Attachment 7

Design, Construction and Rolling Stock Requirements

Portions of this Attachment 7 have been supplemented, modified or superseded by the Alternative Technical Concepts. Many, but not all, of such changes are referenced in the provisions herein. Please see Section E (Alternative Technical Concepts) of Volume 3 of the Technical Proposal contained in the Concessionaire's Proposal, which includes a complete description of each concept and how it is intended to be implemented, and Section 1.3 (Conflict of Terms) of the Agreement, which concerns resolution of any potential conflict, ambiguity or inconsistency resulting from the application of the Alternative Technical Concepts.
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GENERAL REQUIREMENTS FOR

DESIGN, CONSTRUCTION AND ROLLING STOCK

1. Definitions

1.1 Definitions and Abbreviations

Unless the context requires otherwise, capitalized terms used in this Attachment 7 shall have the meaning given to them in Section 1.1 (Definitions) of the Agreement. In addition, the following capitalized terms shall have the meanings set out below. Names and acronyms of entities promulgating regulations, codes and industry standards used in this Attachment 7 are defined in Appendix 1 (Regulations, Codes and Standards).

**AAR** means the Association of American Railroads.

**BNSF** means Burlington Northern Santa Fe Railway Corporation and its Affiliates.

**CCD** means the City and County of Denver

**CDOT** means the Colorado Department of Transportation.

**CDPHE** means the Colorado Department of Public Health and Environment.

**Central Corridor LRT Extension Project** means the light rail project to be constructed by others as an extension from the existing 30th/Downing Street station to the 38th/Blake station, which will serve a transfer point to the Commuter Rail Network.

**Closed Circuit Television (CCTV)** means a video surveillance system used for monitoring public areas and assets of the Commuter Rail Network.

**Control Center** means the operational and administrative base for commuter rail operations, comprising the Dispatch Center and the Security Command Center (in each case as such term is defined in Attachment 10 (O&M Specifications)).

**Corridor Protection Barrier** means a longitudinal structure between the tracks for the Commuter Rail Network and the UPRR Parallel Railroad Tracks, as required by Section 5.9 (Corridor Protection Barriers) of Part B.

**DIA** means Denver International Airport.

**EMC** means electromagnetic compatibility as defined in Section 6.1 (Electromagnetic Compatibility Requirements) of Part A.

**Emergency Telephones** means the emergency call devices placed in strategic locations around transit facilities providing a direct connection to the security entity responsible for monitoring and responding to situations at that location.
**EMU** means electric multiple units, a type of electric Rolling Stock arranged in train consists suitable for Passenger service for which propulsion power is derived from continuous contact with an overhead electrical distribution conductor.

**Environmental Permits** means those Permits listed in Attachment 5 (RTD Permits) and Attachment 18 (Concessionaire’s Records of Decision Obligations).

**Fare System Equipment** means ticket vending machines, stand alone validators and smartcard readers located at stations for the purpose of collecting fare revenue and dispensing and validating tickets as further described in Section 11 (Fare System Equipment) of Part B.

**Final Design** means a level of design development at, or nearly at, 100% design completion, at which point all design details are developed and shown on design documentation.

**I-225 LRT Project** means the light rail corridor to be constructed by others as an extension from the existing Nine Mile station to the Peoria station, which will serve a transfer point to the Commuter Rail Network.

**LRFD** means load and resistance factor design, as applied to bridge design.

**MUTCD** means the FHWA Manual on Uniform Traffic Control Devices and any provisions, applicable in the context in which used, of the CDOT Colorado Supplement to the FHWA Manual on Uniform Traffic Control Devices, both as listed in Part 1 (Federal Regulations) of Appendix 1 (Regulations, Codes and Standards) of this Attachment 7.

**NFPA** means the National Fire Protection Association.

**North Metro Corridor** means the commuter rail corridor to be constructed by others from the DUS Rail Segment to 162nd Avenue, comprising an alignment of approximately 18 miles and 8 stations, on which service will be provided by EMU trains.

**Northwest Rail Corridor** means the commuter rail corridor from DUS to Longmont, comprising the NWES and a section from South Westminster to Longmont to be constructed by others.

**OCS** means Overhead Contact System as described in Section 12.3.1 (Overhead Contact System) of Part B.

**Operating Plan** has the meaning given to it in Attachment 10 (O&M Specifications).

**Parallel Railroad Tracks** means those tracks owned by the Railroads running next to a Commuter Rail Network track on the same or nearly the same alignment.

**park-n-Ride or pnR** means parking lots provided at transit stations for Passengers to transfer to bus and rail service.

**Peña Transportation Corridor** means a right of way under the ownership of CCD extending 1,000 feet on either side of the Peña Boulevard centerline, designated as a "scenic buffer" under the 1988 Intergovernmental Agreement between Adams County and CCD.

**Periodic Design Review Meeting** has the meaning given to it in Section 3.2 (Concessionaire Design Review) of Attachment 9.
Preliminary Design means a level of design development that may be anywhere between 30% and 65% design completion, at which point key design and interface issues can be finalized.

PTC means Positive Train Control as defined in Section 9.1(b) of Part B.

PUC means the Colorado Public Utilities Commission, an agency of the Colorado Department of Regulatory Agencies.

Railroad means BNSF or UPRR.

Railroad Property has the meaning given to it in Section 3.2 (Work on Railroad Property) of Part B.


RTD Commuter Rail Design Criteria means RTD's Commuter Rail Design Criteria included as Reference Data Item No. 1GCP in Attachment 23 (Reference Data List).

SCMD means Sand Creek Metropolitan District.

SCMD Access Date means the date by which RTD shall procure that all design and construction of the lowering of 40th Avenue has been performed by SCMD, as set forth in the Inter-Governmental Agreement between RTD and SCMD.

System Performance Demonstration has the meaning given to it in Section 4.2 (System Performance Demonstration) of Part D.

TES means the Traction Electrification System as defined in Section 12 (Traction Electrification System) of Part B.

UPRR means Union Pacific Railroad Company and its Affiliates.

Urban Drainage and Flood Control District (UDFCD) means an independent agency, established by Colorado legislature for the purpose of assisting local governments in the Denver metropolitan area with multi-jurisdictional drainage and flood control problems.
2. **INTRODUCTION**

2.1 **Purpose of Attachment**

This Attachment 7 defines the technical scope of the Work for the Eagle Project during the Design/Build Period. The requirements set out in this Attachment 7 are mandatory. The Concessionaire is obliged to comply with these requirements, subject to any waivers and variations from specific requirements that RTD may grant in its sole discretion.

2.2 **Design and Construction Principles**

(a) The overall goal of the Work is to provide a Commuter Rail Network that is capable of being operated and maintained in an efficient and reliable manner and in accordance with the requirements of the Agreement. Therefore, in developing and implementing its approach to design and construction, the Concessionaire shall make reference to Attachment 10 (*O&M Specifications*) in determining the scope of the Work.

(b) Final design and construction of the Commuter Rail Network shall include appropriate provisions and accommodations for the increases in service demand that are anticipated to occur during the Operating Period. The Concessionaire shall demonstrate in the Concessionaire Design Submittals that Final Project Design and proposed construction provide the ability, through additional final design and construction activities not included in the Work, to meet the increased operating capacity requirements specified in Figure 2.2.
Figure 2.2 – Design and Construction Requirements by Time Period and Major Elements

<table>
<thead>
<tr>
<th>Major Element</th>
<th>Design Basis</th>
<th>Construction/Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolling Stock</td>
<td>Sufficient to meet 2035 service capacity requirements for:</td>
<td>Sufficient Cars to provide service capacity up to 2035 service capacity requirements for:</td>
</tr>
<tr>
<td></td>
<td>• East Corridor;</td>
<td>• East Corridor;</td>
</tr>
<tr>
<td></td>
<td>• Gold Line;</td>
<td>• Gold Line;</td>
</tr>
<tr>
<td></td>
<td>• Northwest Rail Electrified Segment.</td>
<td>• Northwest Rail Electrified Segment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phased delivery is allowed prior to 2035 consistent with the increasing service capacity requirements through 2035.</td>
</tr>
<tr>
<td>CRMF</td>
<td>Service and storage of:</td>
<td>Sufficient for service and storage of the EMU fleet supplied for:</td>
</tr>
<tr>
<td></td>
<td>• EMU fleet (as set out in Part C) to meet forecasted 2035 ridership for East Corridor, Gold Line and the Northwest Rail Electrified Segment;</td>
<td>• East Corridor;</td>
</tr>
<tr>
<td></td>
<td>• 30 additional EMU Cars (as set out in Part C)</td>
<td>• Gold Line;</td>
</tr>
<tr>
<td></td>
<td>CRMF designs may propose a separate maintenance facility site and facility to accommodate such increased capacity outlined above.</td>
<td>• Northwest Rail Electrified Segment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provision of storage tracks may be phased to match the fleet on hand.</td>
</tr>
<tr>
<td>Station Park and Ride Lots</td>
<td>Number of spaces for 2030 (as set out in Part B, Section 6).</td>
<td>Number of spaces for 2015 (as set out in Part B, Section 6).</td>
</tr>
<tr>
<td>Traffic Mitigation Elements</td>
<td>As required for traffic levels around stations in 2015.</td>
<td>As required for traffic levels around stations in 2015.</td>
</tr>
<tr>
<td>Station Platforms</td>
<td>East Corridor: Sufficient to handle service carrying double 2035 service capacity requirements.</td>
<td>Sufficient to handle service carrying 2035 service capacity requirements.</td>
</tr>
<tr>
<td></td>
<td>Northwest Rail Electrified Segment and Gold Line: Maximum platform length possible within physical constraints.</td>
<td></td>
</tr>
<tr>
<td>Traction Electrification System and Train Control System</td>
<td>Sufficient to handle service carrying 2035 service capacity requirements plus a conceptual ability for expansion to handle increased service levels up to 2055 service capacity requirements.</td>
<td>Sufficient to handle service carrying 2035 service capacity requirements. Traction substations shall include load capacity for North Metro service.</td>
</tr>
</tbody>
</table>

Details of the service capacity requirements referred to in Figure 2.2 are set out in Section 2.1.2 (Service Capacity Requirements) of Attachment 10.
2.3 Requirements

All aspects of the Work shall be performed in accordance with the requirements of applicable Law, the Agreement, the Project Requirements, Good Industry Practice, applicable industry codes and standards, and other guidance and best practice documents typically applied to commuter railroad projects, including primary regulations, codes and standards as set forth in Appendix 1 (Regulations, Codes and Standards). The Concessionaire is responsible for identifying all applicable regulations, codes and standards.

2.4 Interpretation of Requirements

If there is any conflict between any of the requirements described in Section 2.3 above, the most restrictive requirement shall apply. If any requirement is unclear, the Concessionaire shall seek clarification from RTD.

2.5 Visual Identity and Branding

(a) All systems, equipment and facilities for the Commuter Rail Network visible to Passengers and the general public shall reflect the visual identity and branding directed by RTD in color and signage, as appropriate to its location. The Concessionaire shall coordinate with RTD during the Design/Build Period to establish the application of this identity and branding on the Commuter Rail Network.

(b) Rolling Stock shall be branded using RTD's standard striping similar to the application on its buses and light rail vehicles unless RTD specifies otherwise. The Concessionaire may include its own operating insignia or logo on the Rolling Stock, subject to RTD approval.
3. DESCRIPTION OF THE PROJECT

3.1 Overview of the Eagle Project

The Eagle Project includes:

(a) design and construction of the Commuter Rail Projects;
(b) design and construction of the CRMF;
(c) provision and installation of the DUS Systems;
(d) provision of the Rolling Stock;
(e) provision of the Commuter Rail Services;
(f) maintenance of the Commuter Rail Network and Rolling Stock; and
(g) dispatch of the Heavy Rail Movements;

in each case performed in accordance with the terms of this Agreement.

3.2 Denver Union Station Rail Segment

3.2.1 DUS Overview

DUS will be the hub for multiple transportation modes in the Denver metro area. Services operating on the Northwest Rail Corridor, the Gold Line, the East Corridor, the North Metro Corridor will all terminate at DUS, as will light rail services on the Central Platte Valley line. RTD’s regional bus facility will be located below grade and will serve as the terminal for the US 36 Bus Rapid Transit corridor and numerous other RTD bus routes. DUS will continue to accommodate Amtrak services as well as other Heavy Rail Movements. The 16th Street Mall shuttle will continue to run in dedicated lanes along 16th Street and extend to the Central Platte Valley light rail station. The new Downtown Circulator will include stops for easy commuter rail and light rail transfers. There will also be a number of public spaces including plazas at Wynkoop Street, 17th Street, and 18th Street. The Eagle Project includes only the commuter rail portions of the DUS.

3.2.2 DUS Infrastructure and the Fare System Equipment

(a) The DUS Infrastructure Contractor will design and construct the DUS Infrastructure, as described in detail in Attachment 3 (The DUS Infrastructure).

(b) RTD will install Fare System Equipment at DUS for use by the Passengers.

3.2.3 The DUS Rail Segment

The Concessionaire is responsible for all design, construction and installation activities necessary for full functionality of the DUS Rail Segment not provided as part of the DUS Infrastructure or the Fare System Equipment. The DUS Systems comprises the following Work:

(a) electrification of the commuter rail tracks;
(b) signaling of all tracks and interlocking of switches;  
(c) station equipment for passenger information and operations control; and  
(d) coordination with the DUS Infrastructure Contractor with regard to design integration, construction access, and provision of permits and approvals for the Work.

3.3 Northwest Rail Electrified Segment

The NWES runs from the DUS Rail Segment to South Westminster station and includes the alignment of DUS to CRMF, required for movement of Rolling Stock from the CRMF to DUS. The NWES is shown in Figure 3.3. The Concessionaire shall design and construct the NWES as defined in this Section, in its entirety except as noted below.

Figure 3.3: NWES Alignment Overview
3.3.1. NWES Overview

The NWES runs northwest from the DUS Rail Segment to South Westminster on an alignment that is to be shared by the NWES Service, the Gold Line Service and DUS to CRMF non-revenue movements. The alignment generally follows adjacent to and east of the BNSF Front Range subdivision but does not require any shared operations with BNSF. The right of way in this segment provides sufficient width for a double-track system dedicated to the Commuter Rail Network. The Gold Line diverges from the NWES immediately west of Pecos Street at Pecos Junction, with the NWES continuing to South Westminster on a single track that parallels the BNSF track, but that does not require any shared operations with BNSF.

3.3.2. NWES Alignment Description

The primary features of the NWES alignment shall be implemented as defined in Table 3.3.2.

Table 3.3.2: NWES Alignment Features

<table>
<thead>
<tr>
<th>Corridor Feature</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Wewatta Street crossing</td>
<td>Grade separated; alignment passes underneath in an existing opening.</td>
</tr>
<tr>
<td>(b) 23rd St Yard fueling facility access crossing</td>
<td>Grade separated; providing access from Fox St.</td>
</tr>
<tr>
<td>(c) Consolidated mainline crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(d) South Platte river crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(e) BNSF property access</td>
<td>New at-grade private crossing with a locked chain-link gate.</td>
</tr>
<tr>
<td>(f) I-25 crossing</td>
<td>Grade separated; alignment passes underneath in an existing opening.</td>
</tr>
<tr>
<td>(g) 38th Avenue crossing</td>
<td>Grade separated; east of existing Railroad bridge</td>
</tr>
<tr>
<td>(h) BNSF Rennick Yard</td>
<td>Railroad will relocate its tracks off commuter rail right of way.</td>
</tr>
<tr>
<td>(i) 41st/Fox Street station</td>
<td>See Section 6 of Part B</td>
</tr>
<tr>
<td>(j) BNSF Jersey cut-off crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(k) I-70 crossing</td>
<td>Grade separated; alignment passes underneath in an existing opening.</td>
</tr>
<tr>
<td>(l) 48th Avenue crossing</td>
<td>Grade separated; alignment passes underneath in an existing opening.</td>
</tr>
<tr>
<td>(m)</td>
<td>BNSF TOFC yard access from 48th Avenue frontage road</td>
</tr>
<tr>
<td>(n)</td>
<td>CRMF location east of mainline</td>
</tr>
<tr>
<td>(o)</td>
<td>BNSF TOFC yard crossing</td>
</tr>
<tr>
<td>(p)</td>
<td>Utah Junction crossing</td>
</tr>
<tr>
<td>(q)</td>
<td>Running parallel on the south side of BNSF track</td>
</tr>
<tr>
<td>(r)</td>
<td>Utah Junction Bypass Bridge crossing</td>
</tr>
<tr>
<td>(s)</td>
<td>Pecos Street station</td>
</tr>
<tr>
<td>(t)</td>
<td>Pecos Street crossing</td>
</tr>
<tr>
<td>(u)</td>
<td>Pecos Junction</td>
</tr>
<tr>
<td>(v)</td>
<td>I-76 crossing</td>
</tr>
<tr>
<td>(w)</td>
<td>Clear Creek crossing</td>
</tr>
<tr>
<td>(x)</td>
<td>64th Avenue crossing</td>
</tr>
<tr>
<td>(y)</td>
<td>Federal Boulevard crossing</td>
</tr>
<tr>
<td>(z)</td>
<td>South Westminster station</td>
</tr>
</tbody>
</table>

[intentionally left blank]
3.3.3. NWES Alignment Station Locations

(a) The 41st/Fox Street station is located east of the BNSF corridor and north of 38th Street roadway underpass. A pnR Site is located east of the station, and access between the station platform, pnR, and communities to the west requires a grade-separated pedestrian facility. The 41st/Fox Street station shall be constructed as part of the Gold Line Project Work.

(b) The Pecos Street station is located to the east of Pecos Street and south of the BNSF alignment. A pnR is located to the northeast of the platform. A grade-separated pedestrian facility is necessary to convey patrons from the pnR Site, across the BNSF track, to the platform. The Pecos Street station shall be constructed as part of the Gold Line Project Work.

The South Westminster station is located near 71st Avenue and Irving St, west of Federal Boulevard and south of the BNSF alignment. A pnR Site is located to the north of the BNSF track. A grade-separated pedestrian facility is necessary to convey Passengers from the pnR, across the BNSF track, to the platform.

3.4 Gold Line

The Gold Line runs from Pecos Junction to Ward Road and is shown in Figure 3.4. The Concessionaire shall design and construct the Gold Line as defined in this Section, in its entirety except as noted below.
3.4.1. Gold Line Overview

The Gold Line diverges from the NWES at Pecos Junction and runs west to Ward Road in Wheat Ridge. The 7.4-mile long Gold Line corridor runs parallel to BNSF and UPRR right of way, but does not require any shared operations. The right of way provides sufficient width for a double-track system dedicated to the Gold Line Service, except where specifically identified below.

3.4.2. Gold Line Alignment Description

The primary features of the Gold Line alignment shall be implemented as defined in Table 3.4.2.
Table 3.4.2: Gold Line Alignment Features

<table>
<thead>
<tr>
<th>Corridor Feature</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Pecos Junction1</td>
<td>Follow CDOT embankment</td>
</tr>
<tr>
<td>(b) West 61st Avenue crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(c) Run parallel and north of UPRR Moffat Line corridor</td>
<td>Maintain 50 feet clearance or provide Corridor Protection Barrier.</td>
</tr>
<tr>
<td>(d) I-76 crossing</td>
<td>Grade separated; alignment passes underneath in an existing opening.</td>
</tr>
<tr>
<td>(e) Federal Boulevard station</td>
<td>See Section 6 of Part B</td>
</tr>
<tr>
<td>(f) Federal Boulevard crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(g) Clear Creek crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(h) Lowell Boulevard crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(i) Tennyson Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(j) Sheridan Boulevard station</td>
<td>See Section 6 of Part B</td>
</tr>
<tr>
<td>(k) Sheridan Boulevard crossing</td>
<td>Grade separated; alignment passes underneath in an existing opening.</td>
</tr>
<tr>
<td>(l) UPRR Moffat Line crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(m) Ralston Road crossing</td>
<td>Grade separated; alignment passes underneath in an existing opening.</td>
</tr>
<tr>
<td>(n) Run parallel and north of BNSF Golden Subdivision track</td>
<td>Alignment width is limited allowing only single track between Ralston Road and Carr Street.</td>
</tr>
<tr>
<td>(o) Ralston Creek crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(p) Lamar Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(q) Salisbury Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(r) Wadsworth Bypass crossing</td>
<td>Grade separated; deep foundations, designed for a two track E-80 loading structure, are</td>
</tr>
</tbody>
</table>

already in place and may be used by commuter rail.

<table>
<thead>
<tr>
<th>(s) Vance Street crossing</th>
<th>At-grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>(t) Olde Town Arvada station</td>
<td>See Section 6 of Part B</td>
</tr>
<tr>
<td>(u) Olde Wadsworth Boulevard crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(v) Allison/Zephr Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(w) Balsam Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(x) Carr Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(y) Garrison Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(z) Independence Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(aa) Kipling Street crossing</td>
<td>Grade separated; Railroad will vacate its existing bridge and will construct a new bridge for its own use. The existing single track bridge may be re-used by commuter rail.</td>
</tr>
<tr>
<td>(bb) Arvada Ridge station</td>
<td>See Section 6 of Part B</td>
</tr>
<tr>
<td>(cc) Lee Street/State Home Road crossing</td>
<td>Closed; no crossing required</td>
</tr>
<tr>
<td>(dd) Miller Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(ee) Parfet Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(ff) Robb Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(gg) Tabor Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(hh) Ward Road station</td>
<td>See Section 6 of Part B</td>
</tr>
</tbody>
</table>

3.4.3. **Gold Line Alignment Station Locations**

(a) The Federal Boulevard station site is located east of Federal Boulevard and the pnR Site is located adjacent to the station, north of the alignment.

