Port of
LONG BEACH
The Green Port

RAILROAD

DESIGN CRITERIA

AND

STANDARD PLANS

REVISED: 4-13-11

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I. RAILROAD DESIGN CRITERIA

1.0 INTRODUCTION

The basic requirement for railroad geometric design shall be to provide economical and efficient transportation while maintaining adequate factors of safety with respect to overall operation, maintenance, and rolling stock stability.

The criteria presented herein relating to the design of operational components emphasizes safety and follows accepted engineering practices used on operating, Class 1 railroads.

The criteria relating to other elements of design for work items necessitated by railroad system construction, such as miscellaneous utility work, are based on the latest specifications and practices of the agencies having jurisdiction.

Specific Design Criteria may be waived only when unique circumstances warrant and then only with permission of the Chief Harbor Engineer.

1.1 DEFINITIONS

All definitions used in this Railroad Design Criteria document are in accordance with those used in AREMA except as modified herein:

Engineer:	The Chief Harbor Engineer or his authorized representative
Industrial Yard Track:	Storage Tracks outside of terminals
Industrial Service Track:	Storage and working tracks within terminals
Mainline Track:	A railroad feeder track beginning at the Equilon Curve track split north of the Dominguez Channel extending to POLB Terminals, Railyards, and spur tracks under the jurisdiction of the PHL.
Spur Track:	A track diverting from the Mainline Track.

2.0 DESIGN CODES, MANUALS, STANDARDS AND SPECIFICATIONS

The railroad design shall meet all applicable parts of the State of California general laws, CPUC requirements, FRA safety requirements, and the specific requirements of this section.

Unless specifically noted otherwise in this criteria, the latest edition of the code, regulation, and standard that is applicable at the time the design is initiated shall be used. If a new edition or amendment to a code, regulation, or standard is issued before the design is completed, the design shall conform to the new requirements to the extent approved or required by the agency enforcing the code, regulation, or standard changed.

The guidelines/design criteria assembled in this document are based on industry standards, governmental regulations, local practices, and railroad standards. The following publications and documents were used as references:

- California Public Utility Commission (CPUC) General Orders (GO) (see below)
- Burlington Northern &, Santa Fe Standards (BNSF)
- Union Pacific Railroad Standards (UPRR)
- American Railway Engineering Maintenance Association Standards (AREMA)
- Federal Railroad Association Safety Standards (FRA)
- Standard Specifications for Public Works Construction (SSPWC)

The specific CPUC General Orders that shall govern are:

- CPUC GO No. 26 – D
  REGULATIONS GOVERNING CLEARANCES ON RAILROADS AND STREET RAILROADS WITH REFERENCE TO SIDE AND OVERHEAD STRUCTURES, PARALLEL TRACKS, CROSSINGS OF PUBLIC ROADS, HIGHWAYS AND STREETS
- CPUC GO No. 75 – C
  REGULATIONS GOVERNING THE PROTECTION OF CROSSINGS AT GRADE OF ROADS, HIGHWAYS AND STREETS WITH RAILROADS IN THE STATE OF CALIFORNIA
- CPUC GO No. 118
  REGULATIONS GOVERNING THE CONSTRUCTION, RECONSTRUCTION, MAINTENANCE OF WALKWAYS ADJACENT TO RAILROAD TRACKAGE AND THE CONTROL OF VEGETATION ADJACENT THERETO

All new and existing tracks shall be constructed or upgraded to meet the most current version of these orders and standards.

2.1 RAILROAD PLANNING

During the preparation of plans and specifications for new rail projects within the POLB, the applicable local railroads such as the BNSF, UPRR and PHL shall be a part of the planning and design process.

2.2 DESIGN LOADING

The Design of Track Systems shall be based on a Cooper E-80 loading in accordance with AREMA. Associated Track layouts shall include loops for train engine power flexibility to enter and exit to reduce push/pull movements. A train shall use five (5) road power engines for all movements unless directed otherwise by the POLB.

2.3 DESIGN SPEED

The Design Speed for main line track alignments shall be twenty five (25) miles per hour and ten (10) miles per hour for terminals.

3.0 HORIZONTAL ALIGNMENT

3.1 GENERAL

The parameters for the design of horizontal alignments are established in accordance with the recommendations of the Manual for Railway Engineering, published by the American Railway Engineering and Maintenance Association (AREMA), latest edition.

The horizontal alignment of mainline tracks shall consist of tangents joined to circular curves by transition spirals. Spiral curves shall not be used in yards and service areas.

The desirable operating speeds for Port of Long Beach rail projects shall be as follows:

- Mainline Tracks 25 mph
- Intermodal and Yard Tracks 10 mph

3.2 TRAIN LENGTHS

Three hundred nine feet (309') per double stack container rail car

Five platforms equal one (1) double stack container railcar.

Twenty five (25) double stack container railcars is the length of a unit train.

Eight thousand one hundred (8,100) feet is the maximum length of a unit train with five (5) engines (road power).

Bulk train data varies. Although a typical bulk car length such as for coal is approximately sixty three (63) feet from coupler to coupler.

3.3 TRACK CENTERS

Track centers (Distance between the centerlines of two adjacent tracks) for mainline, lead tracks, tangent tracks and tracks parallel to mainline tracks shall be a minimum of fifteen (15) feet.

Track centers for yard tracks shall be a minimum of fourteen (14) feet with fifteen (15) feet preferred.

Track centers for tracks parallel to ladder tracks shall be a minimum of twenty (20) feet.

Curves over a six (6) degree of curve (D_C) shall have their track centers increased two (2) inches per degree of curve.

3.4 TANGENT ALIGNMENT

The desired minimum tangent length (L) between curves or spirals shall be determined by the following formula:

$$L = 3V$$

where: L = minimum tangent length, feet
V = design speed through the curve, mph

The minimum tangent length between curves or spirals shall be one hundred (100) feet.
All turnouts shall be located on tangent track sections.

3.5 HORIZONTAL CURVED ALIGNMENT

3.5.1 CIRCULAR CURVES

Circular curves shall be defined by the ARC definition of curvature and specified by their radii and/or degree of curvature.

Horizontal curvature shall be a maximum of seven (7) degrees thirty (30) minutes with a minimum radius of seven hundred sixty four and forty nine one hundredths (764.49) feet on mainline tracks.

Horizontal curvature shall be a maximum of ten (10) degrees zero (0) minutes (minimum radius of 573.69 feet) on intermodal container stack train storage yard tracks, intermodal container stack train loading/unloading tracks and mainline yard tracks.

Special approval for lesser radii must be obtained from the Chief Harbor Engineer.

No turnouts shall be located within a horizontal curve.

Horizontal curvature shall be a maximum of twelve (12) degrees thirty (30) minutes (Minimum radius of 459.28 feet) on industrial yard tracks and individual service tracks.

The desired minimum length (L) of a superelevated circular curve shall be determined by the formula:

$$L = 3V$$

where: L = minimum length of curve, feet
V = design speed through curve, mph

3.5.2 SUPERELEVATION

a. In the design of horizontal alignments, the allowable superelevation throughout curved sections shall be determined by considering actual speeds and allowable Eu. Superelevation is defined as the elevation difference in inches between the

high rail and low rail.

b. Superelevation shall be determined from the following formula:

$$Ea + Eu = 3.839\ V^2/R$$

where V = design speed through the curve, mph
R = Radius of curve, feet

c. Values for actual superelevation (Ea) shall be rounded to the nearest one quarter (¼) inch.

d. Actual superelevation (Ea) shall be attained and removed linearly throughout the full length of the spiral transition curve by raising the outside rail while maintaining the top of the inside rail at profile grade.

e. Where spirals are not possible, Ea shall be attained linearly over a length equal to 1.5EaV, rounded to the next ten (10) feet, and divided equally between the tangent and curve.

f. Yard, intermodal, and secondary tracks and special trackwork shall not be superelevated.

g. Mainline tracks shall have a maximum super-elevation of two and three-quarters (2.75) inches with and one and one-half (1.5) inch of unbalance. No super-elevation is preferred.

3.5.3 SPIRAL TRANSITION CURVES

a. Spiral transition curves shall be used in mainline tracks to connect tangents to circular curves or to connect compound circular curves. The spiral to be used shall be the clothoid spiral.

b. No spirals shall be required for curves with radii of ten thousand (10,000) feet or greater.

c. The desired minimum length of spiral (Ls) shall be the greater of the lengths as determined by the following formulae, rounded to the nearest ten (10) feet, but not less than one hundred (100) feet:

$$Ls = 31\ Ea$$
$$Ls = 1.17\ EaV$$
$$Ls = 1.22\ EuV$$

Where Ea and Eu are in inches; V in mph.

3.5.4 REVERSE CURVES

The minimum tangent length between reversing curves is one hundred (100) feet. Two hundred (200) feet is preferred on main line tracks.

4.0 VERTICAL ALIGNMENT

4.1 GENERAL

The profile grade shall represent the elevation of the top of the low rail.

In areas of curved alignment where profile is given for one track only, the gradients of the second track shall be adjusted uniformly to accommodate the differences in lengths throughout the curves.

Turnouts and switches shall not be placed within a vertical curve.

4.2 GRADES

4.2.1 ALL TRACKS

a. For standard track installation, the maximum desired sustained grade for mainline tracks and sidings shall be one (1.0) percent. The use of greater profile grades must be approved by the Chief Harbor's Engineer.

b. For intermodal container stack train storage yards, intermodal container stack train loading/unloading tracks, and mainline yard tracks, the maximum grade is one –quarter of one percent (0.25%)

c. Profile grades can be a maximum of two percent (2%) for short lengths with approval of the Chief Harbor's Engineer.

d. Loading yard tracks, storage yard tracks, and sidings to mainline tracks shall be at elevations lower than the elevation of the mainline track such that runaway yard cars cannot roll onto the mainline.

e. It is desirable that through storage tracks have a sag in the middle of their profile to prevent rail cars from rolling to either end.

4.3 VERTICAL CURVATURE

4.3.1 ALL TRACKS

All changes in grade shall be connected by a parabolic vertical curve as defined by AREMA.

a. For main line tracks the minimum length of vertical curve shall be determined by the following formula:

$$L = 100(G2-G1)/2a$$

where: (G2-G1) = Algebraic difference in grades
2a = rates of change of grade (per cent per station)
L = length of vertical curve in feet

b. The minimum length of vertical curve shall be thirty three (33) x D feet where D equals the difference in grades in percent. In no case shall the length of vertical curve be less than one hundred (100) feet.

c. Vertical curves shall not be required for grade intersections where the algebraic difference in grade is less than one tenth (0.1) percent.

d. The maximum rate of chance for a vertical curve shall be limited to two tenths (0.20) per foot per one hundred (100) feet in SAG curves and four tenths (0.40) foot per one hundred (100) feet on summit curves.

e. The design of vertical curves shall ensure that there is no "Bottoming-Out" of extended length rail cars on grade summits.

f. There shall be no turnouts within a vertical curve.

5.0 CLEARANCES

5.1 GENERAL

The minimum railroad clearance standards described in this section shall be adhered to for all new construction or design and for all temporary construction or design as noted. Any deviation from these minimum standards shall require the advance written approval of the Chief Harbor Engineer.

