F)	STRUCTURE EXCAVATION (TYPE Y-2) (AERIALY DEPOSITED LEAD)	CY	1,430		
99	024094	TEMPORARY SHORING FOR UNDERPASS EXCAVATION	SQFT	42,800		
100	024095 (F)	FILTER MEDIA (SAND BED) (AUSTIN VAULT)	CY	190		

BID ITEM LIST**07-1218W4**

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
101	024096 (F)	STRUCTURE BACKFILL (AUSTIN VAULT)	CY	469		
102	193003 (F)	STRUCTURE BACKFILL (BRIDGE)	CY	22,349		
103	193004 (F)	STRUCTURE BACKFILL (CULVERT)	CY	623		
104	193006 (F)	STRUCTURE BACKFILL (SLURRY CEMENT)	CY	2,538		
105	193013 (F)	STRUCTURE BACKFILL (RETAINING WALL)	CY	130,327		
106	193030 (F)	PERVIOUS BACKFILL MATERIAL	CY	4,413		
107	198010	IMPORTED BORROW (CY)	CY	279,000		
108	043924	LIGHTWEIGHT FILL (EPS BLOCK)	CY	11,711		
109	043925	GASOLINE RESISTANT GEOMEMBRANE	SQYD	4,477		
110	200001	HIGHWAY PLANTING	LS	LUMP SUM	LUMP SUM	
111	204099	PLANT ESTABLISHMENT WORK	LS	LUMP SUM	LUMP SUM	
112	208000	IRRIGATION SYSTEM	LS	LUMP SUM	LUMP SUM	
113	208026 (F)	2" SUPPLY LINE (BRIDGE)	LF	299		
114	208304	WATER METER	EA	2		
115	208738 (F)	8" CORRUGATED HIGH DENSITY POLYETHYLENE PIPE CONDUIT	LF	695		
116	208739 (F)	10" CORRUGATED HIGH DENSITY POLYETHYLENE PIPE CONDUIT	LF	990		
117	024097	AGGREGATE BASE CEMENT SLURRY	CY	1,040		
118	260210 (F)	AGGREGATE BASE (APPROACH SLAB)	CY	31		
119	260303	CLASS 3 AGGREGATE BASE (CY)	CY	96,000		
120	024098	CRUSHED MISCELLANEOUS BASE	CY	760		

BID ITEM LIST**07-1218W4**

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
121	280000	LEAN CONCRETE BASE	CY	51,700		
122	024099	LEAN CONCRETE BASE RAPID SETTING	CY	3,840		
123	043926	FURNISH HOT MIX ASPHALT (CHANNEL)	TON	124		
124	043927	PLACE HOT MIX ASPHALT (CHANNEL)	SQYD	735		
125	390131	HOT MIX ASPHALT	TON	47,900		
126	390137	RUBBERIZED HOT MIX ASPHALT (GAP GRADED)	TON	640		
127	391007	PAVING ASPHALT (BINDER, GEOSYNTHETIC PAVEMENT INTERLAYER)	TON	1		
128	393004 (F)	GEOSYNTHETIC PAVEMENT INTERLAYER (PAVING FABRIC)	SQYD	5,075		
129	394060	DATA CORE	LS	LUMP SUM	LUMP SUM	
130	394073	PLACE HOT MIX ASPHALT DIKE (TYPE A)	LF	740		
131	394074	PLACE HOT MIX ASPHALT DIKE (TYPE C)	LF	800		
132	394075	PLACE HOT MIX ASPHALT DIKE (TYPE D)	LF	3,370		
133	394076	PLACE HOT MIX ASPHALT DIKE (TYPE E)	LF	4,580		
134	394077	PLACE HOT MIX ASPHALT DIKE (TYPE F)	LF	1,800		
135	397005	TACK COAT	TON	31		
136	401050	JOINTED PLAIN CONCRETE PAVEMENT	CY	79,100		
137	024100	JOINTED PLAIN CONCRETE PAVEMENT (RAPID STRENGTH CONCRETE)	CY	6,290		
138	404092	SEAL PAVEMENT JOINT	LF	281,000		
139	404093	SEAL ISOLATION JOINT	LF	1,500		
140	406050 (F)	DOWEL BAR (DRILL AND BOND)	EA	8,426		