(b) The Sheridan Boulevard station site is located to the east of Sheridan Boulevard and to the north of the UPRR Moffat Line. The pnR Site is located adjacent to the station to the north.

(c) The Olde Town Arvada station is bounded by Olde Wadsworth Boulevard to the west, Vance Street to the east, Grandview Boulevard to the north, and the BNSF tracks to the
south. This is a single track station with a side platform to the north of the commuter rail line. The pnR involves reconfiguration and expansion of the existing RTD pnR Site to the southeast of the station.

(d) The Arvada Ridge station is bounded by Ridge Road on the north, BNSF tracks to the south, Lee Street/State Home Road to the west, and Kipling Street bridge to the east. The pnR Site is located to the south of the freight and commuter rail tracks with a grade-separated pedestrian facility required to cross the freight and commuter rail tracks.

(e) The Ward Road station is bounded on the south by the BNSF tracks, the west by Ward Road, and the east by Tabor Street. Sufficient distance has been left to the west to allow for double tail tracks and the potential for a future structure over Ward Road. The pnR Site is located to the north of the station.

3.5 East Corridor

3.5.1 East Corridor Overview

The East Corridor runs east from the DUS Rail Segment to DIA, as shown in Figure 3.5.1. The approximately 22.8-mile alignment generally parallels the UPRR corridor between DUS and Airport Boulevard and then turns north and then east to DIA within the Peña Transportation Corridor. The right of way provides sufficient width for a double-track system dedicated to the East Corridor Service.
3.5.2. East Corridor Alignment Description

The primary features of the East Corridor alignment shall be implemented as defined in Table 3.5.2.

Table 3.5.2: East Corridor Alignment Features

<table>
<thead>
<tr>
<th>Corridor Feature</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Park Avenue West crossing</td>
<td>Grade separated; alignment passes underneath in an existing opening.</td>
</tr>
<tr>
<td>(b) Broadway Street crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(c) 38th/Blake station</td>
<td>See Section 6 of Part B</td>
</tr>
<tr>
<td>(d) 38th Street crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(e) 40th Avenue right of way</td>
<td>Reconstruct the roadway from 40th Street to York Street.</td>
</tr>
<tr>
<td>(f) York Street and Josephine</td>
<td>Reconfigured between 40th and 42nd to provide a</td>
</tr>
<tr>
<td>Street couplet crossing</td>
<td>single bidirectional at-grade crossing.</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>(g) Columbine Street crossing</td>
<td>Close</td>
</tr>
<tr>
<td>(h) Clayton Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(i) Steele Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(j) Market Lead Railroad corridor crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(k) Colorado Boulevard station</td>
<td>See Section 6 of Part B</td>
</tr>
<tr>
<td>(l) Colorado Boulevard crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(m) Colorado Boulevard to west of Dahlia Street</td>
<td>Relocate Smith Road to the south; provide a reconfigured intersection at Colorado and 40th Street. Close the existing portion of Smith Road under Colorado Boulevard. Remove abandoned ramp from northbound Colorado Boulevard to eastbound Smith Road, regrade and seed.</td>
</tr>
<tr>
<td>(n) Dahlia Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(o) Holly Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(p) Monaco Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(q) Quebec Street crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(r) Quebec Street frontage road crossings (northbound and southbound)</td>
<td>At-grade</td>
</tr>
<tr>
<td>(s) Ulster Street crossing</td>
<td>At-grade</td>
</tr>
<tr>
<td>(t) Central Park Boulevard station</td>
<td>See Section 6 of Part B</td>
</tr>
<tr>
<td>(u) Central Park Boulevard crossing</td>
<td>Grade separated; alignment passes under a road bridge being constructed by Forest City.²</td>
</tr>
<tr>
<td>(v) Sand Creek crossing</td>
<td>Grade separated</td>
</tr>
<tr>
<td>(w) Havana Street crossing</td>
<td>At-grade</td>
</tr>
</tbody>
</table>

² NOTE: See Reference Data Item 2E.10.
| (x) Peoria station                      | See Section 6 of Part B                      |
| (y) Moline Street to Peoria Street     | Realign Smith Road to the existing 33rd Street and close the existing portion of Smith Road. |
| (z) Peoria Street crossing             | At-grade                                    |
| (aa) I-225 crossing                    | Grade separated; alignment passes underneath in an existing opening. |
| (bb) Sable Boulevard crossing          | At-grade                                    |
| (cc) Chambers Road crossing            | At-grade                                    |
| (dd) UPRR crossing                     | Grade separated                            |
| (ee) Power transmission line           | Xcel Energy plans to install a new transmission line on the north side of the UPRR right of way in 2010, which will be a minimum of 100 feet above existing ground level at the location of the commuter rail structure. |
| (ff) Airport Boulevard crossing        | Grade separated                            |
| (gg) East 31st Avenue/ Pagosa Street crossing | Grade separated                      |
| (hh) I-70 crossing                     | Grade separated                            |
| (ii) 40th/Airport                      | See Section 6 of Part B                    |
| (jj) 40th Avenue crossing              | At-grade                                    |
| (kk) 48th Avenue crossing              | At-grade                                    |
| (ll) 56th Avenue crossing              | Grade separated                            |
| (mm) First Creek crossing              | Grade separated                            |
| (nn) Tower Road crossing               | At-grade                                    |
| (oo) 72nd Avenue                       | Grade separated; vehicular crossing for access to the northern portion of the DIA Golf Course lease, enabling access from east of Himalaya Road and west of E-470. |
| (pp) E-470 crossing                    | Grade separated                            |
(qq) Peña Boulevard crossing
Grade separated; the design and construction of the bridge over Peña Boulevard is explicitly excluded from the Work; however trackwork, traction electrification and other necessary systems shall be provided by the Concessionaire.

(rr) New Castle Road crossing
Grade separated

(ss) Employee parking lot
Grade-separated; vehicular crossing of the Corridor alignment for access to the northern portion of the DIA employee parking lot.
Grade separated; pedestrian crossing of the Corridor alignment for access to the northern portion of the DIA employee parking lot.

(tt) Westbound Peña Boulevard crossing
Grade separated

(uu) Airport access roads
Grade separated, alignment passes under a roadways in a new underpass

(vv) Return to terminal road
Grade separated, alignment passes under a road bridge being relocated by DIA.

(ww) DIA station
See Section 3.5.3 (f) below and Section 6 of Part B

### 3.5.3. East Corridor Alignment Station Locations

(a) The 38th St/Blake station site is located southeast of the UPRR corridor and 38th Street and provides a connection to the Central Corridor LRT extension to be constructed by others. The pnRs are located northwest of the station and northeast of the station. Access between the station platform and the northwest pnR will be by grade-separated pedestrian facilities.

(b) The Colorado Boulevard station is located between Monroe Street and Colorado Boulevard. The pnR site is bordered by Monroe Street to the west, 42nd Avenue to the south, Jackson Street to the east, and the rail corridor to the north.

(c) The Central Park station site is located west of the planned Central Park Boulevard and north of Smith Road. The station includes a pnR located adjacent to the station, south of Smith Road. Smith Road shall be reconstructed adjacent to the pnR.

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(d) Peoria station is located in the northwest quadrant of Peoria Street and the existing Smith Road right of way. The future I-225 LRT corridor, to be constructed by another contractor, will come from the south along the west side of Peoria to terminate at this station. A transfer will be provided between the East Corridor and I-225 LRT corridor. The pnR is located south of the station platform area, north of 33rd Avenue, east of Moline, and west of Peoria.

(e) The 40th/Airport station is located south of 40th Avenue, just east of Peña Boulevard, and west of Salida Street, at the site of the existing RTD pnR lot. The existing pnR lot remains in place.

(f) The DIA station site is located between the terminal east and west frontage roads, adjoining the location of a future terminal extension (to be built by others). The Concessionaire shall coordinate all Work with DIA, and is responsible for trackwork and systems equipment at the DIA station, while DIA will provide the station facility. The detailed division of Work between the Concessionaire and DIA at the DIA station will be detailed in the applicable Inter-Governmental Agreement, a copy of which is attached in draft form as Annex 2.1 to Attachment 21 (Inter-Governmental Agreements). The DIA station elevation will be at Level 0 (zero) of the terminal building.

3.6 Commuter Rail Maintenance Facility

(a) The CRMF shall provide facilities to repair, maintain, clean, and store the train fleet that will provide the Commuter Rail Services and the North Metro Corridor Service.

(b) The CRMF Site, covering approximately 24.3 acres, is located northwest of downtown Denver, adjacent to the NWES alignment, north of the I-70/I-25 interchange, at the intersection of W 48th Avenue and Fox Street. Refer to Part D (CRMF Site) of Attachment 2 and Figure 3.6 below.

(c) The Concessionaire is responsible for the design, site preparation, construction, equipping, testing and commissioning of the CRMF, and other activities necessary to enable construction and use of the facility.

4 NOTE. See Reference Data Item No. 2E.7.
Figure 3.6: CRMF Site and Alignment Overview
4. **THIRD PARTY AGREEMENTS**

(a) In accordance with Section 22.1(d) of the Agreement, the Concessionaire shall take all steps and perform all acts necessary to implement each of RTD's obligations to the Project Third Parties under the Third Party Agreements as part of the Work, other than those obligations identified in Section 2(e) of Attachment 20 (*Utilities*), Attachment 21 (*Inter-Governmental Agreements*) and Attachment 22 (*Railroad Agreements*).

(b) If any Project Third Party requests the Concessionaire to fulfill an obligation required of RTD in any Third Party Agreement that the Concessionaire is not required to perform in accordance with this Agreement, the Concessionaire shall notify RTD immediately and respond as instructed by RTD.
5. **SPECIFIC DESIGN REQUIREMENTS**

5.1 **Accessibility**

(a) The Work shall comply with the rules and regulations of the ADA, 49 CFR 37 (Transportation Services for Individuals with Disabilities), and other Law regarding accessibility applicable to new transit facilities.

(b) The Concessionaire shall provide level boarding of the Rolling Stock at commuter rail station platforms without the use of bridgeplates. If level boarding without bridgeplates is technically infeasible, the Concessionaire shall provide such bridgeplates and any ancillary facilities, such as storage cabinets, necessary to satisfy level boarding requirements.

(c) The Concessionaire shall submit to RTD a document (the Accessibility Plan and Compliance Report) detailing the specific design solutions to be incorporated throughout the project to provide compliance with these requirements. [CDRL #7A-01]

(d) AT DUS, the DUS Infrastructure Contractor will provide platforms at 50.5 inches (±0.125 inches) above top of rail height, set back 67 inches from track centerline. The Concessionaire shall implement a sacrificial platform edging or other means, subject to RTD's review, to establish the horizontal gap to the Car door threshold in compliance with paragraph (a) above.

5.2 **Sustainability**

(a) The Concessionaire shall develop and implement a sustainability plan (the Concessionaire's Sustainability Plan) consistent with the Board-adopted sustainability policy.\(^5\) The Concessionaire's Sustainability Plan shall apply to the Concessionaire, the Project Contractors and their respective Subcontractors. The Concessionaire's Sustainability Plan shall be updated on an annual basis and shall address all aspects of the Work, setting out procedures to implement sustainable design practices, and establishing specific annual measurable goals related to construction tasks scheduled in the upcoming year. [CDRL #7A-02]

(b) The Concessionaire shall develop a management system, as described in the Concessionaire's Sustainability Plan, which measures environmental impacts through energy, design and planning, construction, operations and maintenance, land use, and life cycle analysis. This management system shall be developed to help the entire organization understand its impacts through all phases of the Agreement in order to find the most cost effective ways to improve environmental sustainability.

(c) The Concessionaire shall obtain LEED certification for the CRMF consistent with commitments included in Attachment 19 (Concessionaire's Proposal).

\(^5\) NOTE: See Reference Data Item No. 4GCP.
5.3 Design Life

(a) The Concessionaire shall establish detailed design life criteria for assets, which shall identify consumable and replaceable components and shall be consistent with the following general design life criteria:

(i) fixed facilities (including structures, buildings and utility installations) shall be designed for continued operation over a minimum of 60 years before complete refurbishment and renovations may be necessary due to wear and tear and obsolescence;

(ii) major fixed systems equipment (such as substation gear and shop machinery) shall be designed for a minimum of 40 years before complete replacement becomes necessary, with appropriate maintenance policies having been followed;

(iii) Rolling Stock shall be designed for a minimum of 30 years service in the Denver environment assuming an annual design mileage of 125,000 miles per Car, before complete replacement becomes necessary, with appropriate maintenance policies having been followed; and

(iv) computer-based and other electronic hardware shall be designed for the longest viable operating life before replacement becomes necessary due to obsolescence.

(b) Except for the Rolling Stock, any asset which has a design life (defined as the duration for which the asset can be expected to retain the same level of safety, reliability and functionality as its original application) that expires before the End Date shall be replaced by the Concessionaire before the End Date with a replacement asset providing not less than the original asset's level of safety, reliability and functionality, and meeting the design life requirements of this Section. The Rolling Stock shall be replaced in accordance with Section 31 (Rolling Stock) of the Agreement.

5.4 Previous Usage and Modern Design

(a) All equipment, components and materials shall be demonstrated to have a proven record of satisfactory use in railway applications, or other applications providing a similar operating environment. Equipment, components and materials not meeting this requirement shall be used only with RTD's approval, such approval not to be unreasonably withheld. [CDRL #7A-03]

(b) Equipment and systems shall be of modern design, incorporating currently available components, and shall be appropriate for use in electrified railroad systems.

(c) Software systems shall use open architecture principles to the extent practicable.

5.5 Design and Construction Tolerances

Where not specifically identified by statement or reference code, the Concessionaire shall establish design and construction tolerances for all designs. Design and construction tolerances shall be established at a level that supports construction and maintenance requirements of the Agreement.
5.6 Design Conditions

(a) Design shall be based on the altitude conditions and climatic conditions of the Denver area (including levels of wind and snow loading, variations in temperature, frost depths, quantities, intensities, and durations of rainfall, lightning intensity and other climatic conditions that affect performance of the Commuter Rail Projects) as required by Good Industry Practice.

(b) For surface and sub-surface civil works, the basis of design for engineering designs shall be a geotechnical investigation and recommendations sealed by a geotechnical engineer licensed in the State of Colorado.

(c) The Concessionaire shall select systems, subsystems, products, components and materials necessary to meet the requirements of Part B (Infrastructure Requirements) and Part C (Rolling Stock Requirements) that are designed to function within design tolerances in the environment in which they will be used and in accordance with Good Industry Practice.

5.7 RTD Commuter Rail Design Criteria

(a) Designs prepared by the Concessionaire shall comply with Section 14 (System Safety and System Security) of the RTD Commuter Rail Design Criteria. Other than Section 14 and any other specific requirements within the RTD Commuter Rail Design Criteria that are expressly referenced in this Attachment 7 or in any other part of the Agreement as being requirements to be complied with by the Concessionaire, the contents of the RTD Commuter Rail Design Criteria are not mandatory requirements of the Agreement.

(b) The Concessionaire shall document all variances and deviations from the RTD Commuter Rail Design Criteria within the designs prepared by the Concessionaire, with reasoning for the design approach taken and shall submit such documentation to RTD in a timely manner (at a minimum, to be included with design documentation presented at Periodic Design Review Meetings), so that application of such variances and deviations may be considered by RTD for inclusion in revisions to the RTD Commuter Rail Design Criteria for application on other commuter rail projects that may be implemented by RTD. Any variances and deviations from the requirements of this Attachment 7 (including sections of the RTD Commuter Rail Design Criteria referenced within this Attachment 7) shall be subject to approval by RTD. [CDRL #7A-04]

(c) Where any requirement of this Attachment 7 conflicts with a referenced section of the RTD Commuter Rail Design Criteria, the Concessionaire shall notify RTD of such conflict, and RTD shall instruct the Concessionaire as to which requirement shall apply.

5.8 Concessionaire Design Basis

(a) The Concessionaire shall develop and submit to RTD a manual (the Design Basis Manual) that compiles a comprehensive set of design requirements of applicable Law, the Agreement and any other design criteria developed or adopted by the Concessionaire. The Design Basis Manual shall identify which standards, Laws, and Project Third Party design criteria apply to each design element and shall identify the revision status and date of issue of each such standard, Law, and design criteria. [CDRL #7A-05]
(b) Any subsequent changes or variances to the requirements contained within the Design Basis Manual shall be documented and submitted to RTD. [CDRL #7A-05]

(c) The Concessionaire shall ensure that the Design Basis Manual is controlled and distributed to Project Contractors and Subcontractors involved in the design, so that the requirements for design are clearly understood. Records of design verification produced during design QA/QC activities shall be cross-referenced to the applicable design requirement in the Design Basis Manual.

5.9 As-Built Documentation

(a) The Concessionaire shall obtain from the Project Contractors (or other responsible party(ies)) as-built versions of design documentation for all elements of the Eagle Project in a timely manner following the completion of each associated construction activity. Such as-built documentation shall be Record Documents, as defined in Attachment 9 (Project and Construction Management). For Project Third Party facilities and improvements, as-built documentation shall comply with the requirements of the appropriate Project Third Party.

(b) Prior to the Final Completion Date for each Major Project Component, the Concessionaire shall submit to RTD a complete listing of the as-built documentation for that Major Project Component maintained in accordance with Section 2.5 (Record Documentation and Record Drawings) of Attachment 9. [CDRL #7A-06]

5.10 System Support Documentation and Services

(a) During the Design/Build Period, the Concessionaire shall develop, or ensure that it receives from the Project Contractors and Subcontractors, all necessary system support documentation, items and services required for the start-up of revenue service and for activities during the Operating Period. System support items shall include:

   (i) training programs and training materials, covering both operations and maintenance of the system assets;

   (ii) manuals covering operations, preventative maintenance and repair processes;

   (iii) spare parts for consumable and replaceable components, subsystems and systems, as appropriate; and

   (iv) special tools and equipment necessary to perform maintenance of system assets.

(b) RTD reserves the right to review system support documentation and services at any time, and may require the Concessionaire to provide status reports on the progress of such items during the Design/Build Period.
6. **ELECTROMAGNETIC COMPATIBILITY**

6.1 Electromagnetic Compatibility Requirements

(a) The Concessionaire shall conduct a survey of pre-existing conditions with respect to presence of electromagnetic interference (EMI) and radio frequency interference (RFI) characteristics for the entire Eagle Project and shall prepare a report of findings and identification of potentially susceptible sites. The report shall describe the means of testing and measuring, and shall identify locations where sample readings were taken. [CDRL #7A-07]

(b) The Concessionaire shall ensure electromagnetic compatibility (EMC) with respect to EMI and RFI between all elements of the Work, and between the Commuter Rail Network and its environment. The Concessionaire shall achieve EMC in a systematic, documented, comprehensive, and verifiable manner. If EMI or RFI with the surrounding environment occurs, the Concessionaire shall take all necessary action and implement technology as appropriate to eliminate or reduce interference in accordance with the EMC Control Plan.

6.2 EMC Control Plan

(a) The Concessionaire shall submit to RTD a plan (the EMC Control Plan) that shall: [CDRL #7A-08]

(i) establish the generic EMI/RFI source media applicable to the Work;

(ii) identify standards for EMI/RFI that ensure EMC;

(iii) identify and establish the levels and spectra of EMI/RFI generated by project elements and by the external environment along the alignment;

(iv) establish the general EMI/RFI mitigation methods available and develop a strategy to:

   (A) mitigate EMI/RFI at sites that do not meet the standards set forth in the EMC Control Plan by shielding or other means;

   (B) locate and/or shield equipment, such that it is not subjected to emissions from EMI/RFI sources that impair the functioning of such equipment, and that such equipment does not produce EMI/RFI levels and/or spectra that impair the functioning of other surrounding equipment; and

   (C) include requirements for a study to be performed during the design process of EMI/RFI generated by equipment such as Rolling Stock and traction power systems; and assess the potential impacts of such interference on, and effectiveness of rejection techniques within, other equipment such as train control devices.

(b) The findings of the EMI/RFI study shall be submitted to RTD for review. [CDRL #7A-09]
6.3 EMC Test Program

The Concessionaire shall, prior to the Revenue Service Commencement Date for each of the Commuter Rail Services, perform a test program (the *EMC Test Program*), in accordance with applicable rail industry standards, to demonstrate and verify that:

(a) all elements of the Commuter Rail Projects are electromagnetically compatible with all elements of the Work, the Commuter Rail Network and its environment (see Section 6.1 above);

(b) safety and control systems of the Commuter Rail Network and RTD’s light rail network are not compromised by EMI/RFI in the vicinity of each transfer station;

(c) safety and control systems of the Commuter Rail Network and equipment on adjacent Railroad corridors are not compromised by EMI/RFI; and

(d) airport communication systems and FAA systems within the DIA facility are not compromised by EMI/RFI from the Commuter Rail Network. In testing EMI/RFI upon communication equipment, the Concessionaire shall perform this testing in accordance with the Radiated Emissions Test Plan (the *Radiated Emissions Test Plan*) set forth in the Inter-Governmental Agreement between RTD and DIA, unless an alternative test plan is agreed between DIA and the Concessionaire. The Concessionaire shall submit test results to RTD and DIA and, if such results determine that potential EMI exists, the Concessionaire shall mitigate such interference using the technology specified in the Radiated Emissions Test Plan.

All EMI/RFI test reports shall be submitted to RTD. [CDRL #7A-10]
7. **CORROSION CONTROL**

7.1 **Corrosion Control Requirements**

(a) The Concessionaire shall take appropriate measures to provide corrosion control measures protecting buried concrete and metallic structures, and metallic structures exposed to the atmosphere. The Concessionaire shall apply such corrosion control measures to all new facilities installed as part of the Commuter Rail Network, regardless of location, owner, or material of construction, when corrosion of such facilities could adversely affect safety and/or continuity of rail operations or functionality of the facility. The Concessionaire shall coordinate such Work with the owners of assets crossing or adjacent to the Site and Utilities.