Notwithstanding any of the following criteria, all designs must comply with the regulations outlined in the California Public Utilities Commission (CPUC) General Order 26-D.

All horizontal clearances shall be measured from center of track.

All vertical clearances shall be measured from top of rail (T/R). At clearance locations where superelevation is present, vertical clearances shall be measured from the high rail.

The following minimum clearances shall apply:

5.2 TRACK CENTERS

1. For mainline tracks, lead tracks and tracks parallel to mainline tracks the centerline clearance shall be fifteen (15) feet.

2. For yard tracks, the centerline clearance shall be fourteen (14) feet with fifteen (15) feet preferred.

3. For tracks parallel to ladder tracks, the centerline clearance shall be a minimum of twenty (20) feet.

5.3 CLEARANCES FOR NEW CONSTRUCTION AND DESIGN

The following minimum railroad clearance standards shall apply to all new construction or design:

1. Horizontal Clearance - Minimum horizontal clearance shall be 15'-0" from centerline of track to nearest point of structure or obstruction.
2. Vertical Clearance – Minimum vertical clearance shall be 25'-0" above top of rail to nearest point of structure or obstruction.

5.4 CLEARANCES FOR TEMPORARY CONSTRUCTION AND DESIGN

The following minimum railroad clearance standards shall apply to temporary construction, including shoring and falsework.

1. Horizontal Clearance - Minimum horizontal clearance shall be 12'-0" from centerline of track to nearest point of structure or obstruction.
2. Vertical Clearance – Minimum vertical clearance shall be 22'-6" above top of rail to nearest point of structure or obstruction.

5.5 OTHER CLEARANCES

1. All structures, signs, posts or pipes shall have a minimum centerline clearance of ten (10) feet with an increase of one and a half (1.5) inch per degree of curve, or as approved by the Chief Harbor Engineer.

2. Signals and switch stands three (3) feet or less in size located between tracks shall have a minimum centerline clearance of six (6) feet. For switch stands located on the outside of tracks or parallel tracks shall have a centerline clearance of eight (8) foot six (6) inches.

3. All pull boxes located within ten (10) feet of a track centerline shall be installed flush with the track's ties.

4. All walkways shall be located in accordance with CPUC GO No. 118.

5. All approaches within ten (10) feet of a track centerline shall have ballasted approaches with a slope of eight (8): one (1).

5.6 UTILITY CLEARANCES (OVERHEAD UTILITIES)

The following minimum vertical clearance shall apply:

Overhead wires up to 2.9 kv	25.0 Feet
Overhead wires 2.9 kv to 50 kv	27.5 Feet
Overhead wires greater than 50 kv	32.5 Feet

At all times minimum California Public Utilities Commission (CPUC) clearances shall be maintained.

5.7 UTILITY CLEARANCES AND REQUIREMENTS (UNDERGROUND UTILITIES)

1. Utility Pipeline crossings shall be designed in accordance with Section 1, Part 5 of AREMA and as shown on the plans.
2. All utility lines under main line tracks shall be installed using a protective casing pipe. The casing pipe may be omitted for non-pressure sewer or storm drain lines located in branch or industrial line tracks.
3. The casing pipe and joints shall be leak proof and capable of withstanding a minimum railway load of Cooper E-80. The steel casing shall have minimum yield strength of 35.000 PSI and have a protective coating. The annular space between the casing and carrier pipe shall be filled with sand.
4. The casing pipe shall have a minimum inside diameter of one point eight (1.8) times greater than the outside diameter of the carrier pipe.
5. The casing pipe length measured from the track's center line shall be as follows:

Mainline	14 feet + 1.5x Casing Diameter
Spur/Industry:	11 feet + 1.5x Casing Diameter

6. Utility crossings shall be designed with casings so that utility repairs can be made without disturbing the trackage
7. Relocation and construction of utilities shall be coordinated with the affected utility during early stages of the design process.
8. For flammable pipelines the following criteria shall be used:
   a. A minimum cover of five and a half (5-½) feet measured from the base of rail to the top of pipe shall be used.
   b. Above ground markers shall be installed at both ends of the crossing.
   c. Where flammable pipelines run along side rail lines, the perpendicular distance measured from the track's centerline to the pipeline shall not be less than twenty five (25) feet.
   d. For longitudinal pipelines, above ground markers shall be placed at four hundred (400) foot intervals and at a change of direction.
9. For non-flammable pipelines the following criteria shall be used:
   a. A minimum cover of four and a half (4-½) feet measured from the base of rail to the top of pipe shall be used.

b. Where non-flammable pipelines run along side rail lines, the perpendicular distance measured from the track's centerline to the pipeline shall be six (6) feet + one and one half (1.5) x (Depth in feet) or twenty (20) feet whichever is greater.

10. The following criteria shall be used for electrical and communication utility line crossings:

a. A minimum cover of three (3) feet measured from the base of rail to the top of the red slurry (two (2) sack mix) encasement shall be used for electrical crossings.

b. A minimum cover of three (3) feet measured from the base of rail to the top of the red slurry encasement shall be used for communication crossings.

5.8 UTILITY ABANDONMENT (UNDERGROUND UTILITIES)

Stipulations for pipeline abandonments in the vicinity of railroad tracks:

1. All pipeline work, including pipeline abandonment, shall be identified in a Harbor Development Permit (HDP).

2. Comply with other pipeline abandonment procedures outlined in the POLB Design Criteria and Standard Plans.

3. The abandonment operations shall be conducted in a manner that does not endanger the railroad facilities or impede train operations on the railroad tracks. Refer to POLB "Requirements When Working Within, Adjacent to, or Above Railroad Right-of-Way" and comply with railroad work requirements. Submit a Railroad Work Plan to the Engineer for any work within 20-feet of the track centerline. The work plan shall be submitted to the Engineer at least 14 calendar days in advance of the scheduled work.

4. All abandoned pipes shall be removed, except for pipes within the railroad right-of-way to prevent impeding train operations. Do not remove pipe casings within 25-feet of the centerline of the existing railroad tacks. Where there are multiple tracks, measure 25-feet from the centerline of the outside tracks. For pipelines that are not in casings, follow the same procedures for pipes as specified for casings.

5. Carrier pipes shall be removed from the casings. The remaining casings shall be cleaned and filled with slurry in accordance with Item 7, below.

6. Where pipelines or pipe casings are to be abandoned in place, they shall be disconnected from other pipes and filled with slurry.

7. Unless otherwise specified, slurry shall comply with Case 1 for abandoned casings, and pipes where there is no casing. Use 2 or 3 when required by the Engineer:

Case 1 – Cement Slurry for Abandoned Casings and Pipes (sand filler)

1. 1.50 bags of Portland cement per cubic yard
2. 1.50 bags of fly ash per cubic yard
3. 1.00 bag of bentonite per cubic yard
4. Sand filler

Case 2 – Reduced Strength Slurry for Abandoned Casings and Pipes (no aggregate)

1. Portland cement 8%
2. Bentonite 35%
3. Barite (or equal) 57%

Case 3 – Non-Setting Slurry for Abandoned Casings and Pipes (no aggregate)

1. Portland cement 0%
2. Bentonite 35%
3. Barite (or equal) 65%

8. Seal the ends of pipes and casings abandoned in place whether filled with slurry or not.

9. Backfill of trenches shall be in accordance with the POLB Design Criteria and Standard Plans (latest edition). Where cement slurry is to be used as for backfill, it shall be one bag of Portland cement per cubic yard.

10. Any modifications in these procedures require submittal of a written request for a variance. Submit requests for a variance to the Engineer at least 14 days prior to the scheduled work. Do not proceed with changes unless approved in writing by the Engineer.

11. No stockpile material on any roadway or facility unless approved by the Engineer. Secure fencing shall be installed around the work area and/or any stockpile material.

12. With approval of the Engineer, and in the absence of evidence of contamination, soil removed from trenches may be used as backfill in the same trench-location without environmental testing.

13. If soil is rejected by the Engineer, either because of evidence of contamination or for some other reason, the unsuitable soil must be appropriately managed as a waste. On Port-owned projects, the unsuitable soil shall be managed in accordance with the Port's Surplus or Export Soil-Material Quality Requirements. On non-Port-owned projects, the unsuitable soil belongs to the Permittee and shall be managed in accordance with all applicable Federal, State, and local requirements.

14. Storm Water Pollution Prevention Plan (SWPP) provisions, and selected Best Management Practices (BMPs), shall be employed during all construction activities.

15. As a general policy, the Port prohibits dewatering of excavations. Water in an excavation should be managed in the excavation, either by working "in the wet" or by controlling the water within certain portions of the excavation. If water is removed from an excavation, for any reason, that water shall be managed as a waste. All waste water shall be managed in accordance with all applicable Federal, State, and local requirements.

6.0 ROADBED SECTION

The following criteria shall apply to the track's roadbed section:

1. Ballast Depth

   a. For timber and/or concrete ties the ballast depth shall extend not less than twelve (12) inches below bottom of tie for the full length of the tie and shoulders.

2. Subballast Depth

   a. Subballast depth shall be twelve (12) inches below ballast on mainline tracks, intermodal container stack train storage yard tracks, intermodal container stack train loading/unloading tracks, and mainline yard tracks. Use as required for industrial service tracks and other yard tracks.

   b. Subballast material shall conform to section 200.2.4 "Crushed Miscellaneous Base" (CMB), per SSPWC fine gradation.

   c. A geotextile filter fabric shall be placed at base of Subballast throughout areas of all tracks including turnouts and grade crossings.

   d. Subballast shall conform to AREMA Chapter 1 – Roadway and Ballast; Part 2- Ballast; Section 2.11 – Subballast specifications for site specific calculation of total/subballast thickness.

3. Shoulder Width

   a. Ballast shoulder width shall be a minimum of twelve (12) inches beyond the edge of the tie.

   b. Ballast shoulder width shall be twelve (12) inches on mainline tracks, intermodal container stack train storage yard tracks, mainline sidings, and mainline yard tracks.

   c. Subballast shoulder width shall be thirteen (13) feet from centerline on mainline tracks and twelve (12) feet from centerline elsewhere.

d. Side slopes shall be two (2): One (1)

7.0 WALKWAYS

The following criteria shall apply to walkways adjacent to tracks:

1. Walkways shall be provided for all tracks in accordance with California P.U.C. General Order No. 118 and the Pacific Coast Marine Safety Code, latest versions.

2. Minimum walkway width along mainline tracks other than at turnouts shall be two (2) feet six (6) inches and shall conform to California P.U.C. Standard Nos. 1 and 2.

3. Walkways in yards and at points where industrial switching is performed shall be per California PUC Standard No.6.

4. Walkways at power-operated turnouts shall be per California P.U.C. Standard No. 5.

5. Walkways at hand-thrown turnouts shall be per California P.U.C. Standard No. 3.

6. Bridge walkways shall conform to California P.U.C. Standard No. 6.

8.0 TURNOUTS

Turnouts for trackwork shall comply with the standard plans of the specific railroad, AREMA standards, or applicable POLB standard plans. All turnouts shall be sized either Nos. 8, 9, 10, 11, 15 or 20. No other sizes shall be used unless approved by the Chief Harbor Engineer. Specific turnout sizes and uses are as follows:

1. For all mainline tracks or the minimum cross over size shall be No.11 with nineteen and a half (19.5) feet curved switch rails.