BID ITEM LIST
07-1218W4

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
141	411105	INDIVIDUAL SLAB REPLACEMENT (RSC)	CY	900		
142	413113	REPAIR SPALLED JOINTS, POLYESTER GROUT	SQYD	710		
143	024101	SEAL JOINT (EXISTING CONCRETE PAVEMENT)	LF	28,400		
144	420201	GRIND EXISTING CONCRETE PAVEMENT	SQYD	23,400		
145	043928	TIEDOWN ANCHOR	EA	49		
146	477021 (F)	MECHANICALLY STABILIZED EMBANKMENT, LOCATION A	SQFT	18,191		
147	477022 (F)	MECHANICALLY STABILIZED EMBANKMENT, LOCATION B	SQFT	14,750		
148	477023 (F)	MECHANICALLY STABILIZED EMBANKMENT, LOCATION C	SQFT	8,454		
149	477024 (F)	MECHANICALLY STABILIZED EMBANKMENT, LOCATION D	SQFT	9,799		
150	024786	TEMPORARY SCREENING WALL	LF	2,010		
151	490411	FURNISH STEEL PILING (PP 16 X 0.500)	LF	8,130		
152	490412	DRIVE STEEL PILE (PP 16 X 0.500)	EA	187		
153	490550	FURNISH 24" STEEL PIPE PILING	LF	11,795		
154	490555	DRIVE 24" STEEL PIPE PILE	EA	296		
155	024102	JACKED CASING - 60" OUTSIDE DIAMETER STEEL CASING	LF	340		
156	490601	16" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	10,511		
157	490603	24" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	40,479		
158	490604	30" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	18,573		
159	490606	42" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	1,460		
160	490609	60" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	133		

BID ITEM LIST
07-1218W4

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
161	490780	FURNISH PILING (CLASS 200)	LF	7,380		
162	490781	DRIVE PILE (CLASS 200)	EA	156		
163	500001	PRESTRESSING CAST-IN-PLACE CONCRETE	LS	LUMP SUM	LUMP SUM	
164	510051 (F)	STRUCTURAL CONCRETE, BRIDGE FOOTING	CY	4,926		
165	510053 (F)	STRUCTURAL CONCRETE, BRIDGE	CY	19,422		
166	510060 (F)	STRUCTURAL CONCRETE, RETAINING WALL	CY	29,869		
167	510072 (F)	STRUCTURAL CONCRETE, BARRIER SLAB	CY	1,219		
168	024103 (F)	STRUCTURAL CONCRETE, APPROACH SLAB (RAILROAD)	CY	114		
169	510085 (F)	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE EQ)	CY	290		
170	510086 (F)	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE N)	CY	625		
171	510087 (F)	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE R)	CY	303		
172	510088 (F)	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE N MODIFIED)	CY	750		
173	024104 (F)	STRUCTURAL CONCRETE (AUSTIN VAULT)	CY	583		
174	510502 (F)	MINOR CONCRETE (MINOR STRUCTURE)	CY	338		
175	510800	PAVING NOTCH EXTENSION	CF	225		
176	511035 (F)	ARCHITECTURAL TREATMENT	SQFT	161,417		
177	511106	DRILL AND BOND DOWEL	LF	1,608		
178	512354	FURNISH PRECAST PRESTRESSED CONCRETE SLAB (TYPE SIV)	SQFT	65,800		
179	024106	PRECAST CONCRETE FASCIA	SQFT	7,230		
180	024787	EARTH RETAINING STRUCTURE (MSE WALL)	SQFT	196,233		