(b) The Concessionaire shall develop corrosion control and cathodic protection requirements to be implemented as part of the Work and shall document these requirements in a plan (the *Corrosion Control Plan*). The Corrosion Control Plan shall include specific requirements for each engineering discipline. The Concessionaire shall reference these requirements when the Concessionaire defines the scope of Work for each Project Contractor and Subcontractor. [CDRL #7A-11]

(c) The Corrosion Control Plan shall address:

   (i) limits for chemical properties of non-native backfill around concrete and ferrous structures;
   
   (ii) cathodic protection of buried metallic pipes;
   
   (iii) appropriate cement mixtures for buried concrete piping;
   
   (iv) material selection and, as necessary, coating of buried conduits and ducts;
   
   (v) measures for the protection of concrete structures, modular retaining walls and pilings;
   
   (vi) product data for cathodic protection and corrosion control components;
   
   (vii) cathodic protection testing and verification during construction;
   
   (viii) coordination of corrosion control systems with all design disciplines and Utilities; and
   
   (ix) coordination of corrosion and stray current control systems with, and provision of associated documentation to the I-225 LRT Project team and the Central Corridor LRT Extension Project team.

7.2 **Corrosion Control Testing**

(a) The Concessionaire shall ensure that a NACE International certified Cathodic Protection Specialist designs cathodic protection and performs testing of cathodic protection in accordance with NACE Standard SP0169.
(b) The Concessionaire shall include a detailed written description of the proposed testing schedule and procedures in the verification program documentation set forth in Part D (Verification and Demonstration) of this Attachment 7. The proposed procedures shall include a list of instruments to be used for the electrical testing, detailing the manufacturer's name, model number, serial number and calibration certificate for each instrument. Each instrument listed shall have a current calibration (less than one year old). The Concessionaire shall ensure that any specialist performing electrical testing uses the instruments listed and that each instrument used is calibrated.

(c) The Concessionaire shall submit to RTD a copy of the test data sheet showing the proposed format for test data documentation. Test data and calculations shall be submitted to RTD in accordance with the requirements of Part D (Verification and Demonstration) of this Attachment 7.
8. HAZARDOUS MATERIALS

8.1 Hazardous Materials Management Process

(a) The Concessionaire shall manage both Identified Environmental Conditions and Unidentified Environmental Conditions in accordance with the Environmental Requirements, including the Voluntary Clean-Up Application and Materials Management Plans, and Section 12.2 (Environmental Conditions) of the Agreement.

(b) All Work shall be in compliance with the requirements of applicable Law with respect to Hazardous Materials, including as promulgated by or pursuant to:

   (i) U.S. Environmental Protection Agency;

   (ii) FTA;

   (iii) OSHA;

   (iv) CDPHE;

   (v) the National Emissions Standards for Hazardous Air Pollutants (40 CFR 763);

   (vi) the Asbestos Hazard Emergency Reduction Act (40 CFR 763);

   (vii) the Model Accreditation Program (40 CFR 763);

   (viii) the Comprehensive Environmental Response, Compensation and Liability Act; and

   (ix) the Resource Conservation and Recovery Act.

8.2 Environmental Site Assessments

RTD has conducted environmental site assessments (ESAs) as outlined in the Environmental Reports, in two phases:

   (i) Environmental Phase 1 – Evaluation; and

   (ii) Environmental Phase 2 – Investigation (where deemed required).

The Concessionaire shall coordinate all environmental matters related to the Eagle Project with CDPHE on behalf of RTD. The Concessionaire shall inform RTD prior to conducting such coordination activity with CDPHE or any other Relevant Authority.

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6 NOTE: See Reference Data Item No. 2E.9 and Reference Data Item No. 2G.5.
8.3 Remediation, Cleanup and Containment

(a) The Concessionaire shall manage hazardous materials that affect the construction and operations of the Eagle Project in accordance with the Applicable Requirements and the VCUP and MMP. The Concessionaire shall identify necessary procedures for hazardous materials handling, storage, characterization, transport and disposal, and shall submit these as a plan (the *Hazardous Materials Management Plan* or the *HMMP*) to RTD [CDRL #7A-12].

(b) The HMMP shall conform to the VCUP and MMP and shall:

(i) address non-contaminated soils, suspected contaminated soils, and confirmed contaminated soils for both inside and outside the right of way;

(ii) differentiate between soil allowed for on-site re-use and soil requiring off-site disposal;

(iii) differentiate between hydrocarbon contaminated soil and soils contaminated with hazardous waste or materials (characteristically ignitable, corrosive, reactive, and/or toxic as defined in 40 CFR Part 261 Subpart C or listed F-wastes, K-wastes, P-wastes, or U-wastes as defined in 40 CFR Part 261 Subpart D); and

(iv) identify necessary procedures for handling and removing contaminated groundwater.

(c) The Concessionaire shall submit to RTD a monthly report (the *Hazardous Materials Management Plan Report*) summarizing activities conducted to manage hazardous material. [CDRL #7A-13]

(d) The Concessionaire shall coordinate hazardous material remediation with Relevant Authorities. Where required, agency approval and permits shall be obtained prior to implementation of the planned remedial activities. Remediation or risk reduction activities shall cover contaminants of concern required to complete the Eagle Project in accordance with applicable Law. Prior to commencing any remediation work, the Concessionaire shall submit to RTD a plan describing the scope of work to be performed (a Remedial Plan). [CDRL #7A-14]. If hazardous waste is generated on RTD property, the FasTracks Environmental Project Manager will sign profiles and manifests relating to transport and disposal of such material, except with respect to hazardous waste that is the result of a release of Hazardous Materials introduced to the RTD property by the Concessionaire.

(e) The Concessionaire shall arrange and ensure proper transportation and disposal of any hazardous materials removed in accordance with this Section 8 at a licensed disposal facility, maintain records of manifests for transport and disposal, and reasonably protect adjoining property owners, contractors, and the public from damage or nuisance resulting from any remediation activities.

(f) Upon completion of remediation, cleanup, and/or containment activities at each designated parcel, the Concessionaire shall obtain and submit documentation from Relevant Authorities attesting to proper closure of the identified environmental concern(s) for the parcel in compliance with applicable Law. [CDRL #7A-15]
(g) Permits, manifests, documents and records developed, maintained, or obtained by the Concessionaire and its Project Contractors and Subcontractors as part of remediation, abatement, cleanup, risk reduction/management, and/or containment shall be Record Documents and provided to RTD in accordance with Section 2.5 (Record Documentation and Record Drawings) of Attachment 9. [CDRL #7A-16]

8.4 Asbestos Assessment and Abatement

(a) The Concessionaire shall conduct any asbestos assessments and abatement in accordance with applicable Law, including EPA, OSHA, CDPHE (5 CCR 1001-10, Part B, CDPHE Air Quality Control Division Regulation and 6 CCR 1007-2 Part 1, Section 5.5, Asbestos in Soils), and local requirements. The Concessionaire shall perform asbestos assessments of buildings and structures that will be disturbed or demolished.

(b) The Concessionaire shall submit to RTD a plan (the Asbestos Assessment Plan) describing its approach and procedures for conducting asbestos assessments. [CDRL #7A-17]

(c) Subsequent to conducting an asbestos assessment, the Concessionaire shall develop and submit to RTD a report (an Asbestos Assessment Report or AAR) for each assessment including a summary of findings, abatement requirements, and detailed design scope for any necessary asbestos abatement activities. [CDRL #7A-18]

(d) The Concessionaire shall carry out any asbestos abatement in accordance with the process defined in Section 36.3 (RTD Proposed Changes) of the Agreement. Once the asbestos abatement is completed, the Concessionaire shall prepare and submit a report (an Asbestos Abatement Completion Report) that demonstrates the abatement was performed in accordance with applicable Law, including air monitoring results, clearance tests, disposal manifests, and other documentation necessary to demonstrate compliance with applicable Law. [CDRL #7A-19]

8.5 Lead-Based Paint Assessment and Management

(a) The Concessionaire shall conduct any lead-based paint assessments and manage lead-based paint materials in accordance with applicable Law, including EPA, OSHA, CDPHE and local requirements. The Concessionaire shall perform lead-based paint assessments of buildings and structures that will be disturbed or demolished.

(b) The Concessionaire shall develop and submit a plan (the Lead-Based Paint Assessment Plan) describing its approach and procedures for conducting lead-based paint assessments. [CDRL #7A-20]

(c) Subsequent to conducting any lead-based paint assessment, the Concessionaire develop and shall submit a report (a Lead-Based Paint Assessment Report) to RTD including a summary of findings. [CDRL #7A-21]

(d) The Concessionaire shall carry out any lead-based paint abatement in accordance with the process defined in Section 36.3 (RTD Proposed Changes) of the Agreement. Once the lead-based paint abatement is completed, the Concessionaire shall develop and submit a further report (a Lead Based Paint Abatement Completion Report or
LBPACR) that demonstrates the abatement was performed in accordance with applicable Law. Such report shall include air monitoring results, clearance tests, disposal manifests, and other documentation necessary to demonstrate compliance with applicable Law. [CDRL #7A-22]

8.6 Hazardous and Contaminated Substance Health and Safety Plan

(a) The Concessionaire shall establish a health and safety plan (the Hazardous and Contaminated Substance Health and Safety Plan or HASP) in accordance with applicable Law, the Concessionaire's Construction Safety Program, 29 CFR 1910 and 1926 and subsequent additions and/or modifications, establishing health and safety requirements for all activities at the Sites associated with hazardous and contaminated substances, Recognized Environmental Conditions and Unrecognized Environmental Conditions. [CDRL #7A-23]

(b) The Concessionaire shall distribute the HASP to employees of the Concessionaire, the Project Contractors and Subcontractors at each Construction Site. Each such employee shall be required to sign an agreement to abide by the provisions of the HASP. The Concessionaire shall display or make available the HASP at each Construction Site at all times.

(c) Neither the Concessionaire nor any Project Contractor or Subcontractor shall commence any construction activities with the potential for disturbing hazardous or contaminated substances prior to RTD's receipt and review of the Concessionaire's HASP. Neither submission of the HASP nor any review of the HASP by RTD shall relieve the Concessionaire in any way from any of its obligations, liabilities and responsibilities under the Agreement, or shall impose upon RTD any obligation, liability or responsibility.

(d) The following qualifications are required of the person preparing the HASP:

   (i) completion of required OSHA training in accordance with 29 CFR 1910.120, including completion of 40-hour plus 8-hour supervisory training updated annually and completion of three days on-site training by a fully qualified instructor;

   (ii) currently certified in first aid and cardiopulmonary resuscitation (CPR) and must be a Certified Industrial Hygienist;

   (iii) an extensive working knowledge of Federal, state, and local occupational health and safety regulations; and

   (iv) an extensive working knowledge of the development of health and safety programs for personnel working in potentially hazardous or toxic environments.
9. **MISCELLANEOUS RESPONSIBILITIES**

9.1 **Reuse of Salvage Materials**

The Concessionaire may, to the extent not otherwise prohibited within the Agreement, include in its design and construction the reuse of materials salvaged from elements of the Work requiring demolition and removal of existing facilities. Where salvaged materials are not to be reused for the Project, the Concessionaire shall have the right to dispose of or sell such salvaged materials; provided however, that RTD is hereby granted a right of first refusal to purchase any such materials at no more than the available documented market value prior to the Concessionaire's disposal of such materials. RTD shall have 60 days from receipt of notice from the Concessionaire to exercise such right of first refusal.

9.2 **Pre-Construction Site Surveys**

The Concessionaire shall perform site surveys of third-party properties, including structures and appurtenances installed or present thereon, in the vicinity of the Sites prior to the commencement of construction at any location. The findings of each pre-construction survey shall be presented to RTD in a report format. [CDRL #7A-24]

9.3 **Noise and Vibration Analysis**

The Concessionaire shall carry out detailed noise analyses and detailed vibration analyses in accordance with the requirements of FTA's *Transit Noise and Vibration Impact Assessment Guidelines*. The results of each analysis shall be presented to RTD in a report format. [CDRL #7A-25]

(a) Analysis of NWES

The Concessionaire shall perform a detailed noise and vibration analysis for the segment of the NWES corridor from Pecos junction to 72nd Avenue, which shall determine any impacts to the surrounding areas.

Implementation of any vibration mitigation measures determined to be necessary for this segment of NWES is not included in the Work.

(b) Final Analysis of East Corridor and Gold Line

Following finalization to the track alignment design, the Concessionaire shall re-perform the detailed noise and vibration analyses for each of the East Corridor and the Gold Line (which for this purpose shall be defined as the entire corridor from DUS to Ward Road). Any necessary mitigation measures identified from this analysis that are more onerous or additional to those identified in the RODs shall be implemented by the Concessionaire.
Part B

INFRASTRUCTURE REQUIREMENTS

1. CLEARANCES AND ALIGNMENT

The Concessionaire is responsible for all elements and interdependencies of the designs related to the layout of the track alignment, structures, stations, equipment and facilities, and shall address necessary operational and safety factors in accordance with applicable Law and Good Industry Practices.

1.1 Clearances

The Concessionaire shall ensure that the Work provides adequate and appropriate clearance for the safe and efficient operation and maintenance of all elements of the Commuter Rail Network.

1.1.1. Minimum Standards for Clearances

As minimum criteria for commuter rail exclusive alignments, subject to calculation by the Concessionaire of more onerous site-specific requirements and to agreement by RTD of site-specific variances (including those in Section 1.1.2), alignments exclusively used by commuter rail shall comply with the requirements of applicable Law, the Agreement and the following standards:

(a) 4 CCR 723-7 – Rules Regulating Railroads, Rail Fixed Guideways, Transportation by Rail, and Rail Crossings, Sections 7320 through 7328;

(b) AREMA Manual for Railway Engineering Chapter 8 – Pier Protection;

(c) AREMA Manual for Railway Engineering Chapter 28 – Clearances;

(d) AREMA Manual for Railway Engineering Chapter 33.2.2 – Recommended Clearance Specification to Provide for Overhead Electrification;

(e) minimum vertical clearance of 23 feet from top of rail to any object;\(^7\)

(f) minimum horizontal clearance of 8 feet 6 inches from centerline of tangent track to non-structural objects;

(g) minimum horizontal clearance of 12 feet 6 inches from centerline of tangent track to structural objects (which shall include walls more than five feet above top of rail, bridge piers, abutments and buildings);

\(^7\) NOTE: See DTP-ATC-016 (Reduced Vertical Clearance Under I-70 Bridge) in Section E (Alternative Technical Concepts) of Volume 3 of the Technical Proposal contained in the Concessionaire's Proposal.
(h) minimum horizontal track centerline separation of 25 feet from Parallel Railroad Tracks;
(i) an increase of horizontal clearance for curved track Sections of at least 1" for each 30 minutes of curve and 5.1" for each 1" of applied superelevation;
(j) minimum horizontal clearance of 25 feet from centerline of track for bridge piers wherever reasonably practicable. Where 25 feet of horizontal clearance from centerline of track is not reasonably practicable, the Concessionaire shall erect crash wall pier protection; and
(k) provision of Corridor Protection Barriers in locations where the centerline of the commuter rail track, or the rear edge of the station platform, is less than 50 feet horizontally from the centerline of a UPRR Parallel Railroad Track, as further defined in Section 5.9 of this Part B.

1.1.2. Specific Clearance Requirements

(a) For tracks shared with or provided for the exclusive use of Class 1 Railroads, clearances shall, in addition to these criteria, conform to the requirements of the relevant Railroad Agreements. Where Railroad trains may occupy electrified tracks in the DUS throat, clearances shall conform to AAR Plate H.

(b) For tracks shared with Amtrak, clearances shall, in addition to these criteria, conform to current Amtrak standards, including MW1000. OCS wires for commuter rail crossovers of Amtrak tracks shall meet Amtrak clearance requirements.  

(c) Exceptions from the vertical and horizontal minimum clearance standards defined in Section 1.1.1 above that are shown in the 30% design plans shall be deemed to be approved by RTD and the Concessionaire is permitted to implement these exceptions Concessionaire to the extent that they are compatible with other elements of the Concessionaire's system design as if they were approved variances.

1.1.3. Clearance Calculation

(a) In determining clearances, the Concessionaire shall consider procedures and provisions necessary for:

(i) evacuation of Passengers from trains and stations in emergency situations with a minimum 6'6"(H) x 30"(W) walkway adjacent to each track, and

(ii) inspection and maintenance access to the alignment and structures.

(b) The Concessionaire shall, prior to its initial Periodic Design Review Meeting, prepare a report (the Clearance Criteria Report) for review at such meeting that details:

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8 NOTE. See Reference Data Item No. 2E.10.
9 NOTE. See Reference Data Items No. 1G and 1E.
(i) calculation of the Rolling Stock operating envelope, including Rolling Stock static dimensions and tolerances, dynamic movement and wear, excess due to curves and superelevation, and track maintenance tolerances;

(ii) application of either the calculated Rolling Stock operating envelope, or that defined in AMTRAK 1355 Rev E – Vehicle Static and Dynamic Clearance Limits, or a composite of the two, whichever is the larger;

(iii) definition of the structural clearance envelope, addressing tangent and curved track, inclusion of construction tolerances, running clearances, other safety factors and walkways;

(iv) specific clearance provisions (and any exceptions from the provisions) for passage and refuge of maintenance personnel;

(v) specific provisions for clearances within storage yards and Rolling Stock maintenance shops;

(vi) electrical clearances from traction electrification elements;

(vii) specific clearances to station platforms meeting ADA requirements, traction electrification elements, signaling elements, bridge girders, structures and other wayside items which may differ from the standard structural clearance;

(viii) compliance with the requirements (including any variances) stated in this Section 1.1; and

(ix) compliance with any Project Third Party requirements identified by the Concessionaire during coordination efforts.

(c) The Concessionaire shall reissue the Clearance Criteria Report as required during the Design/Build Period and shall submit to RTD a final version prior to each Revenue Service Commencement Date that includes clearance variances and as-built conditions. [CDRL #7B-01]

1.2 Alignment

(a) The alignment design shall meet the design parameters stated in Sections 4.2 (General Track Alignment) and 4.3 (Vertical Track Alignment) of the RTD Commuter Rail Design Criteria, except to the extent that variances and deviations are approved by RTD (as described in Section 5.7 (RTD Commuter Rail Design Criteria) of Part A). The Concessionaire shall implement greater than minimum design parameters wherever necessary.

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10 NOTE: See DTP-ATC-003 (Reduction in Minimum Track Center Distance to 14’ 6””) and DTP-ATC-012 (Minimum Curve Length Definition) in Section E (Alternative Technical Concepts) of Volume 3 of the Technical Proposal contained in the Concessionaire’s Proposal.
possible to provide for higher safety margins, improved passenger ride quality, higher operating speed and reduced maintenance burden.

(b) Permission for variances from the minimum 25 feet separation of track centerlines between the commuter rail track and adjacent freight tracks (in addition to those specifically identified in Section 1.1.2(a)) may be negotiated by the Concessionaire with the applicable Railroad. Any such agreement with a Railroad shall be documented and submitted to RTD and will be deemed to modify the applicable Railroad Agreement.

1.2.1. Steep Grade Hazard Analysis

Vertical grades that exceed 3% are classified as "steep." The Concessionaire shall perform a specific and individual safety and risk mitigation analysis for each such steep grade forming part of the alignment design, consistent with the Steep Grade Preliminary Hazard Analysis prepared by RTD. The Concessionaire shall document all steep grade analyses in one or more reports (each a Steep Grade Hazard Analysis Report), which shall analyze the alignment, train control system and Rolling Stock designs in sufficient detail as required by FRA, and subject to review and concurrence by FRA. Each steep grade analysis shall also be referenced to the Hazard Identification Analysis and Resolution Process as set forth in Section 8.3 (Hazard Management) of Attachment 9. [CDRL #7B-02]

1.2.2. Alignment Drawings

The Concessionaire shall provide horizontal and vertical alignment drawings for each Commuter Rail Project for review at Periodic Design Review Meetings and shall submit final versions of these drawings to RTD. [CDRL #7B-03]

11 NOTE: See Reference Data Item No. 5RR.
2. **TRACKWORK**

The Concessionaire shall design and construct the necessary trackwork for the operation of the Commuter Rail Network in accordance with this Section 2.

### 2.1 Trackwork Requirements

(a) Trackwork, including special trackwork, shall comply with 49 CFR 213 and the AREMA Manual and Portfolio of Trackwork Plans. Trackwork shall be provided such that the Concessionaire can maintain trackwork used for revenue service at FRA Class 4 standards (as defined in 49 CFR 213.9) or better and trackwork not used in revenue service to FRA Class 1 standards (as defined in 49 CFR 213.9) or better.

(b) Rails shall be continuously welded rail (CWR). Switch frogs may be bolted.

(c) Turnouts, both on the mainline and in the yard, shall be fitted with rail and switch heaters suitable for the climate in the Denver region, as further defined in Section 9.9.1(b) of this Part B.

(d) Transition zones shall be included where trackwork changes between ballasted and ballastless types to reduce the impacts of the different track modulus. Transition zones shall comply with the criteria defined in Section 6.8 (Bridges) of the RTD Commuter Rail Design Criteria.

(e) Emergency guard rail or an equivalent safety device shall be used on trackway at bridges and retained fills with a vertical drop of more than 3 feet, capable of retaining a derailing train initially moving at maximum authorized speed. Guard rail (or equivalent) shall extend over the length of the structure plus 50 feet at each end. Emergency guard rail shall not be installed within the limits of special trackwork.\(^{12}\)

(f) Trackwork in grade crossings shall conform to the requirements of applicable Law and applicable AASHTO and MUTCD standards.