2. For all intermodal tracks at the minimum turnout size shall be No. 9 with sixteen and a half (16.5) feet straight switch rails.

3. Turnouts from mainline tracks to all industry spur tracks shall be a minimum size of No.11.

4. Turnouts for end of siding, end of double track, or entrance to an intermodal yard shall be a minimum size of No. 9 with a preferred size of No. 11 where space is available.

5. For all industrial tracks the minimum turnout size shall be No. 8.

Turnouts and switches shall not be placed on horizontal or vertical curves, except with approval of the Chief Harbor Engineer.

II. RAILROAD TRACK CONSTRUCTION

1.0 GENERAL

1.1 Track materials and special trackwork shall conform to recommendations set forth in the most current AREMA Manuals.

1.2 Track components design shall be standardized to facilitate maintenance and minimize the inventory of materials.

2.0 EARTHWORK

2.1 The material to be used for embankment fill shall be provided by the Contractor from a suitable source. Fill material shall be approved by the Engineer prior to being placed on site.

2.2 The material to be used for fill shall be relatively non-expansive soils with an Expansion Index of less than 35. The on-site soils (including non-contaminated ballast) less any debris or organic matter may be used.

2.3 Material for structural backfill shall be provided by the Contractor from an off-site borrow site. Structural backfill shall conform to Caltrans Standard Specifications, Section 19-3, except that jetting of material shall not be allowed.

2.4 Material for pervious backfill shall be provided by the Contractor from an off-site source, and conform to Caltrans Standard Specification Section 19-3.06.

2.5 Sub-drains and geotextile filter fabric are required for drainage of all track systems.

2.6 The exposed bottom of all excavations or surface to receive fill shall be scarified to a depth of six (6) inches, moisture conditioned to optimum moisture content, and compacted to at least ninety (90) percent relative compaction per ASTM 1557.

2.7 The uppermost of two (2) feet of railroad subgrade, and all subballast, shall be compacted to at least ninety five (95) percent of the maximum dry density as determined in accordance with ASTM D1557.

2.8 Fill shall be placed in layers not exceeding eight (8) inches in thickness and conform to Caltrans Specification 19-3.

3.0 TRENCH EXCAVATION AND BACKFILL

3.1 Excavation and backfill shall be in accordance with the SSPWC subsection 306-1.1 “Trench Excavation” and 306.1.3 “Backfill and Densification” and Los Angeles Standard Plan No. S-610-21, unless otherwise specified on the plans.

3.2 Excavations for pipe laying or conduit shall be per City of Los Angeles Standard Plan No. S-251-1, unless otherwise noted on the plans.

3.3 Prior to excavating adjacent to and within six (6) feet. of a subsurface installation, excavate potholes per Section 62.03.1 of the Los Angeles Municipal Code and positively determine the elevation and location of the subsurface installation.

4.0 GEOTEXTILE REINFORCING

Geotextile material shall be required for drainage between the subballast and the subgrade.

4.1 Geotextile material type shall be as follows:

MIRAFI type 140N for under drains
MIRAFI type 600X for subgrade crossing areas.
MIRAFI type 1160N for track subgrade areas.

4.2 Geotextile material shall conform to section 213-2 “Geotextiles” of the latest edition of the SSPWC.

4.3 Geogrid shall be placed on geotextile or between subballast and subgrade to increase subgrade strength for railyard and crossing areas. Geogrid material shall be Tensar SS1. Geogrid material shall conform to section 213-2 “Geotextiles” of SSPWC.

5.0 STORM DRAIN SYSTEM- UNDERDRAINS

All trackage shall be designed with adequate sub-drainage. The following shall apply in the design of track drainage:

5.1 The design storm shall be a ten (10) year storm for all trackage except SUMPs and SAG areas where a fifty (50) year storm shall be used.

All sub-drains shall be the level of the water below the level of the ballast.

5.2 No ponding of water will be allowed.

5.3 All sub drain systems shall be designed using perforated PVC piping, a permeable drainage material and a filter fabric. The following criteria shall be used in the design of the drainage system.

a. All under drain pipe and fittings shall be eight (8) inches in diameter schedule eighty (80) PVC with elastomatic asphalt joints and fittings in accordance with ASTM F578. Perforated pipe shall be used for all underdrains with un perforated pipe being used only as connector piping.

b. PVC piping shall be in accordance with ASTM D1758. Schedule eighty (80) pipe compounds shall be in accordance with ASTM 1784.

c. Joint material shall be a solvent cement in accordance with ASTM D2564.

d. Underdrain outlets and risers shall be fabricated of ductile iron or corrugated metal. They shall be painted blue and marked "POLB" and "O", and spaced evenly three hundred (300) feet.

5.4 Sub-drains pipe shall have geotextile filter fabric wrapped in crushed filter rock. The filter rock shall conform to the following gradation:

Sieve size	**Percentage Passing**
3/4"	100
3/8"	30-100
No. 4	0-30

5.5 Filter fabric for subdrains shall be manufactured from polyester, nylon, or polypropylene material, or any combination thereof. The fabric shall be permeable, non-woven, shall not act as a wicking agent and shall conform to the following:

Weight, ounces per square yard, min. ASTM Designation D3776	4.0
Grab tensile strength (1 inch grip) lbs. Min. each direction ASTM D 4632	90
Elongation at Break, percent min. ASTM D 4632	30
Toughness, pounds, min. (%elongation x grab tensile strength)	6000
Permittivity, 1/sec., min. ASTM D4491	0.5

If filter fabric is to be exposed for more than seventy two (72) hours, all fabric shall be treated with Ultraviolet Ray (UV) Protection. The treated fabric shall provide a minimum of seventy (70) percent breaking strength retention after five hundred (500) hours exposure when tested in accordance with ASTM D4355.

6.0 (NOT USED)

7.0 DEMOLITION AND REMOVAL OF EXISTING TRACK

Track removal shall consist of removing all material from the bottom of the subballast to the top of rail for the length as shown on the project plans. All material removed will be the contractor's for disposal/salvage except for special track work such as turnouts, railroad grade crossings and signal systems. For disposal of these items, the contractor shall contact the POLB Manager of Railroads for direction.

Demolition work shall not interfere with the operation of existing railroad or vehicular traffic.

8.0 SUBBALLAST

8.1 Subballast material shall be in accordance with SSPWC Section 200.24, Crushed Miscellaneous Base, subsection 200-2.4.2, "Grading", Table 200-2.4.2 (A) Fine Gradation. The gradation shall be as follows:

Sieve Size	Percent Passing (Fine)
1" – 11/2"	100
3/4"	85-100
3/8	55-75
No. 4	30-50
No. 30	12-28
No. 200	2-10

8.2 Subballast material must be submitted to the Engineer for approval prior to use.

8.3 Placing, spreading and compaction of crushed aggregate base subballast material shall be in accordance with SSPWC subsection 301-2.2, "Spreading" and 301-2.3, "Compacting". Compaction shall be ninety five (95) percent relative compaction.

8.4 A geotextile filter fabric shall be placed at the base of the subballast throughout areas of all tracks including turnouts and grade crossings.

8.5 Subballast depth shall be as follows:

a. Subballast shoulder width shall be twelve (12) inches below ballast on mainline tracks, intermodal container stack train storage yard tracks, intermodal container stack train loading/unloading tracks, and mainline yard tracks. Use as required for industrial service tracks and other yard tracks.

b. Subballast material shall conform to section 200.2.4 (CMB), per SSPWC fine gradation.

c. A geotextile filter fabric shall be placed at base of Subballast throughout areas of all tracks including turnouts and grade crossings.

d. Subballast shall conform to AREMA Chapter 1 – Roadway and Ballast; Part 2 – Ballast; Section 2.11 – Subballast specifications for site specific calculation of total/subballast thickness.

8.6 Subballast shoulder width shall be as follows:

a. Subballast shoulder width shall be thirteen (13) feet from centerline on mainline tracks and twelve (12) feet from centerline elsewhere.

9.0 BALLAST

Ballast material shall be in accordance with the following:

9.1 Ballast material shall be in accordance with AREMA specifications excluding slag and limestone.

9.2 Ballast shall consist of crushed stone with angular fragments resulting from crushing by mechanical means using the following types of rocks quarried from undisturbed, consolidated deposits: granite and similar igneous rocks; extrusive igneous rocks; or massive metamorphic quartzite or similar rocks. Crushed gravel is not acceptable.

9.3 Gradation testing shall be in accordance with ASTM C-136, utilizing square opening sieves in accordance with ASTM E-11. When testing the ballast material show a loss of not more than five (5) percent at the end of one hundred (100) revolutions and not more than thirty (30) percent at the end of five hundred (500) revolutions.

9.4 Ballast material shall meet the requirements of AREMA number 4A in all track areas.

9.5 For typical track construction provide ballast foundation with percentage passing each sieve falling within the following limits (Ballast size 4A).

Sieve Size	Sieve Opening	Percent Passing by Weight
2½”	2.50”	100
2”	2.0”	90 - 100
1½”	1.50"	60 - 90
1”	1.0”	10 - 35
¾”	0.75”	0 - 10
½”	0.50"	-
3/8”	0.375"	0 - 3
No. 4	0.187"	-

9.6 Property requirements as indicated in AREMA Table 2-1 for “Quartzite”

	Percent by Weight
Soft and friable pieces	0.5
Materials finer than No. 200 sieve	1.0
Clay lumps	0.5

9.7 Determination of ballast bulk density shall be in accordance with the ASTM C29, using three (3) inch nominal maximum size.

9.8 Particles of the ballast shall have been broken by the crusher and have at least two (2) broken surfaces.

9.9 Boulders which will pass through a five (5) inch circular opening before crushing shall be rejected.

9.10 Ballast depth shall be as follows:

a. Timber and/or Concrete Ties – Ballast depth shall extend not less than twelve (12) inches below bottom of tie for the full length of the tie and shoulders.

9.11 Ballast shoulder width shall be as follows:

a. Ballast shoulder width shall be a minimum of twelve (12) inches beyond the edge of the tie.

b. Ballast shoulder width shall be twelve (12) inches on mainline tracks, intermodal container stack train storage yard tracks, mainline sidings, and mainline yard tracks.

9.12 SOURCE QUALITY CONTROL

9.12.1 Representative samples of ballast, of not less than one hundred fifty (150) lbs. for gradation and other required tests shall be taken from each source of ballast and tested as specified herein. Each shipment of ballast to the site shall be accompanied by a certification as specified.

9.12.2 Certified results of the tests required to demonstrate conformance with this Design Criteria shall be provided prior to any material being used for the work.

9.12.3 The ballast delivered to the site shall be from the same source from which samples were tested and found to be in accordance with this criteria and shall be of the same type and quality of that which was tested.