BID ITEM LIST
07-1218W4

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
181	512510 (F)	ERECT PRECAST PRESTRESSED CONCRETE DECK UNIT	EA	206		
182	024107	GRADE CROSSING PANELS	LF	230		
183	024109	CUTOVER TRACK FROM MAINLINE TO SHOOFLY AND REVERSE	LS	LUMP SUM	LUMP SUM	
184	515020	REFINISH BRIDGE DECK	SQFT	1,279		
185	515041	FURNISH POLYESTER CONCRETE OVERLAY	CF	5,483		
186	515042 (F)	PLACE POLYESTER CONCRETE OVERLAY	SQFT	65,800		
187	518002 (F)	SOUND WALL (MASONRY BLOCK)	SQFT	93,101		
188	519081	JOINT SEAL (MR 1/2")	LF	5,410		
189	519091	JOINT SEAL (MR 1 1/2")	LF	203		
190	519100	JOINT SEAL (MR 2")	LF	1,248		
191	520102 (F)	BAR REINFORCING STEEL (BRIDGE)	LB	6,802,291		
192	520103 (F)	BAR REINFORCING STEEL (RETAINING WALL)	LB	4,000,622		
193	024110 (F)	BAR REINFORCING STEEL (AUSTIN VAULT)	LB	137,540		
194	024111	BALLASTED TRACK	TF	31,000		
195	024112	BALLASTED TURN-OUT	LS	LUMP SUM	LUMP SUM	
196	024113	WOOD TIES	EA	6,700		
197	024114	CONCRETE TIES	EA	8,860		
198	024115	RUNNING RAIL	TF	31,100		
199	024116	BALLAST	CY	13,200		
200	540101 (F)	ASPHALT MEMBRANE WATERPROOFING	SQFT	926		

BID ITEM LIST**07-1218W4**

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
201	540104 (F)	WATERPROOFING AND COVER	SQFT	12,840		
202	043929	PUBLIC SAFETY PLAN	LS	LUMP SUM	LUMP SUM	
203	550110 (F)	COLUMN CASING	LB	76,134		
204	550203 (F)	FURNISH STRUCTURAL STEEL (BRIDGE)	LB	3,383,684		
205	550204 (F)	ERECT STRUCTURAL STEEL (BRIDGE)	LB	3,383,684		
206	024117	INSTALL BRIDGE MOUNTED VERTICAL CLEARANCE SIGN	EA	4		
207	560203	FURNISH SIGN STRUCTURE (BRIDGE MOUNTED WITH WALKWAY)	LB	6,940		
208	560204	INSTALL SIGN STRUCTURE (BRIDGE MOUNTED WITH WALKWAY)	LB	6,940		
209	560208	FURNISH SIGN STRUCTURE (TUBULAR)	LB	11,800		
210	560209	INSTALL SIGN STRUCTURE (TUBULAR)	LB	11,800		
211	560213	FURNISH SIGN STRUCTURE (LIGHTWEIGHT)	LB	21,400		
212	560214	INSTALL SIGN STRUCTURE (LIGHTWEIGHT)	LB	21,400		
213	560218	FURNISH SIGN STRUCTURE (TRUSS)	LB	278,000		
214	560219	INSTALL SIGN STRUCTURE (TRUSS)	LB	278,000		
215	560233	FURNISH FORMED PANEL SIGN (OVERHEAD)	SQFT	3,620		
216	560244	FURNISH LAMINATED PANEL SIGN (1"-TYPE A)	SQFT	640		
217	560245	FURNISH LAMINATED PANEL SIGN (1"-TYPE B)	SQFT	280		
218	560248	FURNISH SINGLE SHEET ALUMINUM SIGN (0.063"-UNFRAMED)	SQFT	1,660		
219	560249	FURNISH SINGLE SHEET ALUMINUM SIGN (0.080"-UNFRAMED)	SQFT	990		
220	560251	FURNISH SINGLE SHEET ALUMINUM SIGN (0.063"-FRAMED)	SQFT	180		