### 2.2 Design Documentation for Trackwork

The Concessionaire shall prepare and review at Periodic Design Review Meetings documentation for the following trackwork design components:

(a) track material details including ballast, ties, rail fastening systems, and ballast mats;

(b) special trackwork;

(c) ballasted track details;

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(d) ballastless track details; and
(e) roadway and pedestrian at-grade crossings details.
3. **RAILROAD-RELATED WORK**

3.1 **Railroad Agreements**

(a) Work performed by the Concessionaire in accordance with any Railroad Agreement, or at locations where the commuter rail service shares right-of-way with Railroad tracks shall conform to AREMA standards and the design standards and construction procedures of the applicable Railroad, if more stringent than the requirements of this Attachment 7.

(b) In accordance with Section 22.1(d) of the Agreement, the Concessionaire shall take all steps and perform all acts necessary to implement each of RTD's obligations to any Railroad under any Railroad Agreement as part of the Work, other than those obligations identified in Attachment 22 (Railroad Agreements).

(c) If any Railroad requests the Concessionaire to fulfill an obligation required of RTD in any Railroad Agreement that the Concessionaire is not required to perform in accordance with this Section 3 or any other obligation of the Agreement, the Concessionaire shall notify RTD immediately and respond as instructed by RTD, such instructions to be given in accordance with the process defined in Section 36.3 (RTD Proposed Changes) of the Agreement.

(d) RTD is responsible for completing final design documentation and receiving UPRR approval of the design of facilities for the exclusive use of the Railroads to be constructed by the Concessionaire on the East Corridor. Design documentation for this Work is provided in Appendix 3 (Final Design Documents for Work on UPRR Property) to this Attachment 7, except that in the event of any inconsistency between the Utility plans in Appendix 3 and the Utility plans in Attachment 20 (Utilities), Attachment 20 shall have precedence for all purposes under the Agreement.

(e) The Concessionaire shall submit to RTD a copy of all correspondences between the Concessionaire and the Railroads.

3.2 **Work on Railroad Property**

(a) The Concessionaire shall obtain the necessary right of entry agreements from each Railroad prior to the start of any Work on Railroad Property.

(b) None of the Concessionaire, any Project Contractor or Subcontractor shall enter upon or perform any Work on any property owned, controlled, or leased by the Railroads in connection with the Eagle Project (Railroad Property), until certificates or policies of insurance, if required, in the amounts required by the Railroads in accordance with the Railroad Agreements, have been provided to the Railroads and the Railroads have accepted and approved them in writing. Any such insurance requirements shall be in addition to the requirements set forth in Attachment 12 (Insurance) and shall be procured and maintained by the Concessionaire at the Concessionaire's expense.

(c) The Concessionaire, the Project Contractors and Subcontractors of any tier performing Work on Railroad Property, shall comply with rules and regulations governing contractors working on Railroad Property prescribed by the Railroads, OSHA and FRA.
Such rules and regulations include safety procedures, protective equipment, and the proper manner of protecting tracks (and traffic moving thereon), telephone, telegraph, and signal wires and other property of the Railroads or their tenants at and in the vicinity of the Work during the time it is being performed.

3.3 Notification and Flagging

(a) The Concessionaire shall notify the relevant Railroad at least fifteen working days, or as otherwise stipulated in the applicable Railroad Agreement, in advance of commencing or discontinuing any Work which, in the sole opinion of the affected Railroad, requires Railroad flagging services.

(b) The Concessionaire shall utilize and pay for Railroad employee flaggers at any Site where Concessionaire activities are to be performed within 25 feet of the centerline of any active track or at Railroad track crossings, as well as at any location where Work being performed may affect or in any way endanger train operations or Railroad structures (in the sole opinion of the affected Railroad).

(c) During the Design/Build Period, Railroad flagging and protective services shall be performed by Railroad employees strictly in accordance with directives and instructions issued by the relevant Railroad. The Concessionaire shall coordinate with the relevant Railroad to obtain the required flaggers to complete the Work.

3.4 Phasing of Grade Crossing Work

If the Work involves both the relocation of Railroad tracks and crossing warning devices and the provision of new track crossings and warning devices for commuter rail, then to the extent permitted by the PUC the Concessionaire may proceed with all such elements in a single construction phase. If the Concessionaire implements this approach, then the single construction phase shall include relocation of the Railroad track, the crossing surfaces with rail placed for a small distance to each side of the crossing for the commuter rail, and crossing warning devices constructed in the final configuration.

3.5 Design and Construction Related to BNSF

In the event of any conflict, ambiguity or inconsistency between or among this Section 3.5 and the requirements of any Railroad Agreement with BNSF, the requirements of the applicable Railroad Agreement shall apply.

3.5.1 Design Related to Relocation of BNSF Track and Facilities

(a) With respect to BNSF tracks between DUS and Pecos Street, BNSF will perform final design of all elements of the BNSF relocation Work.

(b) With respect to BNSF tracks between Pecos Street and 72nd Avenue and to the Golden subdivision between Sheridan Boulevard and Ward Road, the Concessionaire shall

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NOTE: See Reference Data Item No. 4RR.
prepare design documentation and obtain approval from BNSF in accordance with Section 3.7 for Work elements necessary for the relocation of the existing BNSF facilities, with the exception of any design of signaling, which will be performed by BNSF.

(c) The format of design documentation for construction work that will be performed by BNSF shall be coordinated with BNSF.

3.5.2. General Construction Responsibility for BNSF Work

(a) The Concessionaire shall coordinate construction activities with the BNSF and permit reasonable access on or across the appropriate Site as may be requested.

(b) With respect to Work between DUS and Pecos Street, the Concessionaire shall construct any drainage Work that jointly serves the BNSF property and the Commuter Rail Network, and BNSF will perform all other Work associated with the BNSF relocation activities.

(c) With respect to BNSF tracks between Pecos Street and 72nd Avenue, the Concessionaire shall perform the construction up to and including the sub-ballast for all BNSF track relocation activities, including utilities; conduits; drainage; grading; sub-ballast; roadway Work; and structures. BNSF will construct ballast; ties; trackwork; signaling; and any grade crossing warning equipment on both sides of the corridor. Construction of any quiet zone elements shall be the Concessionaire's responsibility.

(d) With respect to the Golden Subdivision between Sheridan Boulevard to Ward Road, the Concessionaire shall perform the construction up to and including the sub-ballast for all BNSF track relocation activities, including utilities; conduits; drainage; grading; sub-ballast; roadway Work; structures; grade crossing presence detection and preemption devices for both commuter rail and freight tracks, and grade crossing warning equipment on both sides of the corridor, including any quiet zone elements. BNSF will construct ballast; ties; and trackwork.

(e) The Concessionaire shall procure all permits necessary to complete the BNSF relocation activities.

(f) Modifications to be provided by the Concessionaire prior to BNSF relocations include:

   (i) completion of the design and construction activities defined in this Section 3.4, all in accordance with the FasTracks BNSF relocation schedule provided in Attachment 22 (Railroad Agreements), unless agreed otherwise between the Concessionaire and the BNSF; and

   (ii) relocation of Utilities in accordance with Attachment 20 (Utilities).

(g) Specific scope details and construction approaches may be revised by the Concessionaire subject to approval by BNSF and RTD.
3.5.3. Responsibility for BNSF Work on Northwest Rail Electrified Segment

(a) **711 Building** – BNSF will vacate the building at 711 West 31st Avenue. The Concessionaire shall demolish only that part of the building required for the alignment and shall ensure the remainder of the building is retained in a usable condition, equivalent to the condition of the building at the time of delivery of Vacant Possession, and with a certificate of occupancy issued by CCD.

(b) **At-grade crossing for southern access to Rennick Yard and relocated southern entrance to the Intermodal Facility** – The Concessionaire shall design and construct a new southern entrance to the Intermodal Facility from 48th Street. This Work shall include grading, drainage, paving, and safety systems required by AREMA and/or FRA.

(c) **Jersey Cut-off Track (Denver Post Lead - MP 1.31 to 2.5)** – The Concessionaire shall perform the following Work:

(i) **Structures:**

   (A) Design and construct retaining walls BN 114 and BN 118
   (B) Demolish and remove existing 43rd Avenue pedestrian bridge

(ii) **Drainage Improvements:**

<table>
<thead>
<tr>
<th>Approx. Station</th>
<th>Existing Structure</th>
<th>Required Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jersey Cutoff relocation 28+00</td>
<td>None</td>
<td>Install new 24” culvert</td>
</tr>
</tbody>
</table>

(iii) Relocation of the Jersey Cut-off track must be completed before any construction of the commuter rail grade-separation.

(d) **Replacement facilities for trailer on freight car (TOFC) storage** – The Concessionaire shall design and construct a temporary storage area for the BNSF TOFC trailer parking impacted during the construction of the Utah Junction bridge structure. Following construction, the Concessionaire shall restore the permanent storage area within the BNSF TOFC trailer parking to its maximum possible capacity and include permanent trailer parking under the Utah Junction bridge structure. These temporary and permanent parking areas shall provide a functionally equivalent facility to those that currently exist at the TOFC yard.

(e) **Industrial Spur on Fox Street (MP 3.4)** – the Concessionaire shall remove this track.

(f) **BNSF Wheel Track (MP 2.4 to 2.63)** – BNSF will construct a new wheel track (also known as the repair in place (or RIP) track) on the east side of its property between 48th and 53rd streets, parallel with the CRMF and the BNSF trailer on freight car (TOFC) yard. The wheel track may straddle the property line if necessary for alignment and track separation reasons. The 25-feet separation between the wheel track and the closest commuter rail track shall be accessible for operational use by both BNSF and the Concessionaire. To enable this work by BNSF, the Concessionaire shall perform the following Work:
(i) Structures – demolish and remove existing structures in conflict with new alignment.

(ii) Remove the decommissioned wheel track.

(iii) Drainage Improvements

<table>
<thead>
<tr>
<th>Approx. Station</th>
<th>Existing Structure</th>
<th>Required Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNSF Wheel Track relocation 23+55 to 8+00</td>
<td>None</td>
<td>Install new drainage channel east of wheel track</td>
</tr>
<tr>
<td>BNSF Wheel Track relocation 23+00</td>
<td>Storm Sewer</td>
<td>Remove existing and replace with 24&quot; reinforced concrete pipe (RCP) at station 22+00 with inlet east of wheel track</td>
</tr>
<tr>
<td>BNSF Wheel Track relocation 14+50</td>
<td>None</td>
<td>Install inlet east of wheel track and 30&quot; RCP</td>
</tr>
<tr>
<td>BNSF Wheel Track relocation 12+00</td>
<td>None</td>
<td>Install inlet east of wheel track and 30&quot; RCP</td>
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<tr>
<td>BNSF Wheel Track relocation 5+50</td>
<td>None</td>
<td>Install 3-12'x4' concrete box culverts (CBC)</td>
</tr>
</tbody>
</table>

(g) BNSF Fuel Unloading Facility – BNSF will relocate the fuel unloading facility. The Concessionaire shall design and construct a new grade crossing for access to the fuel unloading facility, including grading, drainage, paving, and safety systems required by AREMA and/or FRA, as applicable.

(h) BNSF Mainline Utah Junction to Pecos (MP 3.41 to 4) – The Concessionaire shall perform the following Work with respect to drainage improvements:

<table>
<thead>
<tr>
<th>Approx. Station</th>
<th>Existing Structure</th>
<th>Required Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utah Junction relocation 28+00</td>
<td>None</td>
<td>Install new 36” culvert</td>
</tr>
<tr>
<td>Utah Junction relocation 28+00 to 40+00</td>
<td>None</td>
<td>Install new drainage channel north of BNSF tracks</td>
</tr>
<tr>
<td>Utah Junction relocation 34+00</td>
<td>36”x30” catch basin (CB)</td>
<td>Remove existing 36”x30” CB</td>
</tr>
<tr>
<td>Utah Junction relocation 35+00</td>
<td>36” smooth steel pipe (SSP) siphon</td>
<td>Remove existing 4’x3’ CB, extend 36” SSP, relocate cleanout 30’ downstream, relocate irrigation inlet structure</td>
</tr>
<tr>
<td>Utah Junction relocation 40+00</td>
<td>None</td>
<td>Install 3-60” RCP Culverts 180’ long</td>
</tr>
</tbody>
</table>

(i) Pecos to South Westminster Segment – The Concessionaire shall perform the following Work:

(i) Structures
(A) Design and construct underpass pedestrian tunnel at South Westminster station

(B) Remove existing slope paving along north abutment under Federal Boulevard bridge. Design and construct new retaining wall against the north abutment of the bridge and crash walls at north abutment and piers.

(ii) Drainage Improvements

<table>
<thead>
<tr>
<th>Milepost</th>
<th>Existing Structure</th>
<th>Required Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.13</td>
<td>36” corrugated metal pipe (CMP)</td>
<td>Extend existing 36” CMP 41’ and install new 36” RCP 114’ long</td>
</tr>
<tr>
<td>4.18</td>
<td>12” CMP</td>
<td>Extend existing 12” CMP 60’</td>
</tr>
<tr>
<td>4.91</td>
<td>5-12’x10’ reinforced concrete box (RCB)</td>
<td>Widen (as necessary)</td>
</tr>
<tr>
<td>5.11</td>
<td>36” RCP/48” CMP</td>
<td>Plug and fill existing 36” RCP/48” CMP and replace with 60” RCP 84’ long</td>
</tr>
<tr>
<td>5.39</td>
<td>48” CIP</td>
<td>Extend existing 48” CIP 29’ and install new 30” RCP 114’ long</td>
</tr>
<tr>
<td>Federal Bridge</td>
<td>None</td>
<td>Construct new flood wall to protect tracks under existing bridge</td>
</tr>
<tr>
<td>5.49</td>
<td>48” CMP</td>
<td>Plug and fill existing 48” CMP and install 2-48” RCP 88’ long</td>
</tr>
<tr>
<td>5.68</td>
<td>5’x3’ RCB siphon</td>
<td>Plug and fill existing 5’x3’ RCB and install 3-36” RCP 82’ long</td>
</tr>
<tr>
<td>5.83</td>
<td>36” RCP</td>
<td>Plug and fill existing 36” RCP and install 2-12’x7’ RCB 101’ long</td>
</tr>
<tr>
<td>6.06</td>
<td>42” RCP</td>
<td>Protect in place</td>
</tr>
</tbody>
</table>

(iii) Earthwork – build embankment up through sub-ballast for BNSF track, as required for realignment.

(iv) Civil Roadway – design and construct new grade-separated crossing of the rail corridor at 64th Avenue.

3.5.4. Responsibility for BNSF Work by Gold Line Track Segment

(a) **W. Sheridan Boulevard to Ralston Road (MP 6.15 to MP 6.65)** – The Concessionaire shall perform the following Work:

(i) Structures – design and construct ballast wall south of BNSF mainline track from MP 6.4 to MP 6.5, approximately 2.2-ft high (average) and 680-ft long.

(ii) Drainage Improvements

<table>
<thead>
<tr>
<th>Golden Subdivision Mile Post</th>
<th>Existing Structure</th>
<th>Required Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 6.38</td>
<td>12”x24” Wood Box (WB) and 18” CMP</td>
<td>Remove existing and replace with 24” RCP</td>
</tr>
<tr>
<td>MP 6.41</td>
<td>60” Storm Sewer</td>
<td>Remove existing and replace with 60”</td>
</tr>
</tbody>
</table>
(iii)  Earthwork – build embankment up through sub-ballast from MP 6.23 to MP 6.65
(Ralston Creek bridge) for track relocation.

(b)  **Vance Street to Miller Street (MP 7.57 to MP 9.53)** – The Concessionaire shall perform the following Work:

(i)  Structures – design and construct new Kipling Street bridge for BNSF mainline track.

(ii) Drainage Improvements

<table>
<thead>
<tr>
<th>Golden Subdivision Mile Post</th>
<th>Existing Structure</th>
<th>Required Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 7.92</td>
<td>12”x24” WB</td>
<td>Remove existing 24”x24” WB</td>
</tr>
<tr>
<td>MP 7.98</td>
<td>18”x12” WB</td>
<td>Remove existing 18”x12” WB and replace with 24” RCP storm sewer</td>
</tr>
<tr>
<td>MP 8.02</td>
<td>30” CMP Irrigation Pipe</td>
<td>Remove existing 30” CMP and irrigation pipe</td>
</tr>
<tr>
<td>MP 8.03</td>
<td>None</td>
<td>Relocate and encase Wadsworth Ditch (Piped)</td>
</tr>
<tr>
<td>MP 8.25</td>
<td>15” CMP Irrigation Pipe</td>
<td>24”x12” WB</td>
</tr>
<tr>
<td>MP 8.50</td>
<td>48” RCP</td>
<td>Install 48” RCP storm sewer connect</td>
</tr>
<tr>
<td>MP 8.77</td>
<td>Storm sewer</td>
<td>Remove existing storm sewer and replace with 24” storm sewer and install inlet</td>
</tr>
<tr>
<td>MP 8.73</td>
<td>None</td>
<td>Encase Swadley Ditch</td>
</tr>
<tr>
<td>MP 9.17</td>
<td>12”x12” WB</td>
<td>Remove 12”x12” WB</td>
</tr>
<tr>
<td>MP 9.28</td>
<td>Storm pipe</td>
<td>Remove existing storm pipe</td>
</tr>
<tr>
<td>MP 9.36</td>
<td>None</td>
<td>Install 12” storm pipe</td>
</tr>
</tbody>
</table>

(iii)  Shoefly – construct commuter rail track for use as a BNSF shoefly.

(iv)  Earthwork – build embankment up through sub-ballast from MP 7.6 (W. Vance Street) to MP 9.5 (W. Miller Street) for track relocation.

(v)  Civil Roadway – design and construct new road crossings at:

(A)  Old Wadsworth Blvd. (MP 7.71)
(B)  Alison Street (MP 7.94)
(C)  Balsam Street (MP 8.10)
(D)  Carr Street (MP 8.24)
(E)  Garrison Street (MP 8.76)
(F) Independence Street (MP 9.02)

(c) W. Miller Street to Ward Road (MP 9.53 to MP 10.83) – The Concessionaire shall perform the following Work:

(i) Drainage Improvements

<table>
<thead>
<tr>
<th>BNSF Golden Subdivision Mile Post No.</th>
<th>Existing Structure</th>
<th>Required Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 9.69</td>
<td>12”x12” WB</td>
<td>Remove existing 12”x12” WB</td>
</tr>
<tr>
<td>MP 9.80</td>
<td>12”x12” WB</td>
<td>Remove existing 12”x12” WB</td>
</tr>
<tr>
<td>MP 9.91</td>
<td>None</td>
<td>Install 2-24” RCP culverts</td>
</tr>
<tr>
<td>MP 10.04</td>
<td>18” CMP</td>
<td>Remove existing 18” CMP and install 3-30” RCP culverts</td>
</tr>
<tr>
<td>MP 10.06</td>
<td>12”x12” WB</td>
<td>Remove existing 12”x12” WB</td>
</tr>
<tr>
<td>MP 10.08</td>
<td>None</td>
<td>Install 36” RCP siphon</td>
</tr>
<tr>
<td>MP 10.38</td>
<td>20”x20” WB</td>
<td>Remove existing 20”x20” WB and install 24” RCP culvert</td>
</tr>
<tr>
<td>MP 10.44</td>
<td>Manhole</td>
<td>Relocate existing manhole approximately 20-ft. to the southeast and install 12”x4’ CBC</td>
</tr>
<tr>
<td>MP 10.61</td>
<td>None</td>
<td>Install 42” RCP culvert</td>
</tr>
<tr>
<td>MP 10.65</td>
<td>None</td>
<td>Install 30” RCP culvert</td>
</tr>
<tr>
<td>MP 10.66</td>
<td>20”x20” WB</td>
<td>Remove existing 20”x20” WB</td>
</tr>
<tr>
<td>MP 10.73</td>
<td>None</td>
<td>Install 24” RCP culvert</td>
</tr>
<tr>
<td>MP 10.77</td>
<td>None</td>
<td>Install 30” RCP culvert</td>
</tr>
<tr>
<td>MP 10.82</td>
<td>24” CMP</td>
<td>Remove existing 24” CMP and install 3-24” RCP culverts</td>
</tr>
</tbody>
</table>

(ii) Shoefly – construct commuter rail track for use as a BNSF shoefly.

(iii) Earthwork – build embankment up through sub-ballast from MP 9.53 (W. Miller Street) to MP 10.81 (Ward Road) for track relocation.

(iv) Civil Roadway – design and construct new road crossings at:

(A) Parfet Street (MP 9.90)
(B) RWBB Street (MP 10.23)
(C) Tabor Street (MP 10.44)

(d) Kipling Street Overpass (BNSF Track)(MP 9.26) – The Concessionaire shall design and construct a new bridge to the south of the existing Kipling Street bridge for BNSF mainline track use. BNSF will vacate the existing bridge for RTD/Concessionaire use. BNSF will leave the existing trackwork on the existing bridge. New bridge construction must be completed prior to the associated track relocation. In connection therewith, the Concessionaire shall:

(i) design Kipling Street bridge for the BNSF mainline track in accordance with BNSF/UPRR Guidelines for Railroad Grade Separation Projects; and
(ii) construct substructure elements, including:

(A) Foundations;
(B) Piers;
(C) Abutments;
(D) Construct superstructure elements;
(E) Girders; and
(F) Deck.