9.13 BALLASTING

Ballasting is the spreading, watering, rolling, tamping, and dressing of ballast rock to bring the rails to grade and alignment. Ballast shall be installed as follows:

a. Ballast shall be placed in two (2) lifts. Each lift shall be compacted with a minimum ten (10) ton roller until no waving or creeping occurs.

b. Ballast shall be tamped with an eight (8) head tamping machine, using not less than three (3) insertions per tie.

c. Ballast shall be placed one (1) inch higher than the top of tie to provide a separate lining between asphalt and the tie.

10.0 CRUSHED WALKWAY ROCK

10.1 Walkway Rock shall be of the same quality material specified for ballast of the shall conform to the gradation requirements for size No. 5 Table 2-2 Section 2.4, of the AREMA manual.

10.2 Crushed Walkway Rock shall be placed two (2) inches in depth where required.

10.3 The percent passing each sieve shall be as follows:

Sieve Size	Percent Passing by Weight
1" – 1/2"	100
1"	90-100
3/4"	40-75
1/2"	15-35
3/8"	0-15
No. 4	0-5

11.0 PERMANENT TRACK CONSTRUCTION

Trackwork for projects will be typical ballasted track construction.

11.1 BALLASTED TRACK

a. Ballasted track shall be the primary type used for track work constructed at grade. It shall consist of subballast, ballast, cross-ties, rails, and rail fasteners.

b. The top of ballast elevation shall be one (1) inch below top of tie, except in the area six (6) inches on either side of the rail where the ballast shall be cribbed to maintain one (1) inch of clearance between the bottom of the rail and the top of ballast.

c. Ballast conforming to AREMA size No. 4A shall be used for all track areas.

d. At locations where subgrade material is unsuitable, a stabilizing course of compacted fill or asphalt shall be utilized.

11.2 TRACK GAUGE

a. The standard track gauge shall be four (4) feet eight and one half (8½) inches. Track gauge shall be measured between the gauge sides of the heads of rails at a distance of 5/8 inch below the top of rails. Wider gauges shall be used in some curves, depending upon the degree of curvature. Track gauges

shall follow AREMA tables of practical gauges and flangeways for curved track, plan no. 791-59.

b. Gauge widening shall be distributed through the spiral curve for a spiral-circular-spiral type curve. For circular curves without spirals, the gauge widening distance shall be distributed by placing half the distance on the tangent and half on the circular curve.

c. Gauges for special trackwork shall be as recommended in the AREMA portfolio of trackwork plans except as modified to reflect the physical and operational characteristics of the system.

11.3 TRACK CONSTRUCTION TOLERANCES

a. Track construction tolerances are determined by taking into consideration safety, speed of operation and type of service to be provided. All new track construction shall be constructed as class 5 in accordance with FRA Title 49, Part 213. Track shall be constructed to the tolerances shown in the following table:

			Vertical Track Alignment		**Horizontal Track Alignment**	
Type of Track	Gauge Variation	Cross Level Variation	Total Deviation	Middle Ordinate in 62’ Chord	Total Deviation	Middle Ordinate In 62’ Chord
Mainline Track	+/- 1/8”	+/- 1/8”	+/- 1/2”	+/- 1/8”	+/- 1/2”	+/- 1/4"
Yard Track	+1.4” -1/8”	+/- 1/4"	+/- 1/2"	+/- 1/4"	+/- 1/2"	+/- 1/4"

Notes:

(1) Variations of gauge and cross level shall not exceed 1/8” per 31’ of track.

(2) Total deviation is measured between the theoretical and actual alignment at any point in the track.

b. Maintenance of existing track shall be Class 3 in accordance with FRA Title 49, part 213.

11.4 RAIL

a. The standard rail section shall be new 136 RE pound Continuous Welded Rail (CWR), meeting AREMA material requirements on mainline tracks, intermodal container stack train storage yard tracks, intermodal container stack train loading/unloading tracks, and yard tracks.

b. Jointed rail may be used only for temporary track construction or as approved by the Chief Harbor Engineer. Second hand (relay) rail may be used providing it meets the requirements of AREMA grading for Class 1 and passes ultrasonic testing for the entire length of the rail.

Rails shall be either control-cooled carbon steel or special alloy rails as manufactured in accordance with the requirements of AREMA.

c. Rail Hardness – Brinell Hardness Number (BHN)

1. For standard strength rail used in tangent track and curves of less than five (5) degrees the minimum BHN shall be three hundred (300).

2. For high strength rail used in curves of greater than five (5) degrees and all turnouts the minimum BHN shall be three hundred sixty (360).

11.5 TURNOUTS

a. Turnout rail size shall be the same as the track size. See Design Criteria for turnout size.
b. All new turnouts shall be constructed of 136-RE rail.
c. Turnouts shall be continuously welded rail except at specific areas indicating a thirty six (36) inch whole joint bar bonded insulated which shall be a poly-insulated type.
d. Switch points, stock rails, closure rails, guard rails, and frog wing rails and all associated components shall be fabricated from new, high strength (Head Hardened) Rail.
e. All turnouts shall be equipped with floating heel blocks and adjustable rail braces. Rail braces shall be Bethlehem boltless adjustable braces with boltless adjustable clamps.
f. All turnouts shall be insulated and utilize resilient rail fasteners throughout.
g. All turnouts shall have electrical conduits and pull boxes for installation of automated power switching in the future.
h. All vertical switch rods and gauge plates shall be insulated.

11.6 FROGS

1. Frogs for open-track turnouts shall be AREMA Railbound Manganese (RBM) high integrity heavy wall three shot explosion hardened steel castings with mitered heel, extended heel and rail wings with frog base plate and gauge plates utilizing a resilient fastening system.
2. Frogs for tracks embedded in pavement shall be one-piece, solid cast manganese with frog base plate and gauge plates utilizing a resilient fastening system.
3. Frogs shall be radiographed tested in accordance with AREMA.
4. Frogs shall have extended legs for thermite welding.

11.7 SWITCH POINTS

1. Switch points shall be Samson undercut type with Manganese steel tips in accordance with AREMA Specifications.
   a. Manganese steel tips lengths shall be as follows:
      1. Two (2) feet eight (8) inches for No. 8 turnouts
      2. Three (3) foot six (6) inches for Nos. 9, 10, 15, and 20 turnouts.
2. Switch points shall have adjustable braces.
3. Switch points shall be straight points with a uniform riser bolted in Manganese steel switch point guard.
4. Switch points, rods, and gauge plates shall all be insulated.
5. Switch point lengths shall be as follows:
   a. Sixteen (16) feet six (6) inches for Nos. 8, 9 and 10 turnouts.
   b. Nineteen (19) feet six (6) inches for No. 11 turnouts.
   c. Twenty six (26) feet zero (0) inches for No. 15 turnout.
   d. Thirty-nine (39) feet zero (0) inches for No. 20 turnouts fabricated from rail fifty-six (56) feet long for field welding.
6. Switch point rollers shall be required for all turnouts.
7. Switch point throw shall be four and three quarters (4-¾) inch with a tolerance of plus or minus one quarter (¼) inch.

11.8 GUARD RAILS

1. Guard rails shall be raised one (1) inch above top of running rail for all turnouts.
   a. Guard rails shall be boltless and adjustable with a hardened ABC U69 type guard bar in accordance with AREMA specifications.
2. Guard rails shall be hook-flange or boltless-adjustable for Nos. 15 and 20 turnouts.
3. Guard rail lengths shall be as follows:
   a. Fifteen (15) feet for Nos. 8, 9, 10 and 11 turnouts.
   b. Twenty six (26) feet for Nos. 15 and 20 turnouts.
4. Guard rails shall be Bethlehem hook flange raised guard rail with plates or an engineer approved equal.
5. Switch point guard shall be adjustable Manganese steel type.

11.9 SWITCH STANDS

Switch stands shall be located on the diverging side of the turnout. For parallel tracks, the switch stand shall be located on the outside of the track. All switch stands shall have switch rods and connections that can be retrofitted to remote – controlled power operation.

For open ballasted track the following shall apply:

1. Switch stand shall be high-star, lockable, non-trailable on mainline tracks.
2. Adjustable switch stand shall be ABC Tri-Glide 22-E.
3. Target shall be low mast fastened sturdy and highly reflective with green and red colors.
4. Headblock ties shall be sixteen and a half (16.5) feet for switch stands located on outside of track and have a minimum clearance of eight and a half (8.5) feet from track centerline to switch stand.
5. Headblock ties shall be fourteen (14) feet for switch stands located between tracks and have a minimum clearance of six (6) feet from track centerline to switch stand.

For track embedded in pavement the following shall apply:

1. Switch stands shall be enclosed, parallel-throw in-pavement type such as Racor 336-EC flush with pavement.
2. Switch throw assemblies shall be supplied with all boxes and components for use in pavement. The lid shall open to a position that provides convenient access to the switch throw handle, and that allows the open lid to rest in a position that it will not inadvertently slam shut while the train person is operating the switch throw lever.
3. Paved switch shall have a spring connecting rod.
4. Vertical switch rods shall be enclosed with steel box cover with ability to support H-25 loading (125,000 lb. Axle load) spread over five (5) square feet.
5. Steel box covers shall be flush with pavement and top of rail.

11.10 TURNOUT SUPPLEMENT FOR PAVED AREAS

1. All turnouts imbedded in pavement shall utilize special fabricated switch rod access boxes and fabricated switch point flangeway guards.
2. Pavements guards are required for switch points.
3. Switch points protectors shall be required and located on the inside running rail web area on the right side for a right hand turnout or the left side for a left hand turnout.
4. Turnouts in paved areas shall be welded with thirty six (36) inch six (6) hole joint bar for jointed areas.
5. Paved switches shall have a spring connecting rod.
6. Guard rails shall be flush with the running rail.
7. Switch and connecting rod boxes shall be flush with the pavement with ability to support H-25 loading (125,000 lb. Axle load) spread owner five (5) square feet

11.11 RAIL ANCHORING

1. In conventional ballasted track construction, where timber ties and track spikes are used, rail anchors shall be applied. Details shall be in accordance with AREMA standard plans.

2. Rail joints shall be used where rail welding is not practical or where required by signal track circuits.

3. Thirty-six (36) inch long, six (6) hole joint bars shall be used at rail joints. Drilling, punching, and track bolts shall be as specified by AREMA standard plans.

4. Where required by the track signal circuits, insulated rail joints shall be installed. These shall be prefabricated bonded joints and shall meet the following track requirements:

11.12 INSULATED JOINTS

All new rail construction shall have bonded insulated joints. The following shall apply:

1. Insulated joints shall be six (6) hole Allegheny-type, epoxy bonded, field fabricated.

2. For installation in CWR (I-bonds) shall be six (6) hole Allegheny-type, epoxy-bonded, pre-fabricated from new rail twenty (20) feet long for field welding in place.

3. For installation in jointed rail I-bonds shall be six (6) whole bolted Allegheny-types for field installation.

The following shall apply for electrical continuity testing of bonded insulated joints:

1. Perform separate tests between the running rails, and between the bar and the running rails.

2. Individual tests of the electrical resistance between each of the running rails and the bar shall be greater than ten thousand (10,000) ohms.

3. The electrical resistance between the running rails shall be greater than thirty thousand (30,000) ohms.

11.13 INSULATED RESILIENT FASTENERS (IRF) FOR CONCRETE TIES

The following shall apply for IRF for concrete ties:

1. Insulated resilient fasteners with rail seat abrasion pads and iron shoulders shall be used on all trackage with concrete ties.