BID ITEM LIST**07-1218W4**

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
221	560252	FURNISH SINGLE SHEET ALUMINUM SIGN (0.080"-FRAMED)	SQFT	570		
222	561005	36" CAST-IN-DRILLED-HOLE CONCRETE PILE (SIGN FOUNDATION)	LF	60		
223	561016	60" CAST-IN-DRILLED-HOLE CONCRETE PILE (SIGN FOUNDATION)	LF	260		
224	024118	METAL SIGN (BARRIER/WALL MOUNTED)	LB	3,850		
225	024119	ROADSIDE SIGN - ONE POST (METAL)	EA	37		
226	566011	ROADSIDE SIGN - ONE POST	EA	121		
227	566012	ROADSIDE SIGN - TWO POST	EA	21		
228	568001	INSTALL SIGN (STRAP AND SADDLE BRACKET METHOD)	EA	56		
229	024120	INSTALL PANEL (BARRIER/WALL MOUNTED)	EA	2		
230	024121	6" PLASTIC PIPE	LF	260		
231	650010	12" REINFORCED CONCRETE PIPE	LF	560		
232	650012	15" REINFORCED CONCRETE PIPE	LF	100		
233	650014	18" REINFORCED CONCRETE PIPE	LF	2,700		
234	650018	24" REINFORCED CONCRETE PIPE	LF	2,530		
235	650030	42" REINFORCED CONCRETE PIPE	LF	660		
236	650034	48" REINFORCED CONCRETE PIPE	LF	1,160		
237	665024	24" CORRUGATED STEEL PIPE (.109" THICK)	LF	50		
238	665717	18" SLOTTED CORRUGATED STEEL PIPE (.079" THICK)	LF	6,050		
239	024124	12" CORRUGATED HIGH DENSITY POLYETHYLENE PIPE	LF	1,350		
240	024125	6" CORRUGATED HIGH DENSITY POLYETHYLENE PIPE	LF	130		

BID ITEM LIST**07-1218W4**

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
241	024127	6" GALVANIZED STEEL PIPE (DECK DRAIN)	LF	100		
242	024128	30" CONCRETE ENCASEMENT	LF	50		
243	024129	STORM DRAIN PROTECTION FOR 18" REINFORCED CONCRETE PIPE	LF	160		
244	024130	STORM DRAIN PROTECTION FOR 4'X2.5' REINFORCED CONCRETE BOX	LF	140		
245	024131	6" PERFORATED DRAIN PIPE	LF	430		
246	024132	8" PVC PIPE (SCHEDULE 80)	LF	220		
247	024788	12" CORRUGATED PERFORATED HIGH DENSITY POLYETHYLENE PIPE (UNDERDRAIN)	LF	15,100		
248	024789	2 1/2" GALVANIZED STEEL PIPE (DECK DRAIN)	LF	190		
249	024790	8" CORRUGATED PERFORATED HIGH DENSITY POLYETHYLENE PIPE (UNDERDRAIN)	LF	10,000		
250	024791	8" CORRUGATED PERFORATED HIGH DENSITY POLYETHYLENE PIPE	LF	110		
251	024134	UNDERDRAIN CLEANOUT	LF	220		
252	024792	21" CONCRETE ENCASEMENT	LF	65		
253	024135	6" PLASTIC PIPE UNDERDRAIN PERFORATED (AUSTIN VAULT)	LF	570		
254	680903	6" NON-PERFORATED PLASTIC PIPE UNDERDRAIN	LF	12		
255	024136	18" HIGH DENSITY POLYETHYLENE DOWNDRAIN	LF	85		
256	024137	FILTER FABRIC (AUSTIN VAULT)	SQYD	440		
257	024138 (F)	PERMEABLE MATERIAL (AUSTIN VAULT)	CY	165		
258	024139	CORRUGATED STEEL PIPE DROP INLET	LF	44		
259	024133	PARKWAY DRAIN	LF	20		
260	024140	24" DUCTILE IRON PIPE - FORCE MAIN PIPING	LF	600		

BID ITEM LIST**07-1218W4**

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
261	024141	4" DUCTILE IRON PIPE - SUMP PUMP PIPING	LF	620		
262	719300	MANHOLE	LF	170		
263	721810	SLOPE PAVING (CONCRETE)	CY	27		
264	024142 (F)	GABION (AUSTIN VAULT)	CY	33		
265	024143	MINOR CONCRETE (CURB, SIDEWALK, AND DRIVEWAY)	CY	1,780		
266	730045	MINOR CONCRETE (GUTTER) (CY)	CY	240		
267	731502	MINOR CONCRETE (MISCELLANEOUS CONSTRUCTION)	CY	270		
268	731530	MINOR CONCRETE (TEXTURED PAVING)	SQFT	49,300		
269	731623	MINOR CONCRETE (CURB RAMP)	CY	11		
270	750001 (F)	MISCELLANEOUS IRON AND STEEL	LB	44,870		
271	750041 (F)	ISOLATION CASING	LB	261,480		
272	750498 (F)	MISCELLANEOUS METAL (RESTRAINER - CABLE TYPE)	LB	1,450		
273	750501 (F)	MISCELLANEOUS METAL (BRIDGE)	LB	582,960		
274	024144	BRIDGE DECK DRAINAGE SYSTEM (RAILROAD)	LF	2,080		
275	750505 (F)	BRIDGE DECK DRAINAGE SYSTEM	LB	9,757		
276	024145 (F)	MISCELLANEOUS METAL (AUSTIN VAULT)	LB	230		
277	024146	HYDRODYNAMIC SEPARATOR	EA	1		
278	800320	CHAIN LINK FENCE (TYPE CL-4)	LF	380		
279	800360	CHAIN LINK FENCE (TYPE CL-6)	LF	14,500		
280	043930 (F)	CHAIN LINK FENCE (TYPE CL-6) (MODIFIED)	LF	39		