3.5.5. Division of Grade Crossing Work related to BNSF

(a) On the Golden Subdivision:

(i) The Concessionaire shall supply and install track circuits and any other preemption devices for both commuter rail and freight tracks and cable these to the crossing house;

(ii) BNSF will participate in testing; and

(iii) the Concessionaire shall perform all other design, supply, construction and testing activities related to the grade crossings.

(b) On the Pecos Street station to South Westminster station section:

(i) the Concessionaire shall supply and install its track circuits and cable these to a pull box between the two sets of tracks;

(ii) the Concessionaire shall provide any quiet zone elements and roadway Work;

(iii) the Concessionaire shall participate in testing; and

(iv) BNSF will perform all other design, supply, construction and testing activities related to the grade crossings.

3.6 Construction Related to UPRR

In the event of any conflict, ambiguity or inconsistency between or among this Section 3.6 and the requirements of any Railroad Agreement with the UPRR, the requirements of the applicable Railroad Agreement shall apply.

3.6.1. General Construction Responsibilities for UPRR Work

(a) The Concessionaire shall coordinate construction activities with the UPRR and permit reasonable access on or across the appropriate Site as may be requested.

(b) The Concessionaire shall perform the construction from the sub-ballast level down for all UPRR track relocation activities, including utilities; conduits; drainage; grading; sub-ballast; roadway Work; any quiet zone elements; and structures.
(c) UPRR will construct from the ballast level up for all UPRR track relocation activities, including ballast, ties, rail, signals (including wayside and bungalows) and grade crossings (inclusive of tracks panels, cross bucks, gates, flashers, and advanced notification for preemption).

(d) Grade crossing warning devices located on the Commuter Rail Network side of UPRR grade crossings that are decommissioned as the Commuter Rail Network is constructed may be salvaged and reused by the Concessionaire.

(e) Railroad track elements demolished by the Concessionaire become the Concessionaire's responsibility to dispose of or reuse.

3.6.2. Construction Responsibilities for UPRR Work by Gold Line Track Segment

(a) Moffat Flyover to I-76

(i) UPRR will allow Concessionaire to place structural supports on UPRR property on the inside of the UPRR curve, outside the clearance envelope.

(ii) The Concessionaire shall construct the Corridor Protection Barrier as necessary, and in accordance with Section 5.9 of this Part B.

(iii) No UPRR track shall be relocated by the Concessionaire in this segment.

3.6.3. Construction Responsibilities for UPRR Work by East Corridor Track Segment

(a) Adjacent to DUS Throat

(i) The Concessionaire shall perform civil work; and

(ii) UPRR will perform new track construction to tie DUS into corridors.

(b) Henry Meyer Track

(i) The Concessionaire shall perform civil work; and

(ii) UPRR will remove existing turnout and lay proposed track.

(c) Tracks 701 & 718 (near 38th St. underpass)

(i) UPRR will remove existing turnouts and straight rail track; and

(ii) The Concessionaire shall remove all track beyond turnout once the turnout is removed.

(d) UPRR TOFC Yard

(i) UPRR will remove existing turnout and straight rail track;
(ii) The Concessionaire shall remove all track beyond turnout once the turnout is removed;

(iii) UPRR Gate at Williams Street. The Concessionaire shall not build track or grade until UPRR has moved the bungalow to its permanent location near York Street;

(iv) UPRR is responsible for all facilities west of the new curb-cut at York Street; and

(v) The Concessionaire shall perform construction of new roadway improvements adjacent to the TOFC yard.

(e) Relocated Mainline – York Street to Colorado Boulevard

(i) The Concessionaire shall perform civil and structural work including construction of the Market Lead bridge; and

(ii) UPRR will perform new track construction.

(f) 2nd Mainline – Colorado Boulevard to Dahlia Street

(i) This Work is not a prerequisite for Concessionaire access to the commuter rail right of way;

(ii) The Concessionaire shall perform civil work; and

(iii) UPRR will perform new track construction and modification at Dahlia Street.

(g) 2nd Mainline – Dahlia Street to Kearney Street

(i) This Work is not a prerequisite for Concessionaire access to the commuter rail right of way.

(ii) 2nd mainline

(A) The Concessionaire shall perform civil work; and

(B) UPRR will perform new track construction;

(iii) Industrial leads (3) to the north of the mainline east of Dahlia Street

(A) The Concessionaire shall perform civil work; and

(B) UPRR will perform new track construction.

(iv) Industrial lead to the south of the mainline east of Dahlia Street & Holly Street

(A) UPRR will remove existing turnouts and straight rail track; and

(B) The Concessionaire shall remove all remaining industrial lead track beyond turnout.
(v) UPRR will remove/relocate KIK industrial lead track.

(vi) UPRR will build the new crossover west of Holly Street.

(h) 2nd Mainline – Kearney Street to Havana Street

(i) 2nd mainline

(A) The Concessionaire shall perform civil work; and

(B) UPRR will perform new track construction.

(ii) New Brunskill yard must be built before removal of Monaco yard can begin.

(A) Brunskill yard construction is not constrained by other relocation activities.

(B) The Concessionaire shall perform civil work; and

(C) UPRR will perform new track construction including turnouts from mainline.

(iii) Sand Creek bridge: The Concessionaire shall perform civil and structural work.

(iv) Salt track and team track

(A) UPRR will remove existing turnouts;

(B) Concessionaire shall remove all other track and perform civil work; and

(C) UPRR will perform new track construction.

(D) This construction is not constrained by other relocation activities

(i) Havana Street to Sable Boulevard siding

(i) UPRR will remove south industrial lead turnouts; and

(ii) The Concessionaire shall remove remaining industrial lead tracks after the turnouts have been removed.

(j) Sable Boulevard Siding

(i) The Concessionaire shall build dirt service road for UPRR use; and

(ii) UPRR will perform relocation of track.
3.6.4. Division of Grade Crossing Work related to UPRR

(a) On the UPRR side of the crossing:

(i) the UPRR will supply and install its crossing house, control equipment, gates, flashers and crossbucks;

(ii) the UPRR will provide an interface control signal wire to a pull box between the two sets of tracks;

(iii) the UPRR will perform testing once its track is relocated; and

(iv) the Concessionaire shall perform associated roadway modifications.

(b) On the commuter rail side of the crossing:

(i) the Concessionaire will supply and install the crossing house, control equipment, gates, flashers and crossbucks;

(ii) the Concessionaire will provide interface control signal to the pull box (which it shall provide); and

(iii) both the Concessionaire and UPRR shall jointly participate in testing of the completed crossing and control interface.

3.7 Submittal Review and Approval by Railroads

(a) The Concessionaire shall provide to the applicable Railroad for review (with a copy submitted concurrently to RTD) Concessionaire Design Submittals related to the following items at design levels of: 50% (if different from either RTD’s 30% designs or the Concessionaire’s designs as included in Attachment 19 (Concessionaire’s Proposal)); 65%; 95%; and 100% design level:

(i) design of Work elements associated with BNSF relocations for which the Concessionaire is responsible, including alignment, grading and drainage, structures and retaining walls, in accordance with Section 3 of the BNSF/UPRR Guidelines for Railroad Grade Separation Projects;

(ii) grade crossing roadway and warning equipment systems for crossings shared with the Railroad;

(iii) commuter rail structures within 50 feet of the near rail of freight tracks;

(iv) commuter rail structures crossing Railroad property;

(v) Utility relocations on or above Railroad property; and

(vi) drainage for commuter rail alignment segments and station Sites adjacent to Railroad property.
(b) The Concessionaire is responsible for the preparation of and submittal to UPRR (with a copy submitted concurrently to RTD) the necessary construction documentation for the Work defined in Appendix 3 (Final Design Documents for Work on UPRR Property) of this Attachment 7.

(c) The Railroads review and approval process is provided in the relevant Railroad Agreements.
4. CIVIL WORKS

The Concessionaire shall design and perform demolitions, site preparation and civil construction necessary to implement the Commuter Rail Network in accordance with the requirements set out in this Section 4.

4.1 Survey and Monumentation

(a) The Concessionaire shall perform and ensure that each Project Contractor and any Subcontractor performs Final Design and construction using engineering survey control in accordance with Section 3.2 of the RTD Commuter Rail Design Criteria.

(b) The Concessionaire shall perform and ensure that each Project Contractor and any Subcontractor performs right of way survey control for the completion of the Work in accordance with the CDOT Survey Manual and the Right of Way Manual 2 (Plans and Descriptions) and in accordance with the requirements of Relevant Authorities and under the supervision of a professional land surveyor licensed in Colorado.

(c) The Concessionaire shall comply with and ensure that, in performing any Work, each Project Contractor and any Subcontractor complies with CRS 38-53 (Perpetuation of Land Survey Monuments). If any survey monumentation is at risk of being destroyed, the Concessionaire shall:

(i) cease construction activity around the monument;

(ii) fence and flag the location;

(iii) contact the Relevant Authority and consult with the Relevant Authority on an alternative monument; and

(iv) act in accordance with the directions of the Relevant Authority.

(d) The Concessionaire shall establish and ensure that each Project Contractor and any Subcontractor establish monumentation necessary to define the right of way as set forth in Attachment 2 (Description of Sites and Schedules of Site Availability) and any additional right of way acquired in accordance with Section 11.4 (Additional Land) of the Agreement. Permanent monumentation will be established by RTD following completion of Work at each Site.

(e) The Concessionaire shall update and maintain the following documentation as Record Documents in accordance with Section 2.5 (Record Documentation and Record Drawings) of Attachment 9 and make the documents available to RTD upon request for progress and compliance review: [CDRL #7B-04]

(i) a control survey diagram, including any permanent control established in support of construction;

(ii) an ownership map and tabulation sheet, including adjustments for temporary construction easements and approved additional right of way;
(iii) right of way plan sheets, showing adjustments to the design that change the property acquisitions and easements needs from those set forth in Attachment 2 (Description of Sites and Schedules of Site Availability); and

(iv) a monumentation summary, describing the monuments placed by the Concessionaire, Design/Build Contractor or any Subcontractor during the Work and any coordination with any Relevant Authority regarding destroyed and rehabilitated monumentation.

4.2 Roadways

(a) If the Concessionaire, the Design/Build Contractor or any Subcontractor, repairs or replaces existing pavement, the Concessionaire shall ensure that the repaired or replaced pavement provides service equivalent to the existing facilities at a minimum. The Concessionaire shall lay new pavement in public streets in accordance with:

(i) the specifications and practices of the local jurisdictions; or

(ii) if the local jurisdiction does not have its own applicable codes or standards, then the applicable standards of the Metropolitan Government Pavement Engineering Council.

(b) The Concessionaire shall lay pavement on RTD facilities in accordance with the standards and specifications provided in RTD's Bus Transit Facility Design Manual.  

(c) The Concessionaire shall design roadways and perform roadway elements of the Work in accordance with the requirements of applicable Law and the Agreement, including the requirements of the Environmental Permits and the Inter-Governmental Agreements.

4.3 Grading

The Concessionaire shall design and implement grading in accordance with Good Industry Practice and the Environmental Permits.

4.4 Drainage

4.4.1. General Drainage Requirements

(a) The Concessionaire shall provide drainage for the Commuter Rail Network and adjacent properties by providing drainage facilities and/or by participating in a regional drainage system.

(b) The Concessionaire shall design drainage facilities, including with respect to the hydrologic and hydraulic design of facilities, in accordance with applicable Law and the following standards:

14 NOTE: See Reference Data Item No. 1GCP.
(i) for facilities placed within RTD-owned right of way shall conform to the standard provided in the AREMA Manual for Railway Engineering. Storm sewer construction shall conform to Volume 1, Chapter 1, Parts 4 and 5 and Volume 2, Chapter 8, Parts 10, 14 and 15 of the AREMA Manual for Railway Engineering;

(ii) for facilities placed within right of way that is owned by an entity other than RTD shall conform to the standards of that entity;

(iii) for work located within or adjacent to any CDOT right of way, the CDOT Drainage Design Manual shall be followed; and

(iv) for facilities within jurisdictions that do not have applicable criteria or standards, the Urban Drainage and Flood Control District's Urban Drainage Criteria Manual (UDFCD UDCM) Volumes 1, 2, and 3, and the CDOT Drainage Design Manual.

(c) If existing drainage patterns and facilities are changed due to the Commuter Rail Network, the Concessionaire shall design and construct a solution that does not adversely impact property owners outside the Commuter Rail Network right of way.

(d) The Work shall include design and construction of a complete storm drainage system to intercept and remove surface runoff from the Eagle Project Sites, and maintain surface and channel flow through the commuter rail right of way.\(^{15}\)

(e) The drainage facilities provided shall protect public safety, protect the commuter rail infrastructure, and prevent flooding of adjacent public and private property above that currently experienced, in accordance with locally and regionally accepted engineering standards and practices, as modified by this Section.

4.4.2. Permits

Unless otherwise indicated, the Concessionaire shall obtain all permits necessary for construction and operation of the drainage facilities, including those identified herein.

4.4.2.1 NPDES Stormwater Discharge Permit

The Concessionaire shall obtain a National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit from CDPHE and the local jurisdiction for construction of the Work. The Concessionaire's construction documents shall include a Stormwater Management Plan detailing measures best management practices (BMPs) to control erosion and sedimentation; and the discharge of any pollutants that may enter stormwater and be transported to receiving waters. Any new stormwater system in the Work shall meet or exceed goals for discharge of runoff constituents (where these goals have been established) through the use of nonstructural and structural BMPs.

\(^{15}\) NOTE: See Reference Data Items No. 2E.5 and 2G.4.
4.4.2.2 Groundwater Discharge Permit

Any dewatering of groundwater during construction shall be permitted by the Concessionaire in accordance with Water Quality Control Division (WQCD), Colorado Discharge Permit System Application for Construction Wastewater Discharge, obtained from the CDPHE, and equivalent Permits from Relevant Authorities. Any permanent groundwater diversion shall be permitted, in accordance with a permit obtained from CDPHE. Any permanent groundwater diversion shall be permitted in accordance with WQCD, Colorado Discharge Permit System Application. The water quality standard that governs this discharge is that of the receiving water as evaluated by the WQCD. The Concessionaire shall provide all information needed to assist WQCD in their evaluation and setting of a water quality standard for this permit.

4.4.2.3 Section 404 Permit

The Concessionaire shall obtain at its own cost any 404 Permit or any 404 Permit amendments if the Final Design increases the amount of jurisdictional wetlands impacted beyond the amount of impacts to jurisdictional wetlands on which the 404 Permits that are RTD Permits are based.

4.4.2.4 Floodplain Use Permit

The location of floodplain areas shall be delineated from the most current Flood Insurance Rate Maps (FIRM) published by FEMA. The Concessionaire shall obtain a Permit for use of the floodplain from each Relevant Authority for any construction within areas delineated as Zone A, AE, AH, AO, or A99 on the Flood Insurance Rate Maps published by FEMA.

4.4.2.5 Sewer Use and Drainage Permits

Sewer use and drainage Permits shall be obtained by the Concessionaire for connections, including temporary connections, into sanitary sewer and storm sewer systems that are owned by the City of Denver, Wastewater Management Division, or that discharge into storm or sanitary sewer systems owned by the City of Denver, Wastewater Management Division. Sewer use and drainage Permits shall also be obtained from Relevant Authorities by the Concessionaire for:

(a) cutoffs of services lines;
(b) abandonment of sewers (sanitary or storm);
(c) minor modification (manholes and inlets only); and
(d) new or relocated service connections.

4.4.2.6 Municipal Separate Storm Sewer (MS4) Permit

(a) The Concessionaire shall perform any Work in accordance with the terms and conditions and, where appropriate, by implementing the requirements, of each Relevant Authority's MS4 Permit relating to any Site and prepare any required documentation therefore.

(b) Once the Work has been completed, the commuter rail alignments and any surface parking areas greater than 1000 spaces will be added to RTD's MS4 permit by CDPHE, which will apply during the Operating Period.
4.4.3. Drainage Design Approach

(a) The Concessionaire shall design drainage facilities in accordance with the requirements of applicable Law and, to the extent practicable, Section 3.5 (Drainage) of the RTD Commuter Rail Design Criteria, except where deviations from these criteria shown in Reference Data are considered approved by RTD in accordance with Section 5.7 (RTD Commuter Rail Design Criteria) of Part A. Any other variances shall be considered by RTD only if meeting the requirements of the drainage criteria is determined by RTD to be impractical within natural, social or economic constraints. The Concessionaire shall identify, explain, and justify any variance, discrepancy or unusual solution to assist RTD in this determination.

(b) In protecting the commuter rail trackway and facilities from storm runoff damage for storm events up to the 100-year frequency storm, the Concessionaire shall ensure that there is no adverse impact to either upstream or downstream properties from storm runoff either passing through or caused by commuter rail construction.

4.4.4. Hydrologic and Hydraulic Criteria

The Concessionaire shall design the Commuter Rail Projects and appurtenant facilities for both 100-year frequency storms and 5-year frequency storms, in accordance with the following criteria applied to the extent feasible, it being understood that the design of the applicable facilities in accordance with the design contemplated by the Reference Data (including the Master Drainage Plan provided as a Reference Document) will be deemed to satisfy the obligations of this Section 4.4.4, even if such design does not satisfy all of the criteria described in clauses (a) to (c) below:

(a) Commuter rail drainage facilities shall be designed to protect the commuter rail system during the 100-year storm. Storm sewer systems shall be designed to protect the commuter rail trackway and stations from flooding at all times.

(b) Stormwater conveyance systems adjacent to commuter rail trackway shall convey water so that the ballast and sub-ballast is above the energy grade line during a 100-year frequency storm.

(c) Ditches shall run parallel to the trackway to convey trackway runoff and runoff entering the Site from adjacent properties. Ditches shall be designed so that the peak 100-year frequency storm runoff level will not be above the top of the trackway subgrade, unless otherwise required by this Section 4.4.4. Where the commuter rail operates on, or shares right of way with freight rail trackage, the design requirements and concepts of the dominant Railroad shall be used, if more conservative than the standards presented in this section. Minimum ditch grades shall be 0.3%. The commuter rail trackway shall not be used for conveyance of stormwater.

(d) Park-n-Ride facilities shall convey stormwater in accordance with the drainage requirements in the RTD Bus Transit Facility Design Manual and of the municipal jurisdiction in which such pnR is located.

(e) Design peak runoff rates shall be determined using methods specified by the criteria of any Relevant Authority or:
(v) If a method is not specified by a Relevant Authority, the Rational Method or the Colorado Urban Hydrograph Procedure (CUHP) and Storm Water Management Model (SWMM) as presented in the UDFCD USDCM shall be used.

(vi) If a facility is located within or adjacent to a FEMA-regulated flood zone (Zone A, etc.), FEMA jurisdictional flows for facility design shall be used in accordance with the floodplain ordinance of the local drainage authority. The Concessionaire shall prepare and submit to FEMA any Conditional Letter of Map Revision or any Letter of Map Revision required for its design.

4.4.5. Replacement of Existing Facilities

If the Concessionaire replaces any existing storm drainage facilities, the Concessionaire shall provide, at a minimum, services equivalent to the existing facilities. Services to adjoining properties shall be maintained during construction.

4.4.6. Storm Sewer

Storm sewer shall be constructed with pipe materials in accordance with the AREMA Manual for Railway Engineering Volume 1, Chapter 1, Part 5. Within the commuter rail right of way, the minimum pipe diameter shall be 15 inches.

The minimum distance from top of rail to the top of pipe shall be 5 feet. The 100-year energy grade line in the storm sewer system shall be below the top of subgrade.

(a) Cross-culverts under the commuter rail trackway shall have a maximum headwater to depth ratio of 1.5. The 100-year energy grade line in cross-culverts shall be below the top of subgrade for all areas adjacent to the trackway.

(b) Storm sewer structures including manholes, junction boxes, inlets, vaults, or other structures shall be placed outside of the commuter rail right of way to the extent practicable. If located within the commuter rail right of way, such structures shall be designed in conformance with AREMA standards.

4.4.7. Inlets

The Concessionaire shall design and construct inlet boxes and grates according to the following criteria:

(a) Inlet boxes and grates within the commuter rail right of way shall be designed for commuter rail loading;

(b) Inlet grates located adjacent to the commuter rail trackway shall be designed to prevent ballast rock from passing into the storm sewer system;

(c) Inlet grates in pedestrian areas shall be heel-proof and non-slip;

(d) Inlet grates at all locations subject to bicycle traffic shall be bicycle safe; and
(e) Inlets shall be located at the low points of the profile, in sumps rather than on grade, to the extent practicable.

4.4.8. Underdrains

(a) Where right of way constraints do not allow use of the standard ditch section, underdrains may be used. Design and construction of underdrains shall be in accordance with AREMA Manual for Railway Engineering, Volume 1, Chapter 1 Section 1.2.4.3. The Concessionaire shall size underdrains based on a hydrologic and hydraulic analysis of local drainage. Underdrain systems shall be wrapped with a filter fabric and shall include clean outs, pipes, and culverts of sufficient number, located to facilitate maintenance and to reduce the possibility of underdrains becoming clogged, in accordance with Good Industry Practice.

(b) The Concessionaire shall ensure that the 100-year frequency storm hydraulic grade line of any drainage system where the underdrain outfalls shall prevent stormwater from entering into the trackway subgrade through the underdrain system. Flap gates shall not be used in the commuter rail storm sewer system where underdrains are installed for the purpose of intercepting and conveying groundwater. Such underdrains shall not discharge directly to the storm sewer system, but shall discharge to and be conveyed in a separate system to a location where treatment can take place.

4.4.9. Rail Embankment Edge Treatment

In areas where more than 50 feet of trackbed width contributes runoff to a fill slope, or where the fill slope is steeper than 4:1, an interceptor ditch or drainage barrier (Type 7 barricade) in accordance with CDOT M606-13 and M606-14 shall be used to collect flow from the top of the slope and convey it to inlets or rundowns to prevent erosion of the embankment.