2. Pandrol E-2055 clips, Safelok or an Engineer approved equal shall be used as clips to concrete ties. POLB prefers the use of Safelock clips.

3. Two (2) clips shall be used on each base plate

4. When IRF are used with wood ties, the plates and hold-down screws shall be of a type approved for use with IRF by the IRF manufacturer.

11.14 ANCHORS ON TIMBER TIES

The following shall apply for anchors on timber ties:

1. Anchors shall be sixteen (16) per each thirty-nine (39) feet of rail.
2. Box anchor every other tie on CWR.
3. All anchors shall be in accordance with AREMA standards.

11.15 TIE PLATES

The following shall apply for tie plates:

1. Tie plates for timber ties with resilient fasteners shall be seven and three-quarters (7.75) inch by sixteen (16) inch for six (6) inch base rail with screw spikes for plate hold-downs and be of a type approved for use with resilient fasteners by the resilient fastener manufacturer.
2. Hole punching shall be six (6) with four (4) to be one (1) inch holes and two-eleven sixteenth (11/16) inch holes.
3. Tie plates shall be fastened evenly on wood ties within one eighth (1/8) inch alignment.

11.16 JOINT BARS

The following shall apply to joint bars:

1. Bars shall be thirty-six (36) inch bars with six (6) holes utilizing six (6) inch long one and one eighth (1-1/8) inch diameter bolts with four (4) inch thread length. Joint bars are to match the rail section. Joint bars are to be insulated.
2. Hole punching spacing shall be : Two and seven sixteenths (2-7/16) inches; six (6) inches; six (6) inches; six (6) inches, seven and one eighth (7-1/8) inches; six (6) inches; six (6) inches; and two and seven sixteenths (2-7/16) inches in accordance with Chapter 4 of AREMA.
3. Joint bars shall be six (6) hole bars appropriate for the rail size in accordance with AREMA.

11.17 SPIKES

The following shall apply for screw spikes:

1. Screw spikes shall be used for all newly constructed track with timber ties and turnouts.
2. Screw spikes shall be six (6) inches long and be able to fit one (1) inch diameter pandrol plates.

The following shall apply to cut spikes:

1. Cut spikes can be used for shoofly track, temporary track construction and maintenance as necessary.
2. Rail spikes shall be five –eighths (5/8) inch x six (6) inch.
3. Each tie plate in a turnout or horizontal curve shall have two (2) plate holding spikes and two (2) rail holding spikes.
4. Tangent track shall have a minimum of two (2) spikes per tie plate.
5. Cut spikes shall not be used on curves over six (6) degrees. For curves over six (6) degrees, a resilient fastening system shall be used.

12.0 TEMPORARY TRACK CONSTRUCTION (SHOOFLY TRACK)

1. Temporary track construction may be required in order to stage some of the site construction work while maintaining rail service. This temporary track work may be accomplished with timber ties and relay rail. Relay rail shall be Class 1 in accordance with AREMA standards.
2. If timber ties are to be used, the tie spacing shall be nineteen and one half (19.5) inches, center to center. Jointed rail sticks shall not be less than thirty-three (33) feet in length.
3. Tolerances shall be the same as permanent track construction.
4. It is the responsibility of the Contractor to remove this temporary work at the appropriate time and to dispose/salvage all materials.

13.0 CONTINUOUSLY WELDED RAIL (CWR)

The Work specified in this section consists of providing rails, fabricating rails into continuous welded rail (CWR) strings using the electric flash butt welding method, inspecting, testing, shipping and delivering the CWR strings to the project work site.

13.1 RAIL

1. Rail shall be 136 CWR per AREMA.
2. Procedures, material testing and other submittals listed in AREMA standards and herein are to be made to the Engineer and approved prior to initiation of the specific activity.

3. All new rail shall be 136 RE lb meeting the requirements of Chapter 4, Part 2 "Specifications for Steel Rails" of AREMA and Supplementary Requirements S2 "Manual Ultrasonic Testing".

4. Prior to the start of welding, a CWR schedule shall be submitted listing the lengths of CWR strings to be fabricated and the location of each string in the finished track. Also included in the submittal shall be a schedule of CWR lengths and the CWR string designation system.

5. Prior to the start of welding submit drawings and specifications of the proposed equipment, materials, methods and procedures to be used for the electric flash butt welding process for joining of the rail. Include layouts of the welding line showing locations of welding components.

6. Prior to transportation of the rail, submit procedures for transportation of the CWR to work site, proposed off-load locations and timing, stockpiling and handling procedures.

7. Perform flash butt welding and testing of the rail to the requirements of Chapter 4, Part 2 "Specifications for Fabrication on Continuous Welded Rail".

8. The fabrication of the CWR shall be done offsite.

9. Weld CWR strings to minimum delivered lengths at work site of. At grade crossings, strings equal to the width of the crossing plus forty (40) feet twenty (20) feet on each side of crossing measured along the center line of track) will be permitted. A minimum of twenty (20) feet is required between the end of the crossing panel and the first weld.

10. Cut out and reweld rejected welds with a minimum of nineteen (19) feet - 6 inch plugs. This work shall be at the Contractor's expense.

11. Bolt holes are not permitted except for insulated joints.

13.2 RAIL CUTTING AND PREPARATION OF ENDS

1. Saw cut or abrasive disc-cut rails used for electric flash butt welds square and clean by means of accepted equipment.

2. Torch cutting of rail is prohibited.

3. Prepare the head and base of rails prior to welding by removing mill scale down to bright metal for a length of approximately six (6) inches from the welding end.

4. Remove all burrs from the rail end area where the welding current carrying electrodes contact the head and base of the rail.

5. Holes are not permitted in the rail.

6. Torch cut rails at the end of CWR strings must be saw cut a minimum of six (6) inches from the torch cut end or three (3) feet from a shop weld prior to welding.

13.3 RAIL DESTRESSING PROCEDURE (BY MECHANICAL PULLING)

Rail Destressing shall be in accordance with AREMA and the following:

1. Upon track construction at the proposed alignment, place joint bars between each four hundred eighty (480) foot length of ribbon rail.

2. Place ballast material in and around track tie cribs and surface track to its alignment and grade.

3. Weld rail lengths to nine hundred sixty (960) feet each.

4. Calculate the elongation required to bring the rail into equilibrium using the thermal expansion equation:

$$\Delta L = a\,(T)\,L$$
$$= a\,(T_D - T_A)\,L$$

Where: a = coefficient of thermal expansion = 6.5x0.000001/F°
T_D = design temperature (F°)
T_A = actual temperature (F°)
L = rail length (ft.)

5. Unclip the rail on each side of the joint. The amount of rail to unclip is based on the amount of elongation required. For each inch of rail to pull a minimum of one hundred (100) feet of track shall be unclipped on each side of the joint.

6. The rail to be cut shall be equivalent to the calculated rail equilibrium distance plus one (1) inch required for the welding procedure.

7. Rail pullers will be used to pull the rail to the desired distance.

8. The rail shall be welded and the pullers will be released once the rail is cooled less than six hundred (600) F°.

9. The clips shall be replaced and the welds ground flush.

13.4 WELDING

The following method procedures, equipment and materials shall be used for welding CWR.

1. Thermite welding, materials and equipment shall be as manufactured by "Boutet", "Orgotherm", "Elektro-Thermite", or other Engineer approved equal for standard rail.

2. Thermite welding, methods and procedures shall comply with the AREMA Manual, Chapter 4, "Thermite Welding-Rail Joints-1980," and with the welding kit manufacturer's recommendations and as specified herein.

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

4. 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.

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

6. Welds shall not be made within six (6) inches of bolt holes, or pin holes, or within three (3) feet of plant weld.

7. Manufacturers recommendations shall be used for compromise welds.

8. For welding heat treated or high strength rails, the recommendations of the rail manufacturer shall be followed.

9. Welds must be in cribs between ties and located no closer than four (4) inches to nearest tie.

10. Torch cut rails at the end of CWR strings must be saw cut a minimum of six (6) inches from the saw cut end or within three (3) feet of a factory weld prior to welding.

13.5 FIELD WELDING RECORDS

1. Field welding records shall be continuously maintained and furnished bi-weekly to the Engineer. Records shall include the following details:

   - Date and time of weld(s)
   - Location by station, stating track and rail
   - Contractor's foreman
   - Weather, air and rail temperature
   - Track condition, anchorage and rail stress

2. Rail shall be painted in legible characters at least one and one half (1-1/2) inches high at each field weld with the following information:

- Date of Weld (MO/DAY/YR)
- Initials of welder performing weld
- Air temperature at time of weld (AT XXX)
- Rail temperature at time of weld (RT XXX)
- Example: 5/5/93 ABC AT90 RT120

13.6 TOLERANCES OF FIELD WELDS

1. Using a straight edge thirty six (36) inches in length, and placing the straight against the welded joint area the following tolerances must not be exceeded:

Rail Head:

♦ Vertical Offset	0.020 inches
♦ Horizontal Offset	0.040 inches
♦ Vertical Crown	0.030 - 0.045 inches
♦ Horizontal Kink	0.020 inches

Rail Base

♦ Horizontal Offset	0.060 inches
♦ Offset Bending	0.010 per inch

13.7 FINISHING OF FIELD WELDS

The following shall apply to the finishing of welds:

1. Sharp edges and burrs are to be removed, including chimneys from all welds. All welds shall be ground smooth.

2. Weld joints shall be smooth on top and sides and straight in line. No over grinding is permitted.

3. Weld joints shall be smooth on sides and bottom. Offset blending permitted at rate of one hundredth (0.010) per inch.

4. Weld joints shall be smooth on both sides to within approximately one eighth (1/8) inch of original contour. Width of remaining upset will be between one half (½) inch and five eighths (5/8) inch.

13.8 FIELD WELD TESTING

The following shall apply to the field testing of welds:

1. Rail welds shall be tested through the use of a testing agency using the Ultrasonic Testing Method in accordance with ASTM E 164.

2. 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 six hundredths (0.060) square inch and the largest single porosity or slag defect permitted shall not exceed one eighth (1/8) inch in diameter.

3. Other causes for rejection of welds shall be:

- ♦ Cracks that show in the finished weld are cause to reject the weld.
- ♦ Pit holes that show in the web and base of the weld after finish grinding are cause to reject the weld. Pit holes in head not exceeding one quarter (1/4) inch in depth may be repaired by gas welding or as approved by the Engineer.
- ♦ Welded joints not meeting these technical provisions and tolerances will replaced at no additional cost. The defective weld shall be cut out, and a new section of rail not less than thirteen (13) feet long shall be inserted welded and retested at no additional cost.

13.9 CUTTING IN SHORT SECTION RAIL AND THERMITE WELDING THE ENDS

The following procedure shall be used in cutting in short section rail and the thermite welding of rail ends.

1. A short section of rail shall be cut in the CWR, as approved by the Engineer, for the following reasons:

   a. To repair defective rail
   b. To repair defective welds

2. Before cutting out rail in CWR, prevent remaining CWR from further movement by applying anchors. After cutting CWR, rail expander/puller or other means shall be used to prevent rail movement.