BID ITEM LIST
07-1218W4

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
281	802510	5' CHAIN LINK GATE (TYPE CL-6)	EA	1		
282	802601	14' CHAIN LINK GATE (TYPE CL-6)	EA	1		
283	802640	18' CHAIN LINK GATE (TYPE CL-6)	EA	2		
284	820107	DELINEATOR (CLASS 1)	EA	30		
285	024147	INSTALL MEDIAN MILEAGE PANEL	EA	22		
286	832003	METAL BEAM GUARD RAILING (WOOD POST)	LF	1,800		
287	833032 (F)	CHAIN LINK RAILING (TYPE 7)	LF	4,063		
288	833088 (F)	TUBULAR HANDRAILING	LF	990		
289	833142 (F)	CONCRETE BARRIER (TYPE 26 MODIFIED)	LF	482		
290	024148 (F)	CABLE RAILING (AUSTIN VAULT)	LF	438		
291	839521 (F)	CABLE RAILING	LF	17,111		
292	839541	TRANSITION RAILING (TYPE WB)	EA	8		
293	839581	END ANCHOR ASSEMBLY (TYPE SFT)	EA	7		
294	839584	ALTERNATIVE IN-LINE TERMINAL SYSTEM	EA	8		
295	839585	ALTERNATIVE FLARED TERMINAL SYSTEM	EA	4		
296	839604	CRASH CUSHION (REACT 9CBB)	EA	1		
297	839703	CONCRETE BARRIER (TYPE 60C)	LF	3,220		
298	839704 (F)	CONCRETE BARRIER (TYPE 60D)	LF	6,623		
299	043931 (F)	CONCRETE BARRIER (TYPE 60D MODIFIED)	LF	1,197		
300	024149	CONCRETE BARRIER (TYPE 60W MODIFIED)	LF	6,380		

BID ITEM LIST**07-1218W4**

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
301	839717 (F)	CONCRETE BARRIER (TYPE 732 MODIFIED)	LF	164		
302	024150	CONCRETE BARRIER (TYPE 60E)	LF	200		
303	043932 (F)	CONCRETE BARRIER (TYPE 60A MODIFIED)	LF	842		
304	043933 (F)	CONCRETE BARRIER (TYPE 60C MODIFIED)	LF	120		
305	839725 (F)	CONCRETE BARRIER (TYPE 736)	LF	1,601		
306	839726 (F)	CONCRETE BARRIER (TYPE 736A)	LF	665		
307	839727 (F)	CONCRETE BARRIER (TYPE 736 MODIFIED)	LF	2,241		
308	043934 (F)	CONCRETE BARRIER (TYPE 736A MODIFIED)	LF	7,669		
309	043935 (F)	CONCRETE BARRIER (TYPE 60E MODIFIED)	LF	278		
310	839731 (F)	CONCRETE BARRIER (TYPE 736B)	LF	4,728		
311	024151	CONCRETE BARRIER (TYPE 60GE MODIFIED)	LF	350		
312	043936 (F)	CONCRETE BARRIER (TYPE 736SV MODIFIED)	LF	920		
313	839734 (F)	CONCRETE BARRIER (TYPE 736SV)	LF	3,802		
314	840504	4" THERMOPLASTIC TRAFFIC STRIPE	LF	107,000		
315	840505	6" THERMOPLASTIC TRAFFIC STRIPE	LF	3,400		
316	840506	8" THERMOPLASTIC TRAFFIC STRIPE	LF	92,100		
317	840508	8" THERMOPLASTIC TRAFFIC STRIPE (BROKEN 12-3)	LF	6,370		
318	840515	THERMOPLASTIC PAVEMENT MARKING	SQFT	11,550		
319	840521	4" THERMOPLASTIC TRAFFIC STRIPE (BROKEN 6-1)	LF	2,410		
320	840525	4" THERMOPLASTIC TRAFFIC STRIPE (BROKEN 36-12)	LF	118,000		