4.4.10. Detention Facilities

Underground detention shall not be used, except with specific approval by RTD.

4.4.11. Water Quality

Water quality facilities shall be designed in accordance with the requirements of Relevant Authorities and RTD's Municipal Stormwater Permit (MS4), as discussed in Section 4.4.2.6 above; and with consideration for ease of long-term maintenance. Underground facilities (such as water quality vaults and inlets) shall not be used.

4.4.12. License Agreements

Storm sewers crossing the commuter rail right of way that serve upstream properties shall become the property of the Relevant Authority in whose land the storm sewer is located. Where such storm sewer facilities are located outside of public right of way, license agreements shall be prepared for the conduit crossing.
4.4.13. Drainage Permit Documentation

The Concessionaire shall submit to RTD a copy of all drainage plans submitted for any required Permit or in accordance with any Inter-Governmental Agreements. RTD shall receive the plans at the same time as the Relevant Authority.

4.5 Fencing

4.5.1. General Fencing Requirements

(a) The Concessionaire shall provide grounding for fencing in accordance with Section 13.3 (Grounding) of this Part B.

(b) The Concessionaire shall provide fencing plans for review at Periodic Design Review Meetings and at meetings of the Fire and Life Safety Committee in accordance with Section 2.3.6 (Fire/Life Safety Committee Meetings) of Attachment 9.

4.5.2. Right-of-Way Fencing

(a) The Concessionaire shall provide right of way fencing and/or barriers along the entire Commuter Rail Network alignment, of sufficient height, continuity and durability to prevent trespassers in accordance with the standards of Section 14 (System Safety and System Security) of the RTD Commuter Rail Design Criteria, the requirements of the Environmental Permits, and the following requirements:

(i) transitions between fencing and other barriers shall contain no gaps;

(ii) emergency access and egress points and walkways shall be provided in accordance with NFPA 130; and

(iii) fence gates shall have locks.

(b) The Concessionaire shall provide protection fencing adjacent to any emergency walkway on a commuter rail structure of a height no less than 42 inches above the walkway surface.

(c) At all walls greater than 30 inches above the adjacent surface and outside of the commuter rail clearance envelope, the Concessionaire shall provide protection fencing or a barrier of a height no less than 42 inches above the trackway surface or walkway surface, whichever is higher.

4.5.3. DIA/Commuter Rail Shared Fencing

The Concessionaire shall construct fencing between the DIA airside property and the commuter rail right of way in accordance with the Inter-Governmental Agreement between DIA and RTD and in compliance with DIA standards. Existing DIA fencing shall not be removed until DIA has constructed a temporary fence for maintenance of security of DIA airside property during the Work.
4.6 Signage

4.6.1. Construction Signage

The Concessionaire shall install and maintain a 4’ x 8’ sign identifying the Work at the primary entrance to each Site and providing such information as agreed by RTD and the Concessionaire. Each sign shall remain in place at each Site until the Final Completion Date for that Site, unless earlier removal is approved by RTD. The Concessionaire and RTD shall agree upon the specific locations for such signs and details to be displayed on such signs after the Early Work Effective Date or the Phase 1 Effective Date, as appropriate, prior to construction at each Site. The Concessionaire shall install and maintain project identification signs, as required by the FTA.

4.6.2. Permanent Signage

The Concessionaire shall install all necessary road signs, street name signs, wayfinding signage and other such project related signage. This shall include such signs identified in other sections of this Attachment 7, signage required by Relevant Authorities, and signage necessary for the operation and maintenance of the Commuter Rail Network. Signage plans and product details shall be reviewed during Periodic Design Review Meetings.

4.7 Utilities

The Concessionaire is responsible for the coordination and implementation of Utility Work necessary for delivery of the Commuter Rail Network in accordance with the requirements of Attachment 20 (Utilities) and the following criteria.

4.7.1. Horizontal Placement

Existing and proposed Utilities shall be located outside the trackway and the limits of the track right of way, except for the purpose of crossing the tracks or servicing a commuter rail facility. Longitudinal utilities shall not be located within the right of way. Utilities should be designed to avoid placing facilities at the outside of track curves or the ends of bridges or other structures. Utilities crossing the track should be designed, where practicable, to cross at a right angle to the track centerline.

4.7.2. Vertical Placement

Vertical clearance (depth of cover) for buried Utilities crossing under the tracks shall be a minimum of 60” from the top of rail to the top of a Utility or encasement (if encased). Vertical clearances shall conform to specific Utility company requirements and applicable codes, and shall be sufficient so that any work on a Utility does not compromise the commuter rail facilities or other Utilities.\(^{16}\)

\(^{16}\) NOTE: See DTP-ATC-019 (Reduced Minimum Cover and Eliminate Casing on Denver Water Facilities) in Section E (Alternative Technical Concepts) of Volume 3 of the Technical Proposal contained in the Concessionaire’s Proposal.
4.7.3. Design Loads

The material, class, thickness, and depth of buried Utility facilities, including carrier pipes, conduits and casings, shall be designed to withstand the full range of expected internal and external pressures and loads, including internal pressures ranging from zero to maximum expected pressure, and external loads from the trackway, vehicle loads, retaining walls, and other structural loads. Design depths shall be appropriate to protect both the tracks and the Utility.

4.7.4. Abandoned, Retired, and Decommissioned Utilities

Existing abandoned and existing retired Utilities shall be capped, plugged, filled, removed, or otherwise addressed in a manner deemed necessary to protect the commuter rail facility and/or traveling public. Abandoned and retired Utilities shall be taken out of service using proper utility owner and/or industry standard procedures. Utility facilities containing asbestos may not be abandoned or retired in-place.

Decommissioned Utilities shall conform to the same criteria as active facilities. If a decommissioned Utility conflicts with a commuter rail structure or facility, the Utility shall be relocated, modified, or protected in place as design requires.

4.7.5. Encasement and Related Protection of Utility Facilities

(a) Pressurized pipelines under the trackway shall be encased unless otherwise approved by RTD and shall be insulated from underground conduits carrying electric wires.

(b) Casing pipe shall be utilized in the design: (i) when it is necessary to facilitate bored or jacked installations and/or to protect coated carrier pipes from damage during installation; (ii) as a means of conveying leaking fluids or gases to points safely throughout its length under the track and the right of way; or (iii) as necessary to provide for the future adjustment, removal or replacement of the carrier line without disturbing commuter rail facilities or operations.

(c) The inside diameter of casings shall be designed at least 10% larger than the outside diameter of the carrier pipe or to the Utility owner specifications but no less than 2 inches greater than the largest outside diameter of carrier pipe, joints or couplings. Where the ends of a casing are below ground, the casing shall be sealed to the outside of the carrier pipe to prevent the intrusion of foreign material which might prevent removal of the carrier pipe. Casing vent pipes shall be designed as follows:

(i) Casings must be properly vented above ground with vent pipes having inside diameter equal to 10% of nominal size of the carrier pipe but no less than 2 inches and extending not less than 4 feet above ground surface.

(ii) The low end of casings shall be connected with the bottom of the casing and vent pipes at the high end of casings shall be connected with the top of the casing.

(iii) The top of vent pipes shall be fitted with a down-turned elbow that is screened.
(d) For existing brick and vitrified clay pipe sanitary lines, the Concessionaire may implement slip-lining as an alternative to casing, subject to any applicable Railroad approval.

(e) Utility crossing installations shall be designed to provide protection across the right of way, or further as required to allow access to the Utility and to prevent disturbing the structural integrity of the trackbed or other commuter rail facilities during future maintenance of the Utility.
5. **BRIDGES AND STRUCTURES**

The Concessionaire shall design, construct and rehabilitate bridges and other structures necessary for the Commuter Rail Network in accordance with this Section 5.

5.1 *General Structural Requirements*

(a) The Concessionaire shall design and construct commuter rail bridges and associated structures in accordance with the AREMA Manual for Railway Engineering and the CDOT Bridge Design Manual. Where the commuter rail alignment is either on or crossing above or below the right of way of any Railroad, the design and construction of any commuter rail bridge or associated structure shall also be in accordance with the BNSF/UPRR Guidelines for Railroad Grade Separation Projects.

(b) The Concessionaire shall design and construct freight rail bridges and associated structures in accordance with the requirements of the AREMA Manual for Railway Engineering, the BNSF/UPRR Guidelines for Railroad Grade Separation Projects and the CDOT Bridge Design Manual.

(c) The Concessionaire shall design and construct highway bridges, pedestrian bridges and associated structures in accordance with the requirements of the AASHTO LRFD Bridge Design Specifications and the CDOT Bridge Design Manual. If the highway or pedestrian bridge alignment is either on or crossing above or below the right of way of any Railroad, the design and construction of such highway or pedestrian bridge or associated structure shall also be in compliance with the BNSF/UPRR Guidelines for Railroad Grade Separation Projects. The vibration criteria for pedestrian bridges shall be in accordance with AASHTO Guide Specifications for Design of Pedestrian Bridges. The Concessionaire shall enclose pedestrian bridges over Railroad tracks.

(d) The Concessionaire shall comply with requirements of the Environmental Permits with regard to aerial structures and retaining walls in specific locations having designs and finishes sensitive to their setting; and shall perform appropriate consultations, as defined in Attachment 9 (Project and Construction Management) as part of the structural design process.

5.2 *Structure Types*

(a) The Concessionaire shall use bridge types historically used by RTD. The Concessionaire may propose a bridge type that has been accepted for general use by other transportation authorities. RTD shall approve such proposal provided that the Concessionaire can demonstrate to RTD's satisfaction that the proposed bridge types and components will perform well under the project's environmental conditions, including frequent freeze-

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17 NOTE: See Reference Data Item No. 5RR.

thaw cycles. Experimental bridge types, timber bridges, masonry bridges, structural plate arches, and movable bridges are not permitted. The use of or any lightweight concrete in structural members is not permitted.

(b) Any changes proposed by the Concessionaire in the type of bridge selected for each bridge location from those defined in Attachment 19 (Concessionaire's Proposal) shall be subject to the process defined in Section 36.1 (Concessionaire Proposed Changes) of the Agreement.

5.3 Design Method

The Concessionaire shall design bridges in accordance with the following methods:

(a) concrete structures – load factor design method;
(b) prestressed concrete structures – service load design method with check for ultimate strength;
(c) steel structures – service load design method;
(d) abutments and piers – load factor design method;
(e) foundations – service load design method; and
(f) highway and pedestrian bridges – load and resistance factor design method.

5.4 Design Documentation

(a) The Concessionaire shall provide Preliminary Design structural design plans and calculations for review at Periodic Design Review Meetings that shall include structure layout plans, geotechnical and foundation information, structural details, and special provisions completed to the level (% completion) set forth in the Current Baseline Schedule as defined in Section 2.6.3(b) (Current Baseline Schedule) of Attachment 9.

(b) The concessionaire shall submit to RTD for review Final Design structural design documents as follows: [CDRL #7B-05]

(i) a complete set of proposed structural design documents including plans, calculations, and special provisions addressing and incorporating all Preliminary Design review comments provided by RTD, CDOT, the Railroads, and any Relevant Authority; and

(ii) for each major structure (not only structures related to CDOT), as "major structure" is defined by CDOT Bridge Design Manual Section 19:

(A) a final submittal letter certifying that the structural plans and specifications have been prepared in accordance with the project criteria, signed and sealed by a professional engineer licensed in the State of Colorado;
(B) the complete set of Final Design calculations including revisions reconciling any differences between the original design, the independent design check (as "independent check" is defined by Section 19 of the CDOT Bridge Design Manual) and any design changes resulting from subsequent reviews;

(C) the complete set of final independent design check (as "independent check" is defined by Section 19 of the CDOT Bridge Design Manual) calculations; and

(D) a rating package for each bridge, including a rating summary sheet for girders and deck, rating information and calculation sheets and rating computer output (in each case as defined in the CDOT Bridge Rating Manual).

(c) The Concessionaire is responsible for making design submittals to applicable Project Third Parties.

5.5 Loads and Forces

(a) For bridge design purposes, Rolling Stock loading shall be either as shown in Figure 6.1 and 6.2 of the RTD Commuter Rail Design Criteria, or as recommended by the Concessionaire to match its Rolling Stock, subject to approval by RTD. Bridge design shall assume fully loaded train consists of up to the maximum operating train consist sufficient to provide the 2055 service capacity shown in Tables 2.1.2-1 through 2.1.2-3 of Attachment 10 (O&M Specifications).

(b) On right of way dedicated for RTD commuter rail Rolling Stock only and not shared with any Railroad or Heavy Rail Operator, the Concessionaire shall not apply AREMA Cooper E80 train load for bridge design.

(c) To provide for possible future vehicle alternatives in addition to the applicable commuter rail loading, the Concessionaire shall comply with one of the following equivalent design live loads for structures in the DUS to South Westminster segment at a minimum.

Either:

(i) Cooper E40 loading for structures with minimum span lengths equal to or greater than 70 feet; and

(ii) Cooper E50 loading for structures with minimum span lengths less than 70 feet.

Or:

(iii) The alternative live loading shown in Annex A to this Section 5.

In either case, structural elements designs governed by axle loading shall apply the axle loading shown in Annex A.
(d) The Concessionaire shall design highway and pedestrian structures in accordance with the live load requirements of the AASHTO LRFD and CDOT Bridge Design Manual.

(e) For bridges on which tracks are directly affixed, the Concessionaire shall perform analyses or justifications to determine design parameters including live load distribution factor, impact factor, and forces due to temperature variations in the rail, addressing both unbroken and broken rail conditions.

(f) The Concessionaire shall address derailment loads in accordance with Section 6.4.4 (Derailment Load) of the RTD Commuter Rail Design Criteria.

(g) Any commuter rail bridge that will be used by a Heavy Rail Operator during the construction period shall be designed for Cooper E80 loading, unless agreed otherwise by the applicable Railroad.

(h) Deflection under commuter rail loads shall be limited to span/1000, and span/375 for cantilevers. Bridge design documentation shall include analysis of the dynamic interaction between the superstructure and the commuter rail train. Limits on the dynamic interaction between the superstructure and the commuter rail train shall be not less than 2.5 hertz for the first mode natural frequency of each simple span, and not less than 3.0 hertz for one span in a series of three consecutive spans. Long simple spans having lower natural frequencies may be used, provided that due consideration is given by the Concessionaire in accordance with Good Industry Practice to possible vibrational interactions between the structure and the Rolling Stock, and the effect of such interactions on vertical impact loading.

5.6 Pier/Abutment Protection

The Concessionaire shall provide pier/abutment protection in accordance with the AREMA Manual for Railway Engineering, the CDOT Bridge Design Manual, the AASHTO LRFD Bridge Design Specifications and applicable Railroad Agreements and guidelines.

5.7 Mechanically Stabilized Earth Retaining Structures

(a) The Concessionaire shall design and construct mechanically stabilized earth (MSE) walls in accordance with AASHTO Standard Specifications for Highway Bridges or LRFD Bridge Design Specifications, except as modified by other provisions of AREMA and applicable Railroad guidelines. Any use of MSE walls to support freight rail loadings shall be subject to the approval of the applicable Railroad.

(b) The Concessionaire shall not use modular walls for primary mainline retaining walls supporting freight rail or commuter rail loadings. Modular walls may be used only for secondary retaining wall locations. Modular wall height shall not exceed 15 feet.

(c) MSE wall designs shall include site-specific corrosion protection/prevention measures, as defined in Section 7 (Corrosion Control) of Part A.

(d) The Concessionaire shall demonstrate in its design submittals that it has given consideration to the potential for accelerated corrosion or deterioration of structural elements of MSE walls due to the relatively high permeability of roadbeds and the
potential for precipitation and other potentially corrosive substances infiltrating the roadbed. The Concessionaire shall consider use of an impermeable geo-membrane connected to lateral drains below the sub-ballast but above the top level of reinforcement in order to prevent accelerated corrosion.

(e) MSE wall panels shall be constructed of reinforced concrete. Appropriate corrosion protection shall be provided for pre-stressing or post-tensioning steel. Reinforcing steel shall be covered to a minimum of 2 inches. All reinforcing, mild or pre-stressed steel shall be galvanized or epoxy coated in splash zones of adjacent roadways.

(f) MSE walls shall include a mechanical connection to the wall facing for soil reinforcement. The Concessionaire shall not use friction connections that rely on gravity alone.

(g) The Concessionaire shall provide MSE wall design plans and calculations for review at Periodic Design Review Meetings at Preliminary Design level and shall submit such plans and calculations to RTD at Final Design level. [CDRL #7B-06]

5.8 Waterproofing and Damp-proofing of Railway Structures

(a) The Concessionaire shall ensure structures are waterproof and damp-proof in accordance with the AREMA Manual for Railway Engineering, except in relation to Work performed under any Railroad Agreement as specified therein.

(b) For any structure used exclusively by commuter rail, and subject to RTD approval, the Concessionaire may substitute a spray elastomer waterproofing coating system for either a Butyl Rubber or elastomer bridge deck membrane as set forth in the AREMA Manual for Railway Engineering. Such elastomer bridge deck membrane shall be suitable for both concrete and steel deck surfaces. The coating system shall be spray applied, 100% solids, and a fast cure high build system. The thickness shall be 80 mils unless otherwise agreed by RTD. The Concessionaire shall use protective asphaltic panels with any elastomer bridge deck membrane unless otherwise agreed by RTD. The Concessionaire shall perform a film thickness test and shall ensure any membrane meets the thickness required in this Section 5.8.

5.9 Corridor Protection Barriers

(a) The Concessionaire shall construct Corridor Protection Barriers between the freight track and commuter rail facilities wherever offsets from UPRR mainline tracks to commuter rail tracks, station platforms, or retaining walls are less than 50 feet. Offsets shall be measured from freight track centerline to either the commuter rail track centerline, the back of any platform, or the front plate of any retaining wall, whichever of these commuter rail elements is closest to the freight track.

(b) Corridor Protection Barriers shall be designed for an equivalent static force of 400 kips, in accordance with AASHTO LRFD Article 3.6.5.2.
5.10 Parking Structures

The Concessionaire shall review design plans and calculations for parking structures at Preliminary Design level at Periodic Design Review Meetings and shall submit to RTD such plans and calculations at Final Design levels. [CDRL #7B-07]

5.11 Drainage for Bridges and Retaining Walls

5.11.1. Bridges

The Concessionaire shall design ballast deck bridge structures to include means to collect and convey runoff from the bridge deck. Runoff shall be intercepted at floor drains or drains located at the abutments and conveyed to ground in drain pipes, or drains located at the abutments.

5.11.2. Retaining Walls

The Concessionaire shall not allow runoff and concentrated flows from slopes above retaining walls to discharge behind any retaining wall. Pipes shall intercept and convey such flows down to grade before reaching the wall.

5.12 Tunnel Ventilation

The Concessionaire shall provide tunnel ventilation in accordance with NFPA 130.

5.13 Structural Coordination with Traction Electrification

The Concessionaire shall ensure any bridge, wall or tunnel supporting electrification equipment is consistent with traction electrification design and installation requirements, as defined in Sections 12.7.7 through 12.7.9 of this Part B.
Annex A – Alternative Live Loading Diagram
6. **STATIONS**

The Concessionaire shall design and construct all elements of the commuter rail stations for the Eagle Project in accordance with the requirements set out in this Attachment 7.

6.1 **Station Design Principles**

(a) Commuter rail stations shall include platforms, a bus transfer facility, pnR areas, kiss-n-ride areas and bicycle parking. Passenger areas shall include lighting and protection from the elements appropriate for the safety and comfort of the Passengers.

(b) The Concessionaire shall submit a report to RTD (the Means of Egress Report) demonstrating compliance for each station with NFPA 130 "means of egress" requirements. [CDRL #7B-08]

(c) Station designs shall incorporate, to the extent feasible, incorporate "crime prevention through environmental design" (CPTED) strategies to minimize potential threats and vulnerabilities to the Commuter Rail Network, facilities and Passengers and to maximize safety and security through engineering and design.

(d) Publicly accessible receptacles, including trash receptacles, bike lockers, and news racks shall not be placed within 250 feet of the station, station area or Passenger gathering area, unless (i) otherwise determined by a threat and vulnerability analysis in accordance with Section 8.3 (Hazard Management) of Attachment 9 or (ii) such receptacles are explosive-resistant receptacles meeting USDHS Transportation Security Administration requirements, as set forth in Section 6.4.2. The Concessionaire shall not place any receptacles in passenger tunnels, parking structures, and other enclosed areas.

6.2 **Station Designations and Specific Requirements**

Specific station requirements are provided in Figures 6.2A, 6.2B and 6.2C. The Concessionaire shall, to the extent feasible, apply the canopy designs and features shown in Appendix 2 (Station Canopy Templates) to the stations identified and present such designs to the public in accordance with Section 9 (Public Information) of Attachment 9. The architectural style for each station shall be as listed in Figures 6.2A, 6.2B and 6.2C.