3. The ends of the short rail section and the CWR shall be sawed or abrasive cut.

4. Follow procedures specified for completing field welding by the thermite process.

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

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

7. If secondhand rail was originally installed, replacement is to be in kind.

13.10 TOLERANCES IN ELECTRIC FLASH BUTT WELDS

Tolerance in electric flash butt welds shall be in accordance with tolerances set forth in the AREMA Manual, Chapter 4, Part 2, Section "Specifications for Fabrication of Continuous Welded Rail - 1983."

13.11 ULTRASONIC TESTING OF PRODUCTION WELDS

The following shall apply for the Ultasonic Testing of Production Welds:

1. Test all welds ultrasonically at the welding plant for defects in accordance with ASTM E164 using an inspection team approved by POLB. The cost for testing is to be borne by the Vendor.

2. The POLB will perform weld testing on field welds through the use of an inspection agency conducting ultrasonic testing.

13.12 REPLACEMENT OF DEFECTIVE WELDS

Defective flash both production welds giving fault indications in Magnetic Particle or Ultrasonic Inspection during production shall be cut-out, rewelded and retested. These repairs shall be done in the shop and not left for field repair.

14.0 CONCRETE TIES

All track construction shall utilize concrete ties for regular track and timber ties for turnouts.

The following criteria shall apply for concrete ties:

1. Concrete ties shall be spaced at a maximum of twenty four (24) inches and not less than twenty (20) inches, center to center. On curves of radius less than three hundred (300) feet concrete ties shall be used and spaced a maximum of twenty (20) inches and not less than eighteen inches (18), center to center.

2. For road crossings the tie spacing shall be in accordance with manufacturers' specifications for paving material, for both timber and concrete ties.

3. Concrete ties shall be of the type referred to as the "Union Pacific Scallop Style" with dimensions as follows:

    a. Length: Eight (8) foot six (6) inches +/- one eighth (1/8) inch.

    b. Height, at rail seat: Eight and three quarters (8 ¾) inches +/- three sixteenths (3/16) inches

    c. Base width: Ten and one half (10-1/2) inches +/- one eighth (1/8) inch.

d. The rail seat shall provide for a cant of one (1) in forty (40) toward the centerline of the tie.

e. Weight: Maximum weight shall be seven hundred fifty (750) pounds.

f. Height, at center of tie: Six and one quarter (6-1/4) inches, +/- three sixteenths 3/16 inches.

g. Rail pad: Pandrol three (3) part assembly with six point five (6.5) mid polyurethane pad in double dimple studded configuration including a nine tenths (0.9) mm steel plate.

h. All concrete ties must be imprinted with the letters POLB on top of the tie.

4. Standard concrete ties shall be designed to the following bending moment capacities:

Rail positive seat bending: 300 in-kips
Center negative bending –200- in-kips

5. Concrete grade crossing ties shall be ten (10) foot long, flat top, prestressed, in accordance with AREMA standards.

6. Maximum weight for grade crossing ties shall be nine hundred (900) lbs.

7. Guard rail ties shall be eight (8) foot six (6) inches long

8. Concrete Tie Materials: Wire shall conform to ASTM A881. Strand shall conform to ASTM A886. Cement shall comply with ASTM C150 type III. Aggregate shall be non-reactive. Ductile castings shall comply with ASTM A53665-45-12. Concrete admixtures shall comply with ASTM C494 (no fly ash or silica fume may be used)

9. Concrete Material Qualification Testing: Aggregates shall be tested to ASTM C227 and C1260 prior to use. Cement shall be tested to ASTM C112 and C150. Total alkali level of cement shall not exceed four tenths (0.4) percent

10. Concrete Tie Qualification testing:" Six (6) ties shall be taken at random from the first (3) three casts and tested for RS+, RS-, C+, C-, and Bond development. Ties shall be tested for dimensional compliance. Two (2) ties shall be jointly picked by the supplier and the Port's representative to show acceptable surface finish, air voids, and spalling/breakage.

11. Concrete tie Production testing: Concrete ties shall be tested for compressive strength using four (4) x eight (8) or six (6) x twelve (12) cylinders. A minimum of two (2) concrete cylinders shall achieve forty five hundred (4500) psi prior to detensioning. Concrete twenty eight (28) day compressive strength shall exceed seven thousand (7000) psi (average of three (3) cylinders) with no individual cylinder less than six thousand five hundred

(6500) psi. For each production day, at least one (1) tie shall be tested for dimensional conformance, RS+, and C- bending. All ties produced shall be inspected visually for defects and certified.

12. Concrete tie shall be prestressed, mono-block type.

13. Concrete tie fasteners shall be Safelok Clip 36800. Other components shall include Insulators (type 38249), Rail pads (type 38280) and Assembly (type 36192-A1). For curves over two (2) degrees shall include insulators type 36180. For curves over four (4) degrees include Rail, Pad Assembly type 38319.

14. Protrusion of Pretensioning Tendons - One eighth (1/8) inch maximum beyond the ends of the ties.

15. Markings - Mark on top of the ties with indented or raised letters to indicate the manufacturer, type of tie and year of manufacture and POLB.

15.0 TIMBER TIES

Timber ties shall have dimensions as follows:

a. Length: Nine (9) feet
b. Height: Seven (7) inches
c. Width: Nine (9) inches

1. Timber ties shall be in accordance with Chapter 3 of AREMA.
2. Timber tie spacing shall be a maximum of nineteen and one half (19.5) inches and a minimum of eighteen (18) inches, center to center.
3. All wood ties shall have steel end plates.
4. Timber tie fasteners shall be Pandrol E-2055 clips.
5. Timber tie wood treatment shall be in accordance with AREMA.
6. Switch ties shall have the dimensions for height and width as previously stated, but the length shall vary as required.

16.0 SPECIAL TRACKWORK MATERIALS

16.1 GENERAL

This section specifies the material requirements for complete special trackwork materials including, turnouts and crossovers with ties, derails, bolts, lock washers, bumping posts and wheel stops to be furnished in accordance with Plans and these technical provisions.

16.2 TURNOUTS AND CROSSOVERS

1. Turnouts and crossovers shall have switch points with uniform risers.

2. There shall be no “Laced Ties”, use appropriate “Long Ties”.

3. Electric switches shall be of Model M23A as manufactured by Union Switch, or approved equal.

4. Manual switches shall be of Model T-20 as manufactured by Union Switch, or approved equal.

5. Electric Locks shall be of Model SL-21 or SL-25 as manufactured by Union Switch, or approved equal.

6. Pandrol Type “E” fasteners or an Engineer approved equal, shall be used on all timber turnout ties.

7. Switch ties shall be timber, with Pandrol Type "E" Fasteners or Engineer approved equivalent.

17.0 DERAILS

1. The Engineer shall provide a positive method to protect individuals working on rail equipment located on other than mainline track. Consideration shall be given to locations of derails, grades, on tracks and other derail installation requirements.

2. Derail type shall be Western-Cullen-Hayes model HBX double end sliding derail, size Nos. 8, with standard two (2) tie operated stand with connecting rods and reflectorized low target.

18.0 BUMPING POSTS

1. Bolt material and coatings shall be per AREMA Class B specification for rail fastening size.

2. All bolts shall be new.

19.0 WHEEL STOPS

Wheel stops shall be site specific. Wheel stops shall be Western Cullen Hayes type SH, hinged wheel stop.

20.0 CONCRETE GRADE CROSSINGS

20.1 GENERAL

No field welds shall be allowed through crossings or within twenty (20) feet of the end of the crossing.

20.2 MODULE CROSSINGS

1. Concrete grade crossing on POLB main roadways four (4) lanes or more with heavy truck traffic and loading shall be as follows:

   a. Grade crossing shall be eleven (11) feet wide by five (5) feet long Star Track II HD module or eight (8) feet wide by five (5) feet long Star Track II module with grout holes or ten (10) feet wide by eight (8) feet long CXT PTS Prestressed Track Slab System or Engineer approved equal.

   b. Module shall sit on twelve (12) inches of CAB on twenty-four (24) inches of granular fill compacted to ninety five (95) percent, Geogrid to be placed between layers. Geotextile to be placed below the granular fill.

   c. The roadway approaches to the grade crossing systems shall include a ten (10) feet wide concrete reinforced approach slab. The track approaches shall include an eight (8) to one (1) approach.

2. Concrete grade crossing on POLB secondary roadway with minor truck traffic shall be as follows:

   a. Grade crossings shall be Railroad Common Standard Type 10W manufactured by OMNI or CXT full depth concrete crossing panel or engineer approved equal. The crossing panels shall be prestressed, full depth with steel frame and pre-attached flangeway filler with precast end restraints.

   b. Grade crossing panels shall sit flush evenly to one another with zero gap for tangent track. For curved track over four (4) degrees, the gap between panels shall not exceed one-quarter (1/4) inch maximum gap between panels.

   c. Concrete panels to sit on ten (10) foot long wood ties, on eighteen (18) inch track centers with lag bolts.

   d. The roadway approaches to the grade crossing system shall include a ten (10) feet wide concrete reinforced approach slab. The track approach shall include an eight (8) to one (1) approach.

   e. Geotextile filter fabric shall be placed under all grade crossings between the subballast and the ballast.

      Tamping of ballast shall not be performed until a minimum of eight (8) inches of ballast is below the base of cross ties and then precaution shall be taken in setting the tamping feet to prevent driving the ballast through the geotextile. Probes of any type, including alignment probes, will not be used where geotextile is installed.

f. Construction of track through a grade crossing shall be completed to finish line and grade, surfaced, and ballast compacted and dressed before grade crossing panels are installed.

g. Concrete grade crossing panels shall be installed in accordance with manufacturer's instructions.

h. Grade subgrade to drain away from ballast section at completion of crossing work.

i. Flange way filler shall be as recommended by manufacturer. Asphalt paving filler shall be AR 8000 class B mix per SSPWC.

j. Wearing surface shall be diamond mark "POLB".

k. Each crossing shall have a four (4) feet minimum reinforced concrete approach. The concrete shall be type II Portland concrete cement 520-C-3250 minimum strength with four (4) inch slump per Section 201, "Concrete Mortar and Related Materials" and 203, "Bituminous Materials" of the SSPWC.

l. The manufacturers warranty for the grade crossing shall be for a minimum of five (5) years.

21.0 ASPHALT CONCRETE PAVING IN RAILYARDS

21.1 Asphalt concrete shall be in accordance with SSPWC Subsection 203-6, "Asphalt Concrete" with the exception that crushed aggregates will not be allowed.

21.2 Asphalt shall be in accordance with SSPWC Subsection 203-1, "Paving Asphalt" (except Subsection 203-1.6 "Measurement and Payment")

21.3 The asphaltic concrete shall be three quarter (3/4) inch Class B AR8000 mix per SSPWC.

21.4 Hot paving grade liquid asphalt shall be AR-1000 and placed at all feather edge joints as directed by the Engineer.

21.5 Placing of asphalt concrete shall conform to the Project Plans and SSPWC Subsection 302-5, "Asphalt Concrete Pavement", (except 302-5.9) "Measurement and Payment".