BID ITEM LIST
07-1218W4

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
321	840526	4" THERMOPLASTIC TRAFFIC STRIPE (BROKEN 17-7)	LF	22,100		
322	840550	8" THERMOPLASTIC TRAFFIC STRIPE (BROKEN 36-12)	LF	4,260		
323	840656	PAINT TRAFFIC STRIPE (2-COAT)	LF	744,000		
324	840666	PAINT PAVEMENT MARKING (2-COAT)	SQFT	2,230		
325	850101	PAVEMENT MARKER (NON-REFLECTIVE)	EA	9,550		
326	850111	PAVEMENT MARKER (RETROREFLECTIVE)	EA	24,200		
327	860090	MAINTAINING EXISTING TRAFFIC MANAGEMENT SYSTEM ELEMENTS DURING CONSTRUCTION	LS	LUMP SUM	LUMP SUM	
328	024152	FURNISH AND INSTALL TRAFFIC SIGNAL SYSTEM COMPLETE	LS	LUMP SUM	LUMP SUM	
329	860251	SIGNAL AND LIGHTING (LOCATION 1)	LS	LUMP SUM	LUMP SUM	
330	860252	SIGNAL AND LIGHTING (LOCATION 2)	LS	LUMP SUM	LUMP SUM	
331	860400	LIGHTING (TEMPORARY)	LS	LUMP SUM	LUMP SUM	
332	860402	LIGHTING (CITY STREET)	LS	LUMP SUM	LUMP SUM	
333	024153	RAILROAD LIGHTING	EA	16		
334	860705	INTERCONNECTION CONDUIT AND CABLE (LS)	LS	LUMP SUM	LUMP SUM	
335	860775	SPRINKLER CONTROL CONDUIT (BRIDGE) (LS)	LS	LUMP SUM	LUMP SUM	
336	860797	ELECTRIC SERVICE (IRRIGATION)	LS	LUMP SUM	LUMP SUM	
337	024154	MICROWAVE VEHICLE DETECTION SYSTEM (TEMPORARY)	LS	LUMP SUM	LUMP SUM	
338	024155	MODIFY COMMUNICATION SYSTEM	LS	LUMP SUM	LUMP SUM	
339	861088	MODIFY RAMP METERING SYSTEM	LS	LUMP SUM	LUMP SUM	
340	861497	MODIFY SIGNAL AND LIGHTING (LOCATION 1)	LS	LUMP SUM	LUMP SUM	

BID ITEM LIST
07-1218W4

Item No.	Item Code	Item Description	Unit of Measure	Estimated Quantity	Unit Price	Item Total
341	861498	MODIFY SIGNAL AND LIGHTING (LOCATION 2)	LS	LUMP SUM	LUMP SUM	
342	861499	MODIFY SIGNAL AND LIGHTING (LOCATION 3)	LS	LUMP SUM	LUMP SUM	
343	861500	MODIFY SIGNAL AND LIGHTING (LOCATION 4)	LS	LUMP SUM	LUMP SUM	
344	861504	MODIFY LIGHTING AND SIGN ILLUMINATION	LS	LUMP SUM	LUMP SUM	
345	861505	MODIFY SIGNAL AND LIGHTING (LOCATION 5)	LS	LUMP SUM	LUMP SUM	
346	024156	RAILROAD SIGNALING	LS	LUMP SUM	LUMP SUM	
347	994650	BUILDING WORK	LS	LUMP SUM	LUMP SUM	
348	999990	MOBILIZATION	LS	LUMP SUM	LUMP SUM	

TOTAL BID:

\$ _____