**Figure 6.2A: Specific Station Requirements – Northwest Rail Corridor**

<table>
<thead>
<tr>
<th>South Westminster Station</th>
<th>Required features:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i. Six bus bays</td>
</tr>
<tr>
<td></td>
<td>ii. Approximately 350 parking spaces on opening day, increase to 1,000 spaces by 2030</td>
</tr>
<tr>
<td></td>
<td>iii. One driver relief kiosk Type 3</td>
</tr>
<tr>
<td></td>
<td>iv. Pedestrian underpass linking Irving St to the side platform and the pnR on the south side of the tracks</td>
</tr>
<tr>
<td></td>
<td>v. Architectural Style: Neighborhood Craftsman</td>
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</tbody>
</table>
### Figure 6.2B: Specific Station Requirements – Gold Line

<table>
<thead>
<tr>
<th>Station</th>
<th>Required features</th>
</tr>
</thead>
</table>
| 41st / Fox Street Station     | i. Six bus bays  
|                                |   ii. Approximately 500 parking spaces on opening day, increase to 770 spaces by 2030 |
|                                |   iii. One driver relief kiosk Type 1  
|                                |   iv. Pedestrian overpass linking Inca St to the platform and, if necessary, the pnR |
|                                |   v. Architectural Style: Industrial Loft Modern                                  |
| Pecos Street Station           | i. Two bus bays  
|                                |   ii. Approximately 300 parking spaces on opening day, no increase for 2030       |
|                                |   iii. One driver relief kiosk Type 1  
|                                |   iv. Pedestrian structure over the BNSF track                                    |
|                                |   v. Architectural Style: Industrial Loft Modern                                  |
| Federal Boulevard Station      | i. Three bus bays  
|                                |   ii. Approximately 280 parking spaces on opening day, increase to 370 spaces by 2030 |
|                                |   iii. One driver relief kiosk Type 1  
|                                |   iv. Architectural Style: Town Center Contemporary                               |
| Sheridan Boulevard Station     | i. Two bus bays  
|                                |   ii. Approximately 330 parking spaces on opening day, no increase for 2030       |
|                                |   iii. One driver relief kiosk Type 1  
|                                |   iv. Wolff Street extension to include access to adjacent light industrial facilities |
|                                |   v. Architectural Style: Neighborhood Craftsman                                 |
| Olde Town Arvada Station       | i. Nine bus bays  
|                                |   ii. Approximately 200 parking spaces on opening day (including reuse or modification of 200 existing spaces), increase to 400 spaces by 2030 |
|                                |   iii. One driver relief kiosk Type 1  
|                                |   iv. Retain the existing historic feature south of the alignment                  |
|                                |   v. Architectural Style: Main Street Historic                                   |
| Arvada Ridge Station           | i. Four bus bays  
|                                |   ii. Approximately 200 parking spaces on opening day, increase to 280 spaces in 2030 |
|                                |   iii. One driver relief kiosk Type 1  
<p>|                                |   iv. Architectural Style: Neighborhood Craftsman                                |</p>
<table>
<thead>
<tr>
<th>Ward Road Station</th>
<th><strong>Required features:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i. Eight bus bays</td>
</tr>
<tr>
<td></td>
<td>ii. Approximately 290 parking spaces on opening day, increase to 450 spaces in 2030</td>
</tr>
<tr>
<td></td>
<td>iii. One driver relief kiosk Type 1</td>
</tr>
<tr>
<td></td>
<td>iv. Architectural Style: Town Center Contemporary</td>
</tr>
</tbody>
</table>

**Figure 6.2C: Specific Station Requirements – East Corridor**

<table>
<thead>
<tr>
<th>38th/Blake Station</th>
<th><strong>Required features:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i. Four bus street stops (two on the northwest site and two on Blake Street)</td>
</tr>
<tr>
<td></td>
<td>ii. Approximately 200 parking spaces on opening day (100 spaces in each parking area), increase to 500 spaces by 2030</td>
</tr>
<tr>
<td></td>
<td>iii. A pedestrian overpass between the parking areas and the platform</td>
</tr>
<tr>
<td></td>
<td>iv. Two driver relief kiosks Type 1 (one close to each pair of bus stops)</td>
</tr>
<tr>
<td></td>
<td>v. Direct transfer to the LRT Central Corridor Extension Project; design/build coordination with contractors for that project</td>
</tr>
<tr>
<td></td>
<td>vi. Architectural Style: Industrial Loft Modern Airport</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Colorado Station</th>
<th><strong>Required features:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i. Five bus bays</td>
</tr>
<tr>
<td></td>
<td>ii. Approximately 200 parking spaces on opening day, increase to 1,800 spaces by 2030</td>
</tr>
<tr>
<td></td>
<td>iii. One driver relief kiosk Type 1</td>
</tr>
<tr>
<td></td>
<td>iv. Smith Road relocated to join the intersection of Colorado Boulevard and 40th Ave</td>
</tr>
<tr>
<td></td>
<td>v. Architectural Style: Industrial Loft Modern Airport</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Central Park Station</th>
<th><strong>Required features:</strong></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Architectural Style: Industrial Loft Modern Airport</td>
</tr>
</tbody>
</table>

19 NOTE: See Reference Data Item No. 2E.6.
### Peoria Station

**Required features:**

1. Nine bus bays
2. Approximately 550 parking spaces on opening day, increase to 1,900 spaces by 2030
3. One driver relief kiosk Type 5
4. Realignment of Smith Rd between Moline St and Peoria St, without precluding future intersection improvements at Peoria St and Smith Rd or a future grade separation of Peoria St from the railroads
5. Direct transfer to LRT I-225 line; design/build coordination with contractors for that project
6. Architectural Style: Town Center Contemporary Airport

### 40th/Airport Station

**Required features:**

1. Retain existing twelve bus bays and 1,079 parking spaces, increase to 2,200 parking spaces by 2030
2. Do not preclude future grade separation by lowering 40th Avenue under the commuter rail alignment
3. Architectural Style: Town Center Contemporary Airport

### Denver International Airport Station

**Required features:**

1. As specified in the Intergovernmental Agreement with DIA
2. Architectural Style: No canopies to be provided by Concessionaire at this station

### 6.3 Station Area Designs

(a) The Concessionaire shall provide the following station design documentation for review at Periodic Design Review Meetings:

(i) station area layout plans, including configuration for opening day and for conceptual expansion of parking to 2030 requirements;

(ii) platform and transition plaza architectural designs standardized within each architectural style, including ramps and railings, pavement materials and colors, and platform furnishings;

(iii) lighting designs including photometric plans for platforms, transition plazas, bus and parking areas;

(iv) structural design details of the canopy, the platform and any other structural element; and

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20 **NOTE:** See Reference Data Item No. 2E.7.
(v) civil site designs including details at platform site utilities, drainage, grading and demolition plans.

(b) Modifications to station layout concepts shown in the 30% design documents are subject to approval by RTD and the Relevant Authority in accordance with applicable Law and the Intergovernmental Agreements.

(c) The Concessionaire shall submit documentation for Final Design of each station to RTD. [CDRL #7B-09]

6.4 Station Platforms

(a) Station platforms shall be designed in accordance with the requirements of applicable Law, including the ADA and PUC regulations, and the standards of NFPA 130.

(b) All station platforms shall provide full-length high level boarding. The nominal height of the platform shall be 50.5 inches (±0.125 inches) calculated from the top of the rail.

(c) The platform edge horizontal dimension, inclusive of the sacrificial edging required by Section 6.4.1(d) below, shall be as defined by the clearance calculation specified in the Clearance Criteria Report.

(d) Stations adjacent to UPRR mainline tracks shall use a side platform toward the UPRR track that incorporates a structural Corridor Protection Barrier as set forth in Section 5.9 (Corridor Protection Barriers) above.

6.4.1. Platform Size

(a) Passenger station platforms shall be constructed to the length required to accommodate train consists providing the service capacity for 2035 ridership forecasts, as defined in Attachment 10 (O&M Specifications). Designs shall allow for future platform extension without changes to the track alignment, as follows:

(i) East Corridor: accommodation of twice the service capacity for 2035 ridership forecasts.

(ii) Gold Line and NWES: a minimum length of 300 feet, and 350 feet to the extent practicable.

(b) Minimum width for center platforms shall be 30 feet. Minimum width for side platforms shall be:

(i) 16 feet, when peak hour ridership for the platform is projected to be 500 people or less; and

(ii) 18 feet, when peak hour ridership for the platform is projected to be more than 500 people.
(c) RTD shall approve variances in platform width only if the Concessionaire is able to demonstrate to RTD in its request for a variance that such variance provides sufficient, safe capacity and egress for forecast passenger loads.

(d) The platform edge shall include a sacrificial edging that protects the platform structure in case of impacts from the Rolling Stock and assists with attaining the required gap between platform edge and door threshold. Beneath the platform edge, there shall be a recess of sufficient horizontal depth for refuge from passing trains and in no case less than 24 inches deep.

6.4.2. Platform Furnishings

(a) The Concessionaire shall provide on each platform:

   (i) platform shelter canopies with a minimum coverage of 300 square feet per 100 feet of platform length (except at DIA where no shelters are required);

   (ii) windscreens with a minimum coverage of one 6 feet by 6 feet windscreens per each 100 feet of platform length and at least 75% translucent or transparent windscreen surface;

   (iii) benches with a minimum of one bench per 100 feet of platform length, each providing seating for at least four persons and preventing persons from lying down;

   (iv) One USDHS-approved trash receptacle per 200 feet of platform, placed in accordance with the Hazard Identification Analysis and Resolution Process as set forth in Section 8.3 (Hazard Management) of Attachment 9; and

   (v) for side loading platforms a physical barrier at the back edge in the form of ornamental railing/fencing or walls as needed for Passenger safety and of an architectural style consistent with the architectural style of the station platform.

(b) Bike lockers and/or racks shall not be located on the station platform.

6.4.3. Pedestrian Platform Access Crossings

(a) The Concessionaire shall provide at the end of each platform a pedestrian crossing to provide access to each platform across the commuter rail track or tracks. Pedestrian platform access crossings shall be:

   (i) 20 feet wide and include a two-foot wide tactile warning strip along each side; and

   (ii) located such that the operator of a train berthed at the platform can view the entire crossing surface without obstruction.

(b) At Pedestrian platform access crossings at the station, the Concessionaire shall provide equipment to warn Passengers of approaching trains, including:
(i) manual, self-closing pedestrian control gates on both ends of the crossing;

(ii) lighting that illuminates the crossing whenever platforms are lit; and

(iii) warning bells and flashing lights that indicate the approach or presence of a train in accordance with Section 9.10.8 (Pedestrian Platform Access Crossing Warning) of this Part B.

(c) The Concessionaire shall coordinate details of pedestrian platform access crossing designs and the warning time and system design with RTD through the Safety and Security Working Group and Periodic Design Review Meetings.

6.4.4. Other Platform Requirements

(a) The Concessionaire shall provide platform skirting along the sides of any platform open on the sides to prevent access underneath the platform. Platform skirting materials shall, at a minimum, be chain link fencing with a maximum of ½" openings, or as otherwise approved by RTD.

(b) Platforms shall slope away from the trackway to restrict rainwater runoff from entering the trackway.

(c) Where two tracks run between two side platforms, the Concessionaire shall provide a black-vinyl clad chain link fence between the tracks, not less than 5 feet high for the full length of the platform.

6.5 Public Access

(a) The Concessionaire shall provide public access to the stations in accordance with RTD's Transit Access Guidelines unless otherwise approved by RTD.21

(b) The Concessionaire shall provide elevators in accordance with Section 2.16 of RTD's Facility Maintenance Criteria and Equipment Manual22 and Section 14 (System Safety and System Security) of the RTD Commuter Rail Design Criteria.23

6.5.1. Transition Plaza

(a) The Concessionaire shall provide transition plazas to facilitate movement of Passengers from the platform access points to pnR, transit facilities and adjacent streets. Each transition plaza shall be constructed of concrete and sized appropriately for their purpose.

21 NOTE: See Reference Data Item No. 2GCP.

22 NOTE: See Reference Data Item No. 8GCP.

23 NOTE: See DTP-ATC-022 (Revision to Elevator Requirements) in Section E (Alternative Technical Concepts) of Volume 3 of the Technical Proposal contained in the Concessionaire's Proposal.
(b) The Concessionaire shall provide support infrastructure at transition plazas for Fare System Equipment in accordance with Section 11 (Fare System Equipment) of this Part B.

(c) Each transition plaza shall be equipped with two public payphones, consistent with Section 5.7.3 of RTD's Commuter Rail Design Criteria.

6.5.2. Parking Areas

(a) The Concessionaire shall provide access to the parking areas in accordance with applicable Law, including ADA requirements, Good Industry Practice and so as not to interfere with pedestrian, bus and emergency services.

(b) Parking stalls shall be striped and shall be 9' x 18'. Parking areas shall be constructed of concrete or asphalt pavement and include a curb and gutter for drainage.

(c) Landscaping in parking areas shall comply with the requirements of Relevant Authorities. Landscaping shall not impede visibility within the parking area.

6.5.3. Bus Transit Facilities

(a) The Concessionaire shall provide bus transit facilities in accordance with RTD's Bus Transit Facility Design Guidelines and Criteria Manual.  

(b) Except where a bus bay is located on public streets, bus bays shall be designed with saw-tooth geometry. Standard bus bays shall accommodate a 45-foot bus, at a minimum, and extended bus bays shall accommodate a 60-foot articulated bus. One extended bus bay shall be provided for every three standard bays at each station. Bus bays shall be constructed with portland cement concrete at a minimum thickness of 10 inches.

(c) Design changes to bus circulation shown on the 30% design station layouts shall be submitted to RTD for approval. [CDRL #7B-010]

6.5.4. Driver Relief Kiosks

The Concessionaire shall provide a driver relief kiosk and associated utility connections in the bus facility at each commuter rail station except DIA (which has no bus facility), and 40th and Airport (which has an existing kiosk), as identified in Figure 6.2 above. Kiosks are provided for the use of RTD's bus operations and security personnel, and the Concessionaire's operations and maintenance personnel. Kiosk types identified in Figure 6.2 refer to those in RTD's Standard Drawings and represent the minimum requirement. The Concessionaire may increase the kiosk size and functionality as necessary for its operation and maintenance needs. The Concessionaire shall provide kiosk designs for review at Periodic Design Review Meetings.

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24 NOTE: See Reference Data Item No. 1GCP.
25 NOTE: See Reference Data Item No. 5GCP.
6.6 Station Lighting

(a) The Concessionaire shall provide lighting of a minimum illumination level of 5 foot-candles measured at any point on each of:

(i) station platforms;

(ii) transition plazas; and

(iii) parking structures.

(b) Lighting in surface parking areas shall be of a minimum illumination level of 2 foot-candles.

(c) Lighting at Fare System Equipment shall be a minimum illumination level of 8 foot-candles.

(d) Illumination values shall be measured no less than 24 inches from poles and equipment support structures.

6.7 Station Signage

(a) At a minimum, the Concessionaire shall provide fixed signage at stations in accordance with the requirements of applicable Law, including the ADA, any applicable standards of the MUTCD, and the following minimum requirements:

(i) one station identification sign per 100 feet of platform accompanied by a minimum of one directional sign;

(ii) two wayfinding signs per platform and two wayfinding signs per transition plaza, that provide Passengers direction to surrounding uses and attractions;

(iii) one set of information and safety-related signs every fifty feet of platform length and where warranted on transitional plazas; and

(iv) one sign per bus gate denoting the bus route at that gate and routes served at each gate located at that station.

(b) Each sign shall be consistent with RTD's current sign standards. The Concessionaire shall review signage at Periodic Design Review Meetings.

(c) Fixed signage at DUS will be provided by the DUS Infrastructure Contractor. The Concessionaire shall coordinate with the DUS Infrastructure Contractor signage at DUS and notify RTD if it believes the signage proposed by the DUS Infrastructure Contractor does not meet the requirements of this Section 6.7.

6.8 Provision for Future Stations

(a) The Concessionaire shall ensure the design and construction of the East Corridor shall, to the extent practicable, not preclude the opportunity for addition of stations in the general
locations described in Item (b) below. These potential future stations are not included in the base scope of Work and their implementation would be subject to Section 36.3 (*RTD Proposed Changes*) of the Agreement. If such a Change is required by RTD, more detailed engineering will be required in coordination with the property developer and other stakeholders to determine final platform location and configuration.

(b) The Concessionaire shall design a track alignment that allows for the later provision of stations, consistent with the locations of tangent track included in the 30% design plans\(^{26}\) at the following approximate locations:

(i) intersection of 62nd Avenue and Pena Boulevard; and

(ii) intersection of 72nd Avenue and Dunkirk Road.

(c) The Concessionaire shall avoid placement of track, equipment housings, or equipment in the areas identified above except where there is no practical alternative. In the event that such placement is determined to be necessary, the Concessionaire shall immediately notify RTD in writing.

\(^{26}\) NOTE: See Reference Data Item No. 1E.
7. **COMMUTER RAIL MAINTENANCE FACILITY**

7.1 **General Requirements for the CRMF**

(a) The Concessionaire shall design, construct and commission the CRMF in accordance with this Section 7 such that it accommodates the capabilities, functions, equipment and personnel necessary for the operation and maintenance of the Commuter Rail Network and the Rolling Stock as required by the Operating Plan.

(b) The Concessionaire shall design the CRMF in accordance with applicable Law and so as to

   (i) ensure expedient and proper traffic flow, work flow and space allocations;

   (ii) maximize safety and personnel comfort; and

   (iii) ensure that the Rolling Stock and the Commuter Rail Network can be properly maintained.

(c) The Concessionaire shall provide equipment and furnishings required to maintain and administer the Commuter Rail Network, except where that function is to be provided through an outsourcing arrangement agreed by RTD. Equipment shall be new unless otherwise approved by RTD and shall be designed for the purpose for which it will be used. Furnishings shall be new and sufficient to accommodate the anticipated level of year 2035 commuter rail operating staff set forth in the Operating Plan.

7.2 **Yard Area**

The yard shall accommodate Rolling Stock to be moved to and from the mainline, be stored, maintained and tested, as further detailed below. The Concessionaire shall provide plans of the yard's layout and descriptions of how such layout supports the operation and maintenance functions set forth in this Section 7 for review at Periodic Design Review Meetings.

7.2.1. **Departure and Arrival Requirements**

Trains shall be able to depart directly and efficiently from the yard in both mainline directions. Arriving trains shall be able to enter the yard from both mainline directions, and be routed to either storage spots or servicing locations.

7.2.2. **Yard Layout**

(a) The yard layout and storage track design shall be sized for the entire Rolling Stock fleet to be supplied under this Agreement and as defined in Figure 2.2 in Section 2.2 (Design and Construction Principles) of Part A, except that a limited number of trains may be stored at terminal stations provided that such storage is in accordance with the Operating Plan set forth in Section 2.4 (Operating Plan) of Attachment 10.

(b) The yard layout shall provide the capability to perform all necessary train consist changes to support the Commuter Rail Services as set forth in Tables 2.1.2-1 thru 2.1.2-3 in
Attachment 10 (O&M Specifications). Construction of the yard capacity may be phased to match the actual fleet on hand at any given time.

(c) The yard shall be designed to allow visual walk-around inspection at each Car storage location; and allow testing of trains and training of staff without unduly restricting the normal flow of trains to and from the CRMF including departure tests on trains of any operating length and consist formation.

7.2.3. Shop Circulation Routes

Access from the storage tracks to the shop tracks shall be such that there is no interference with arrival or dispatch of Rolling Stock operating in revenue service. Accessibility to shop tracks shall be consistent with work flow plans.

7.2.4. Motor Vehicle Access and Parking

(a) The Concessionaire shall provide primary motor vehicle access to the CRMF through a main entrance with manned security. Secondary motor vehicle access gates may be provided and shall have access control. Roadways within the CRMF shall be used for emergency and shop vehicles only.

(b) The Concessionaire shall provide parking for employees, RTD and visitors to the CRMF within the property, close to each building. The Concessionaire shall review the quantity of parking spaces at Periodic Design Review Meetings.

(c) The Concessionaire shall provide a delivery and outdoor storage area adjacent to the materials management area. Access roads shall enable delivery vehicles up to a HS-20 truck to maneuver, load and unload materials at the materials management area. The Concessionaire shall take into account the method of delivery of Rolling Stock in the design of access roads.

7.2.5. Lighting

(a) The Concessionaire shall provide lighting for roadways, parking, delivery and storage areas. Lighting in the yard shall accommodate walk around inspection of Cars. The Concessionaire shall review specific lighting levels at Periodic Design Review Meetings.

(b) The Concessionaire shall minimize illumination of adjacent properties.

7.2.6. Security

The Concessionaire shall provide a secure fence around the entire yard and other security features as necessary to ensure the CRMF's security, including:

(a) gates that are electrically controlled during off hours; and

(b) an intercom system or equivalent for processing delivery trucks to the CRMF and for controlling site access.
7.2.7. **Fire Protection**

The Concessionaire shall provide fire hydrants throughout the yard, in accordance with applicable Law, the requirements of Relevant Authorities and Good Industry Practice, each with regard to the traction electrification voltage.

7.3 **Maintenance Facilities**

(a) The maintenance facility shall be sized and equipped as necessary to maintain and inspect the Rolling Stock and the Commuter Rail Network.

(b) Maintenance equipment and tools shall be fit for the purpose for which they are provided and for the components on which they are to be used.

(c) The Concessionaire shall perform the following maintenance on-site:

   (i) running maintenance;

   (ii) preventive and corrective maintenance;

   (iii) subsystem and component replacement; and

   (iv) cleaning.

Other maintenance activities may be outsourced, at the Concessionaire's discretion.

(d) The Concessionaire shall review at Periodic Design Review Meetings layout plans, functional studies and equipment lists that demonstrate how the facilities will meet the functional operations and maintenance requirements of the Commuter Rail Network, both initially and at 2035 service levels.

7.3.1. **Running Maintenance**

The shop shall be sized and equipped for running maintenance such as daily inspection, daily cleaning and daily maintenance of the Rolling Stock. Access shall be provided to Car equipment by way of inspection pits and roof access platforms, as required. The running maintenance area shall provide ready access to other support areas of the shop.

7.3.2. **Cleaning**

(a) The CRMF shall include a Car washing area, suitable for the washing of Cars at all times throughout the year without risk of wash water freezing on the Cars. The washer shall be automated and shall include a wash water recycling system.