21.6 The field density of compacted asphalt concrete shall be in accordance with SSPWC Subsection 302-5.6.2, "Density and Smoothness" except that density testing shall be in accordance with ASTM D2726 which is also an acceptable method of testing. In case of dispute, ASTM D1188 will govern.

21.7 Inside flangeway gap in the railyard shall be approximately two and three quarters (2 ¾) inches wide by one and seven eighths (1 7/8) inches deep.

21.8 Asphalt thickness shall be one (1) inch above timber or concrete ties where applicable.

22.0 RAILYARD STRIPING

Railyard striping shall be in accordance with the following:

1. For straight (Tangent) track sections a safety strip shall be located eight and a half (8.5) feet measured from the track's centerline.

2. For curved track sections a safety stripe shall be located nine and a half (9.5) feet measured from the curved track's centerline.

3. Safety stripes shall be four (4) inches wide, solid, and of yellow paint

23.0 RAILYARD COMPRESSED AIR SYSTEM (MECHANICAL)

23.1 COMPRESSED AIR SYSTEM

Each railyard shall include a compressed air system for rail car air brakes. The following criteria shall apply:

1. The car air reservoir requires fifteen (15) cubic feet of compressed air at eighty five (85) psig.

2. The maximum time for re-pressurization of the total train system shall be twenty (20) minutes.

3. Hook-up outlets shall be located at least at each break of train length. The outlet box covers shall be marked "RAILYARD", "AIR".

4. The compressors shall be located adjacent to railroad in a ventilated masonry building.

There are two rotary screw air compressors in the system. Each compressor produces approximately one hundred forty five (145) SCFM at one hundred forty (140) psig. Each proposed compressor shall be complete with air filter, air aftercooler, separator, and automatic drain valves. Each air compressor feeds directly into the high pressure piping through a flex connection and shutoff valve. The air is dried via a refrigerated air dryer, passed through a coalescing filler and then goes to the receiver tank.

The high pressure header feeds air pit stations, both single and double air connection pits. These stations each contain a shut-off valve, pressure control valve, pressure indicator, check valves, and pressure relief valves.

The pressure control valve maintains a set downstream pressure, tool adjustable to between sixty (60) and ninety (90) psig.

The pressure relief valve downstream of the pressure control valve protects the low-pressure system and freight cars from over-pressure.

Each air connection pit has one or three ball valves that feed an air hose with “Glad Hand” connectors.

23.2 GENERAL SEQUENCE OF OPERATION

The compressors shall be actuated based on the receiver air pressure sensed by the system controller. The lead compressor will maintain a pressure of one hundred forty (140) psig in the receiver. A drop in system pressure to one hundred thirty five (135) psig will cause the second compressor to come on. Program the controller to rotate the lead compressor after each one thousand (1000) hours of operation.

An adjustable low pressure shutdown switch for the air dryer shall cause the air dryer to shutdown when a low pressure of forty (40) psig is reached in the common discharge header from the two compressors. The air dryer will automatically restart when the pressure is increased to forty five (45) psig.

23.3 EQUIPMENT

1. Air Compressors

   The compressors shall be Ingersoll Rand Model SSR-HP-40-SE or approved equal.

   Each compressor shall be a heavy duty industrial type compressor unit consisting of an air cooled compressor, aftercooler, separator, and operating controls.

   Each compressor unit shall consist of a single stage, heavy-duty, air-cooled, oil flooded rotary screw air compressor. Each unit shall be equipped with duplex tapered roller bearings with coolant dam around bearings for high load carrying capacity. Each compressor shall be multiple V-belt driven and shall include an enclosed belt guard.

   Each compressor unit shall be capable of delivering one hundred forty five (145) SCFM at one hundred forty (140) psig.

   Motors: 230-460V 60 Hz 3-phase, rated forty (40) HP, open drip-proof, mounted on adjustable motor base. Motors shall be high-efficiency Class F insulation, Class B Temperature Rise with a one point one five (1.15) Service Factor.

Each compressor assembly shall be suitable for mounting on a level pad with four hold down bolts.

Cooling Lubrication System: The compressor unit shall incorporate an air-cooled oil cooler of sufficient size to ensure that the inlet oil temperature to the compressor shall not exceed one hundred eighty (180) degrees Fahrenheit on a one hundred five (105) degree F day at full load. The cooling fan shall be driven by the same motor that drives the compressor. A thermostatic valve shall be included to ensure that the inlet oil temperature does not fall below one hundred forty (140) F on cold days. A two stage coolant separation system shall be provided to reduce downstream carryover to less than two (2) ppm.

Aftercooler: Each air compressor shall be equipped with an internal air-cooled aftercooler mounted in parallel with the oil cooler and moisture separator with an automatic drain trap. The aftercooler shall cool the air to within 15 degrees F of the ambient air temperature. The aftercooler shall be mounted, pre-piped, and tested as part of the packaged compressor assembly.

Inlet Air Filter: Heavy Duty Dry type.

Sound Enclosure: A seventy eight (78) dba sound attenuating enclosure per ANSI standard S 5.1 shall be provided.

Controls: Provide the following controls as a minimum:

a. Display standards:

- Package discharge pressure
- Airend discharge pressure
- Sump pressure
- Separator element condition
- Total hours/loaded hours
- Air filter maintenance indicator

b. Membrane Touch Panel

- Start and unloaded stop
- Display select up/down
- Set/reset
- Unload/load

c. Adjustable Operating Parameters

- Online and offline pressures
- Control mode select-online/offline, ACS, modulation only
- Display time

- Option selections- auto start/stop, remote start/stop, power outage restart, sequencer control Star Delta transition time.

d. Fault Warnings

- High airend discharge temperature
- Change separator element

e. Fault shutdowns

- High airend discharge temperature
- High discharge pressure
- Low sump pressure
- Control voltage loss
- Open contactor
- Main motor overload
- Fan motor overload
- Reverse rotation
- Pressure transducer failure
- Temperature sensor failure

23.4 SYSTEM CONTROLLER:

Provide microprocessor based controller capable of controlling up to eight (8) rotary screw compressors. The control will load or unload compressors as necessary to maintain an user adjustable, two to ten (2-10) PSI pressure band. The pressure is sensed via a single point in the system. The controller will prevent electrical power surges using technology that will prevent the simultaneous loading of compressors. Up to eight (8) compressor sequences can be designated by the user to provide customized control of the compressor system. The sequences can be changed automatically on the basis of elapsed time, or on specified events. An event specifies a particular sequence to be run on a specified time of day and day of the week. In the event of controller or communication failure, the affected compressor(s) will default to local control and settings. This will prevent interruption of the system.

Motor Controllers:

Full voltage, combination magnetic type with under voltage release feature and motor-circuit protector-type disconnect and short circuit protective device.

Control voltage- 120 volts, a.c., or less, using integral control power transformer.

Motor overload protection- Overload relay in each phase

Coolant:

The compressor shall be factory filled with a synthetic polyglycol compressor coolant suitable for eight thousand (8000) hours of operation without requiring change.

Pressure Protection:

Provide an air pressure relief valve and minimum pressure check valve.

23.5 AIR DRYER

1. The Air dryer shall be Pneumatech Model AD-400 or approved equal.

2. Air dryer shall be a non-cycling, refrigerated, air-cooled, direct expansion flooded evaporator type complete with heat exchanger, refrigeration compressor, automatic controls, moisture separator, internally wired and piped in, and full refrigerant charge.

3. Heat exchangers shall be air-to-air and air-to refrigerant heat exchangers with automatic control system.

4. Air dryers shall have a centrifugal type moisture separator designed to remove ninety-nine (99) percent of all liquids and solid particle sizes ten (10) micron and larger.

5. Air dryer refrigeration unit shall be hermetic type designed to operate continuously to maintain thirty five (35) degree F dew point, completely wired and piped in. Unit shall have an access door and panel for maintenance and inspection.

6. Accessories: An instrument panel shall include refrigerant suction pressure gauge, inlet air temperature gauge, and inlet air pressure gauge. Electrical control panel NEMA 12 shall include motor overload protection control transformer, on/off switch, control fuse, and refrigerant pressure controls. Pilot lights shall be installed to monitor power “on” and high temperature.

7. Air dryer shall have the following capacity:

   - Discharge air: Thirty five (35) degrees F atmospheric dew point
   - Rated air flow- Four hundred (400) SCFM
   - Inlet Air Pressure- One hundred forty five (145) psig
   - Maximum Pressure differential from inlet to outlet- two (2) psi

8. Air dryer shall have the following characteristics:
   - 5 HP
   - 460V, 3 phase, 60Hz

9. Air dryer shall include an automatic drain system. This drain system shall be Pneumatech Model 4484 or approved equal and shall include a solid state timer for variable blowdown intervals and duration. 1/60/115 volt, NEMA 1, non-clogging solenoid valve, manual drain and piping.

10. Provide a low air pressure shutdown switch. The dryer will automatically shutdown when no compressors are operating and start when either compressor is in operation.

23.6 SYSTEM AIR RECEIVER

1. Air receiver shall be vertical built to ASME regulations, Section VIII for working pressure of two hundred (200) psi, with threaded inlet and outlet connections.

2. Air receiver shall have the following fittings: safety valve, temperature gauge, pressure gauge and manual drain valve.

3. Air receiver tank shall be shop primed and finish painted.

4. The air receiver tank size shall be forty eight (48) inches in diameter, one hundred forty four (144) inches long, and shall have a capacity of one thousand twenty (1020) gallons.

23.7 AIR PROFILER

1. The air prefilter shall be a coalescing type capable of removal of particles down to one (1) micron and oil down to one hundredth (0.01) ppm with a maximum of one hundred fifty (150) degrees F entering air temperature. The air prefilter shall be a Deltech model IR-400C or approved equal.

2. The filter shall be capable of handling a minimum of four hundred (400) SCFM air at one hundred (100) psig.

3. The filter housing shall be lightweight cast aluminum housing with two (2) inch threaded inlet and outlet connections, and removable bowl for replacement of filter element. An indicator shall be included to show need for replacement.

4. The filter shall have a timed, automatic, electric drain with adjustable duration and frequency in a NEMA 1 enclosure. 1/60/115 volt. Drain shall be Ingersoll Rand Model ADV-1711 or approved equal.

5. Oil Water Separator: Ultrafilter “UFA-12”, five hundred fifty (550) SCFM air capacity three (3) gph condensate capacity.

23.8 AIR DISTRIBUTION LINES

1. Pipe and fittings shall be stenciled indelibly with the alphanumeric number of the ASTM standard to which they conform.

2. Above ground pipes:

   - Pipes and tubes shall be ASTM B88 Type K, seamless copper, hard drawn temper
   - Pipe and tube fittings shall be ASTM B16.22, wrought copper or copper alloy, solder joint, pressure type.

3. Buried pipes:

   - Piping system shall be High Density Polyethylene (HDPE) high pressure rated compressed air and fittings. Pipe and fitting material shall conform to ASTM D-3035. All components shall be molded or extruded according to ASTM D-1248. Pipe and fittings shall conform to the requirements of ASTM D-2837-88 for establishing a hydrostatic basis. In addition the pipe shall be SDR 7.3 pipe.
   - All pipe and fittings shall be by the same manufacturer. The piping system shall conform to "Air Pro" system of HDPE pipe as manufactured by Asahi/America, or approved equal.

23.9 VALVES AND ACCESSORIES

1. Two Way ball valves shall have bronze body conforming to ASTM B62 and have chrome plated brass ball. Valve shall be two piece construction with teflon seal, threaded ends and vinyl covered steel handle. Valve shall have a minimum four hundred (400) psig rating.

2. Isolation valves- ASTM B 62 cast bronze body, OS&Y wedge gate valve, rated two hundred (200) psi pas, threaded or solder ends. MSS SP-80, class one hundred fifty (150), solid disk, copper-silicon alloy stem, brass packing gland, "teflon" impregnated packing and malleable iron hand wheel.

3. Check valves- Bronze body, stainless steel spring actuated with silicone W.O.G. three hundred (300) psi rubber seal and internal opening. McMaster-CARR No. 4872K6 or equal.

4. Safety valves-Comply with ASME Boiler and Pressure Vessel Code, Section VIII "Pressure Vessels", National Board Certified. Valves shall have the appropriate labeling and have been factory-sealed after testing. Valves to be constructed of bronze body with poppet safety valve for compressed air service.

5. Pressure indicators-Furnished with bronze bourdon tubes, two and one half (2 ½) inches dials and one quarter (¼) inch NPT male alloy steel sockets. Range zero to two hundred (0-200) psig

6. Pressure Regulators (Pressure Reducing Valves): Aluminum alloy diaphragm-operated, direct acting, spring loaded, manual pressure setting adjustment, rated for two hundred (200) psig inlet pressure and sized to handle zero to three hundred (0-300) CFM with an upstream pressure of one hundred forty (140) psig and a downstream pressure range of eighty five (85) psig to one hundred (100) psig.

7. Shut –off valves: Gate valve, bronze body, bronze trim, non-rising stem, hand wheel, inside screw, single wedge threaded ends. NIBCO Model T-113 or approved equal.

8. Air Outlet: FS-4 type hose coupling by WABCO or equal with threaded hose nipple.

9. Flexible hose: Rubber hose reinforced with two wire braids, threaded ends in conformance with AAR M-618 and M-927 specifications.

23.10 UNDERGROUND COMPRESSED AIR CONNECTION PITS

1. Pit covers shall be all primary metal cast aluminum No. A356.2, per Federal Specification QQ-A601F with a T-6 heat treat per Mil. Spec. H-6088F. Service lettering shall be abrasion/corrosion/ chemical resistant, color coded, and polyester powder coated. Counterweight cover and cover eighteen (18) inches access door shall have a hand-hole with a minimum one and three quarters (1¾) inch depth and seven and a half (7½) cubic inch volume, located near edge opposite of hinge side, and safety orange panel on topside (for counterweight pit) and underside. Non-counterweight cover door shall have a maximum thirty five (35) pounds lift using non-weight bearing, free floating hinges and a minimum of one half (½) inch diameter hinge pins: providing a minimum twenty three and one half (23½) inches diameter opening, and access under opening to highest pit internal component at a maximum of four (4) inches from pit top, if applicable.

2. Counterweight cover shall be one piece, and have a one single motion automatic non-spring, latch lever without any above grade protrusions whether in use or not and with a minimum of one quarter (¼) inch clearance from latching surface. Cover shall open ninety (90) degrees with a maximum thirty five (35) pounds lift and close with a minimum fifty (50) pounds push, without spring shocks, using fixed lead weighted arm with attachment to cover to include safety through bolt. Arm set shall be attached to gears within grease-packed totally enclosed gear box. Gear ratio shall allow cover to go to fail-safe automatic position once lifted beyond seventy (70) degrees. In non-arm latch areas, highest pit internal component shall be accessible from a maximum of five and a half (5½) inches from pit top, if applicable.

3. For each pit cover style's prototype, submit a test report conducted by an independent testing laboratory for the following requirements: Cover loading over each two hundred (200) sq. in. footprint shall result in a minimum one thousand (1,000) psi rating with a maximum one tenth (0.100) (or fifteen hundredths (0.150) for cover larger than thirty one (31) inches) full load deflection at center indicator and deflection rebound within one hundredth (0.010) inch after load release. Cover shall comply with L.A. City D.O.T. AC 150/5320-5C.

23.11 COMPRESSED AIR SYSTEM ENCLOSURE

This section is for the building that houses the compressed air system. The following references apply:

- -Standard Specifications for Public Works Construction (SSPWC)
- -ASTM Standards
- -AWS
- -Steel Door Institute Specifications
- -American Standard Association, Inc. Specifications
- -Architectural Sheet Metal Manual
- -AISC

MATERIAL

Floor

The site is approximately three (3) feet below finished floor grade and compacted to ninety five (95) percent compaction. The Contractor shall fill and compact to a minimum ninety five (95) percent under the slab to a limit of ten (10) feet zero (0) inches outside the slab.

The furnishing, forming, placement compaction of cast-in-place concrete shall be in accordance with SSPWC.

Concrete Block Masonry Walls

Masonry units shall be Grade N-1 conforming to the requirements of Subsection 202-2.1 of the SSPWC. Units shall be two (2)-core type, eight (8) inch nominal height, sixteen (16) inch nominal length, and twelve (12) inch nominal width.

Mortar shall be Class D as indicated in Subsection 201-5.1

Masonry construction shall conform to the requirements of 303-4 of the SSPWC.

Fabricated steel

Steel tubes for columns shall be ASTM A500, Grade B, Fy=46ksi.

Structural plates and shapes shall conform to ASTM A36, Fy=36ksi.

Bolts and anchor bolts shall conform to ASTM A36.

Weldable headed studs for embedment in concrete shall conform to ASTM A108 Grades 1010 through 1020. Yield strength shall not be less than 55ksi.

Plates, gussets, clips, preformed sheet steel- minimum eighteen (18) gauge thickness.

Preformed Metal Roofing

Preformed metal roofing shall be a twenty (20) gauge minimum steel sheet, conforming to ASTM A446, 33ksi yield. Panel profile shall be three (3) inch standing seam with twenty four (24) inch panel coverage, VERCO N-24, or approved equal.

Flashing shall be twelve (12) gauge steel sheet conforming to ASTM A526.

Galvanize flashing and accessories to ASTM A525, G90 coating class.

Sealants

Sealants used at vertical or overhead joints shall be a one-part polyurethane-based sealant, conforming to ASTM C920, Type S, Grade NS, Class 25, as applicable.

Sealants used at horizontal joints shall be a two-part polyurethane based sealant, conforming to ASTM C920, Type M, Grade P, Use T. Class 25, as applicable.

Steel Door and Frame

Hollow metal door and frame, of the size shown on the plans, shall be fabricated from steel sheet of commercial quality complying with ASTM A 526. Galvanization shall comply with ASTM A525, G60 coating class, mill phosphatized.

Supports and anchors shall be fabricated of not less than eighteen (18) gauge galvanized sheet metal.

Inserts, bolts, and fasteners shall be manufacturer’s standard units, except that all items to be built into exterior walls shall be hot-dip galvanized in compliance with ASTM A153, Class C or D as applicable.

Compressed Air System Enclosure Louvers

Manufacturer shall be Ruskin two (2) feet High two (2) feet eight (8) inches wide or Engineer approved equal.

Fixed continuous louver design with hidden mullions. Provide blade braces as necessary for a straight, non-sagging louver blade.

Drainable blades shall be at forty five (45) degree position and spaced approximately five (5) inches center to center.

AMCA certified rating.

Maximum twenty five one hundredths (0.25) ounce per square foot water penetration at eleven hundred (1,100) fpm air velocity, when tested in accordance with AMCA Standard 500.

24.0 RAILROAD CROSSING SIGNAL SYSTEM

The following shall apply to railroad crossing systems used within the POLB system:

1. The design shall be in accordance with both FRA and PUC regulations.

2. Signal system bungalow shall be six (6) feet by six (6) feet aluminum with outside lights. The bungalow shall state "The Port of Long Beach," "Pier #", and Milepost, CPUC #, and a PHL emergency phone number. The area outside the bungalow shall be paved.

3. Two (2) sets of backup batteries and rectifiers. The batteries shall be rated at four hundred (400) amp hours and the rectifier being twelve (12) volt forty (40) amps.

25.0 RAILROAD SAFETY WARNING SYSTEM

All railyard facilities shall have a positive method to warn employees of train movement, which shall include audio and visual signals in keeping with the Pacific Coast Marine Safety Code.

26.0 REQUIREMENTS WHEN WORKING WITHIN, ADJACENT OR ABOVE RAILROAD TRACKS

The following shall apply when working in the vicinity of railroad tracks:

1. The Contractor shall not enter any location, perform any work, or locate any piece of equipment within ten (10) feet of the nearest rail of any railroad track without prior authorization from the Engineer. All work shall be performed in accordance with the provisions of Title 49, Part 214 of the Code of Federal Regulations.

2. The Contractor shall submit a written Work Plan to the Engineer not less than ten (10) days prior to beginning work. The Work Plan shall include the location, starting and stopping times, a description of the work to be performed, the work crews involved, and the Contractor's recommendations regarding track outages and railroad safety protection (Flagmen). No work may be performed, nor any piece of equipment moved within ten (10) feet of the nearest rail of any railroad track until the Work Plan in approved by the

Engineer. Flagmen, if required, will be provided by the City at no cost to the Contractor for days which the City deems necessary for the project. If the number of flagging days are exceeded due to the Contractor's actions the Contractor shall pay for the flagging services beyond the days paid by the Port. The flagging charges paid by the Contractor will be withheld from payment due. The flagging charges are five hundred fifty ($550) day for Pacific Harbor Line flagging services. The Contractor may cancel scheduled Flagmen with written notice to the Engineer at least forty-eight (48) hours prior to the start of the work. However, if the Contractor fails to provide such notice of cancellation within the required time, any cost to the City for scheduled Flagmen will be withheld from payment due to the Contractor.

3. The Contractor shall provide qualified Watchmen when working within twenty (20) feet of the track centerline for the safety and protection of the Contractor's personnel and equipment during construction operations. Watchmen shall be properly trained and equipped in accordance with Title 49, Part 214 of the Code of Federal Regulations. The cost of Watchmen shall be included within the cost of related bid items for such work. The Pacific Harbor Line (PHL) will qualify the Watchmen for the project. The Contractor shall submit an approved list of PHL trained watchmen to the Engineer prior to working within twenty (20) feet of the track centerline.

4. Crossing of tracks by the Contractor's equipment other than at public or private road crossings is prohibited without specific authorization by the Engineer.

5. The Contractor shall report any accidents, injuries, track defects, or any unusual track conditions which may affect the safe and efficient operation of the railroad to the Engineer by the first available means of communication.

6. The Contractor shall be responsible for the prevention of damage to railroad facilities, equipment and operating trains due to his activities. In the event the Contractor damages railroad facilities or equipment, he shall immediately report the damage to the Engineer. Repair of damage caused by Contractor's operations shall be at the expense of the Contractor and accomplished to the satisfaction of the Engineer.

7. The Contractor shall be responsible for compliance with the requirements of the Roadway Worker Protection Act (the Act) issued by the FRA.