(b) The shop shall be equipped for undercar steam cleaning.

(c) Waste water shall be disposed of in a manner approved by each Relevant Authority.
7.3.3. Preventive and Corrective Maintenance

The CRMF shall be sized and equipped for the performance of planned periodic maintenance and unscheduled maintenance such as troubleshooting, testing and unit exchange. This area shall be equipped to provide full access to the trains including both undercar and at roof level, as necessary.

7.3.4. Wheel Truing

Wheel truing shall be accomplished with wheelsets in place on the Car, utilizing automated equipment specifically designed for this function. Should the Concessionaire choose to outsource this function, the site layout shall include provision for future on-site on-Car wheel truing.

7.3.5. Subsystem and Component Removal and Replacement

The shop shall be sized and equipped for the efficient removal and replacement of subsystems and components on the trains as unit replacements.

7.3.6. Support Shops

The CRMF shall include support shops for general purpose repair tasks and support maintenance of the Rolling Stock, non-revenue service vehicles, systems, and facilities.

7.3.7. Battery Area

If an area for the storage and servicing of batteries is required, the Concessionaire shall provide ventilation and fire protection equipment and all other required facilities in accordance with applicable Law.

7.3.8. Car Painting

If the Concessionaire expects to paint Cars at the CRMF, the Concessionaire shall provide space for Car painting that is sized and equipped to prepare and paint a complete Car; and designed in accordance with applicable Law.

7.3.9. Overhead Contact Interlocks

Tracks with overhead electrification shall be equipped with isolating interlocks, such that maintenance staff can electrically isolate and effectively ground the wiring section in order to access the roof area without risk of electrocution from the OCS.

7.3.10. Materials Management

The CRMF shall include a materials management area to receive, store, control and secure parts, consumables, equipment and tools. The materials management area shall be sized for the efficient operation and maintenance of the Commuter Rail Network; be located to facilitate efficient delivery and dispatch with respect to road access; and include ramp and loading areas.
7.3.11. Maintenance of Way

(a) The Concessionaire shall provide non-revenue road-going and/or rail vehicles as necessary for the repair and upkeep of the Commuter Rail Network. Such vehicles shall be considered assets forming part of the Concessionaire-operated Components. The MOW facility shall be capable of storing and maintaining all non-revenue service vehicles provided to maintain track, structures, traction electrification, signal and communication facilities, right of way, yard, building, grounds and roadways. Rail and roadway access shall be provided.

(b) Suitable storage shall be provided for MOW vehicles and materials adjacent to the MOW facility.

7.3.12. Hazardous or Flammable Materials

(a) Storage of hazardous or flammable materials shall be in a secure area in the yard, near the maintenance facility. At a minimum, the storage area shall consist of a concrete slab with a curb and a drainage pit sized to contain any spillage. The storage area shall be covered with a roof and secured and isolated from each adjacent site.

(b) Storage of flammable liquids shall be in an area enclosed with fire rated walls and ceiling in accordance with applicable Law.

(c) Areas that store compressed gases shall be designed in accordance with applicable Law and shall be:

(i) located outside the maintenance shop;

(ii) enclosed within secure cages; and

(iii) designed to separate full cylinders from empty tanks.

(d) Hazardous materials used in or generated by the Rolling Stock and shop processes shall be recovered for disposal in accordance with applicable Law.

7.4 Other Functions Located at the Commuter Rail Maintenance Facility

(a) The CRMF shall include administration facilities including offices and break rooms to support maintenance activities and staff, the transportation staff, and the operations and security staff.

(b) The Control Center and associated equipment may be located at the CRMF, but if located elsewhere, alternative facilities shall be provided at the CRMF to provide work assignments to transportation staff.

(c) The Concessionaire shall provide plans and functional descriptions of the Control Center and administration facilities, including explanation of how operations and maintenance needs are satisfied by the planned facilities, for review at Periodic Design Review Meetings.
7.5 **Signage/Safety Warning Devices**

(a) The CRMF shall include a complete signage and safety warning system that complies with the requirements of applicable Law including ADA and OSHA requirements.

(b) Signs shall, at a minimum, identify:

   (i) building entrances (including corporate logos for the Concessionaire and RTD);

   (ii) room names and numbers;

   (iii) maintenance functions;

   (iv) material delivery;

   (v) fire protection;

   (vi) access panels for maintenance of building system equipment;

   (vii) informational signage; and

   (viii) safety devices such as eye wash fountains.

(c) "Caution yellow" paint stripping shall be used to identify pits, ramps, zones around ladders and hazardous areas, and changes in floor elevations.

7.6 **CRMF Design Submittals**

(a) The Concessionaire shall submit final design documentation and equipment lists for the entire CRMF for RTD compliance review. [CDRL #7B-11]

(b) The Concessionaire shall include in its design development process, a study of how it could incorporate fueling, servicing and maintenance of a small fleet of diesel-powered rail vehicles in the future, either within the CRMF or through provision of an alternative facility. The study should address the viability of adding a fueling facility and associated fuel storage to the CRMF without disruption to ongoing maintenance of the Rolling Stock. Progress with the study shall be presented for review at Periodic Design Review Meetings and a report of the study (the *Diesel-Powered Rail Vehicle Maintenance Feasibility Report*) shall be submitted to RTD for review prior to completion of the CRMF final design. [CDRL #7B-12]
8. **TRAFFIC SIGNALIZATION**

(a) The Concessionaire shall provide new traffic signal facilities and shall relocate (temporary or permanent) and restore existing traffic signal facilities, as required by the Environmental Permits and as otherwise necessary to fulfill the Work, in accordance with requirements of the Relevant Authorities or if there are no such requirements, the guidelines of the MUTCD.

(b) Traffic signal designs shall be consistent with those shown in the Reference Data\(^ {27}\) as set forth in Section 16 (*Reference Data*) of the Agreement unless approved otherwise by the Relevant Authority.

(c) The Concessionaire shall design at-grade crossings in accordance with applicable Law, including the Environmental Permits, and the MUTCD and as approved by each Relevant Authority, including the PUC. For traffic signalization of intersections adjacent to grade crossings, the design shall incorporate cycle preemption to prevent traffic held at closed grade closings from blocking an adjacent intersection.

(d) The Concessionaire shall submit to the Relevant Authority traffic signaling, signing and striping plans and the appropriate specifications and calculations in accordance with applicable Law and submit to RTD a copy of such plans. Construction activities associated with the traffic signalization design shall not start until the necessary approval is received from the Relevant Authority.

\(^{27}\) NOTE: See Reference Data Items Nos. 1G, 2G.2, 1E, 2E.2, 1NWES and 1C.
9. **TRAIN CONTROL SYSTEM**

9.1 **General Train Control System Requirements**

(a) The Concessionaire shall apply state-of-the-art railway signaling techniques and products throughout the Commuter Rail Network to provide safety in the movement of trains and efficiency of train operations. The functions of the train control system shall include:

(i) protection and control of track switches;

(ii) protection and control of bi-directional train operation;

(iii) protection for following trains operating with the normal flow of traffic; and

(iv) provision of highway-rail grade crossing warning systems.

(b) The signal technology used shall be a bi-directional, cab signal type system and shall comply with the Positive Train Control (PTC) requirements of the Rail Safety Improvement Act of 2008 and associated FRA Regulations.

(c) The train control system shall provide the complete functionality required within this Section 9.

9.2 **Train Control System Design**

9.2.1. **Standards and Conventions**

The train control system shall comply with applicable standards listed in Appendix 1 (Regulations, Codes and Standards) to this Attachment 7 and the following RTD specific standards that shall be incorporated in the design:

(a) With respect to orientation:

(i) southbound is always towards downtown/ DUS and northbound is always away from DUS, regardless of geographical direction;

(ii) train control drawings shall reflect this orientation with DUS (south) to the left and remote terminals (north) to the right; and

(iii) tracks shall be referenced by number. The track towards the bottom of the drawing (the left-hand track when facing toward DUS, or any single track) shall be designated as "Track 1" and the next track towards the top of the drawing (the track toward the right when facing toward DUS) shall be designated as "Track 2". Numbering for any additional tracks or instances where track designations are inconsistent shall be as agreed between the Concessionaire and RTD.

(b) Wayside control equipment shall be located in equipment houses. Each equipment house shall have a unique identification that references the corridor and the mile post (rounded to the nearest tenth of a mile).
(c) Signals, switches and track circuits shall each have a unique identification, consistent with (or equivalent to) the conventions detailed in RTD's Commuter Rail Design Criteria, Section 8.6.  

9.2.2. Headways and Block Layout

(a) The signal system shall be designed to support the operational requirements and service headways for planned operations in year 2035, as defined in Attachment 10 (O&M Specifications) and the design requirements of Figure 2.2 in Section 2.2 (Design and Construction Principles) of Part A.

(b) Design headway is defined as the length of time taken for a given signal (block or cab) to upgrade to a permissive aspect/cab rate of at least 30 mph after a leading train has passed that boundary at normal track speed. The train control system shall be designed for normal revenue service trains of the consist length required to meet 2035 ridership projections.

(c) Design headway calculations shall assume that stops are made at every station, with an average dwell time of 45 seconds.

(d) The train control system shall be designed to provide headways for following trains in the normal direction that do not exceed one third of the scheduled headway or 120 seconds, whichever is greater. Design headways for DUS to Pecos Junction shall account for both Gold Line and Northwest Rail Electrified Segment services, as well as movements to and from the CRMF. Design headways in the DUS Rail Segment shall account for Commuter Rail Services and North Metro Corridor services, as well as movements to and from the CRMF and train movements by Heavy Rail Operators.

(e) Unless defined otherwise in Attachment 10 (O&M Specifications), the peak period design headway for services on the North Metro Corridor shall be assumed to be 15 minutes.

9.2.3. Safe Braking Distance

The Concessionaire shall calculate safe braking distances in accordance with Good Industry Practice and the unique characteristics of the Rolling Stock. The Rolling Stock deceleration rate shall be reduced by a minimum of 35% to account for a safety margin. On grades, the Rolling Stock deceleration rate shall be adjusted to compensate for the effects of gravity. Safe braking distance calculations shall include the maximum authorized speed for the governed area plus an overspeed of 3 MPH. The Concessionaire shall submit to RTD formulae and calculations used to determine safe braking distance. [CDRL #7B-13]

28 NOTE: See Reference Data Item No. 7GCP.1.
9.2.4. Safety Design

Train safety shall be the primary consideration in the design of the train control system and in the selection of its components. The following requirements shall govern portions of the system which affect train safety:

(a) Component or system failures shall cause a more restrictive signal indication than that permitted with no failure.

(b) Wherever possible, built-in fault detection shall be included that imposes a restriction and/or actuates an alarm whenever a device fails to assume its most restrictive position when conditions require that it should.

(c) System safety design shall be such that any single independent component or subsystem failure results in a safe condition. For purposes of this requirement, a component or subsystem failure that in turn always causes the failure of another component or subsystem shall be considered a failure of a single independent component or subsystem.

(d) Only components which have high reliability, predictable failure modes and rates, and which have been proven in conditions similar to the projected service shall be used.

(e) Circuits which are not confined to one housing and which affect safety shall be double-wire, double-break, except signal and switch indicator light circuits.

(f) The design shall be based on closed circuit principles.

(g) Redundant design by itself shall not be considered an acceptable method of achieving design safety.

9.2.5. Control Circuitry

(a) Safety circuits and logic shall be designed using vital microprocessors of proven design and successful operating record with the aim of minimizing the use of vital relays.

(b) Non-vital logic circuits shall be controlled either by non-vital logic controllers or emulators.

(c) Each relay shall plug into a separate relay base. Each relay shall be furnished with at least one spare independent front-back contact.

(d) The use of diodes, capacitors, or resistors to change the timing characteristics of a vital relay is prohibited, unless approved otherwise by RTD on a case-by-case basis.

9.2.6. Lightning and Transient Protection

(a) Track circuits and wayside equipment houses shall be protected from lightning strikes. Connections between arresters, other signal equipment, and grounding electrodes shall be protected, except that connections to grounding electrodes shall be by exothermic welding. All protection provided shall be consistent with AREMA Communications and Signals Manual, Section 11 – Circuit Protection.
(b) Electronic and solid-state devices shall have both effective internal and separate external surge protection. High-voltage lightning arresters shall be applied to Utility power connections.

9.2.7. Environmental Rating

Equipment to be housed in equipment houses shall be rated for an operating temperature range of -40ºF to +160ºF at 0% to 95% relative humidity, non-condensing.

9.2.8. Service Proven Equipment and Design

Train control equipment shall be proven in similar railroad or transit service. Each major component shall incorporate provisions to allow for functional and physical interchangeability of replacement/spare parts.

9.3 Design Documentation

(a) The Concessionaire shall develop detailed train control system design documentation demonstrating that the system provides the necessary levels of safety, reliability and operational functionality required by this Attachment 7 and for the successful operation of the Commuter Rail Network. Together with the specific documents detailed elsewhere in this Section 9, train control design documentation shall be provided describing the overall system design, functionality and features for review at Periodic Design Review Meetings. This documentation may be subject to review by FRA and/or PUC.

(b) Final versions of train control system design documentation shall be submitted to RTD for compliance review. [CDRL #7B-14]

(c) The Concessionaire shall, as required by FRA regulations, submit to RTD for review and to FRA for approval the following documentation of its PTC system: [CDRL #7B-15]

(i) PTC Development Plan;

(ii) PTC Implementation Plan;

(iii) PTC Safety Plan; and

(iv) Any additional verification and validation documentation required by FRA for system approval.

9.3.1. Track and Cable Plan

The Concessionaire shall prepare, and review at Periodic Design Review Meetings, a complete system-wide track and cable plan showing the location of equipment, interconnecting cables and survey stationing. The equipment shown shall include equipment houses, highway crossings, wayside signals, switch machines, track circuit feed/relay points and interconnecting cables.
9.3.2. Circuit Plans

(a) Prior to the preparation of any final circuit plans, the Concessionaire shall review at Periodic Design Review Meetings, a set of circuit plans for a typical interlocking, a typical highway crossing, and a typical electric lock.

(b) The Concessionaire shall prepare and review at Periodic Design Review Meetings complete system-wide circuit plans, including signals, switch machines, termination points, relay coils and contacts, controls, signal equipment and energy busses with all interconnections.

(c) The Concessionaire shall place these plans and the application software for these plans under the control of one design entity within the Concessionaire's organization and recheck that the completed system circuit plans and application software that these plans provide the necessary level of safety and operational capability required by the Agreement.

9.3.3. Applications Software

(a) The Concessionaire shall prepare a software management control plan which shall conform to the requirements of 49 CFR 236.18 (the *Software Management Control Plan* or *SMCP*) and shall be submitted to RTD prior to any application software programming. [CDRL #7B-16]

(b) The SMCP shall be designed to ensure that from the time the factory testing is complete through to the time in-service testing is complete (cutover) strict control of the version of application software for each location is maintained.

(c) If the Concessionaire violates any provision of the SMCP, RTD may require the Concessionaire to re-test all affected equipment locations.

9.3.4. Relay Equivalent Circuits

Application software for interlocking shall be converted into relay equivalent circuits, such that the application logic will be depicted using standard relay symbols that an experienced signal person with no knowledge of ladder logic or Boolean algebra will be able to interpret. The relay equivalent circuits shall be included in the book of plans for each interlocking location.

9.3.5. Physical Layout Drawings

(a) The Concessionaire shall prepare drawings showing the physical arrangements of wayside equipment including signals, equipment houses, layouts for equipment within the equipment house. In addition, physical layout drawings of signals, local control panels, and track switches shall be prepared. These drawings shall be drawn to scale and shall contain a parts list. The Concessionaire may incorporate this information as a part of the circuit plans for each relay house. These drawings shall be subject to review at a Periodic Design Review Meeting prior to the manufacture of each item.
9.3.6. Installation Drawings

The Concessionaire shall prepare installation drawings for each major piece of signal equipment to be installed including junction boxes, signals, switch bonding, relay racks, signal cases, and equipment houses. These drawings shall be to scale and contain a parts listing.

9.4 Traffic Control System

(a) The Concessionaire shall implement a traffic control system in accordance with the requirements of applicable Law, including applicable parts of the Rail Safety Improvement Act of 2008 and 49 CFR 236 Subparts D and E, and applicable parts of the following standards:

(i) AREMA C&S Manual, Part 2.2.15 – Recommended Functional/Operating Guidelines for Traffic Control Systems; and

(ii) AREMA C&S Manual, Part 16.4.50 – Recommended Design Guidelines for Automatic Speed Control with Continuous Cab Signaling.

(b) A cut-in/departure test circuit shall be provided at each entrance to signaled territory by means of which carborne equipment shall be tested to prove it is in operative condition before it enters the signaled territory.

(c) Rolling Stock shall be equipped with a cab signal carborne package that is compatible with that of the cab signal wayside design.

9.5 Interlockings

9.5.1. Interlocking General Requirements

(a) Interlockings and control points shall be provided at turnouts and crossovers, except that electric lock switches are permitted where interlocking are not required for normal operation. In conjunction with cab signals, wayside signals shall be provided at interlockings.

(b) Approach or time locking, route locking and traffic locking shall be provided. Detector locking/loss of shunt of not less than 5 seconds shall be provided on each route within interlocking limits.

(c) Non-conflicting train movements shall be permitted simultaneously. If applicable, sectional releasing shall be permitted.

(d) At a minimum, the interlocking shall comply with the following:

(i) 49 CFR 236, Subpart B – Interlocking; and

9.5.2. Vital Microprocessor Interlocking Systems

(a) Vital Microprocessor Interlocking Systems (VMIS) shall be employed to execute vital train control system safety functions.

(b) The VMIS software systems shall be segregated into two independent software levels as follows:

(i) Executive software shall consist of the coding that performs the input, internal and output operations that are defined within the individual interlocking application logic. The executive software shall be configured on a closed loop principle to ensure that the individual vital microprocessors operate in a fail-safe manner. The executive software shall reside in read-only memory.

(ii) Application software shall be segregated from the executive software and consists of the vital signal logic defining a specific interlocking configuration. The application software shall derive its safety from signal circuit design practices similar to that used for relay logic.

(c) For large interlockings (more than four power switches and/or movable point frogs), the VMIS system shall be segregated into zones and configured in a manner that failure in one zone will not affect the operation of an adjacent zone. Redundant microprocessors (normal and warm standby) shall be provided at interlocking locations and configured such that shut down of the primary microprocessor would automatically transfer control to the standby unit.

(d) Individual microprocessor units shall interface with the Control Center and other microprocessor units. Vital relays are permitted to provide interface between locations/wayside signal equipment only when necessary due the absence of a microprocessor at a location.

(e) The VMIS shall be equipped with a data recorder and diagnostic system capable of being accessed on-site at the VMIS location using a standard laptop personal computer, and remotely using a diagnostic terminal. The diagnostic system shall be capable of identifying a failure, the nature of the failure and failure location.

(f) Individual VMIS units shall be equipped with protection against power surges. The VMIS units shall be protected against high levels of electric noise transmitted from external sources including radio, Rolling Stock propulsion systems and hi-tension commercial power lines. Lightning protection including appropriate lightning arresters and equalizers shall be provided at input terminals interfacing with wayside signal apparatus.

9.6 Train Detection

(a) Train detection shall be accomplished by using track circuits.

(b) The design of the Rolling Stock propulsion systems and selection of track circuit frequencies and modulation schemes shall be coordinated to preclude interference between the Rolling Stock and the train control system.
(c) A shunt with 0.06 Ohm resistance or less at any point between the two rails of any track circuit shall cause the track circuit to indicate train occupancy. Shunt fouling shall not be allowed. Separate track circuits or series fouling shall be used for all turnouts. Track circuits and associated bonding shall be designed to provide broken rail protection.

9.7 Wayside Signals

9.7.1 Wayside Signal Type, Location, and Designation

(a) Standard railroad LED color light signals, including backgrounds and hoods, and split junction box bases shall be provided at each interlocking.

(b) Wayside signals shall be located to the right of the track governed, close to the train operator's eye level, to the extent practicable. Signals should be located to provide a non-obstructed view from the operator's cab, and should be viewable from a distance not less than 1,000 feet in approach to the signal.

(c) The Concessionaire shall develop a standard interlocking such that corresponding switches and signals at each interlocking have the same number designation.

9.7.2 Wayside Signal Lighting

Approach lighting shall be used and signal light(s) shall be extinguished when the track circuits in approach to a signal are unoccupied. Approach lighting shall be activated two blocks in advance of a signal. Exceptions to this shall include the first signal approached when leaving non-signaled territory and entering signaled territory, which shall be lit continuously. Under all circumstances the over-riding requirement shall be to provide a clear and unmistakable aspect at least 1,000 feet in advance of an approaching train.

9.7.3 Light-Out Protection

Light-out protection with automatic signal downgrading shall be provided on interlocking signals so that any light-out condition will result in the signal displaying an aspect that is both valid and not less restrictive. Light-out condition shall be indicated to the Control Center.

9.7.4 Red Signal Violation

Where applicable, signals shall be equipped with a positive means of detecting a red signal violation. Red signal violations shall be recorded at the local data recorder, as well as being sent to the Control Center.

9.7.5 Wayside Signals for the DUS Rail Segment

Wayside signals that are located on lines without cab signals shall have the standard red, yellow, green aspects. A red aspect shall indicate a stop and stay. A yellow aspect shall indicate that the route is lined and locked and the block is clear to the next signal. A green aspect shall indicate that the route is lined and locked and there are two clear blocks beyond the signal displaying the green aspect. In addition, tracks onto which Amtrak rolling stock can be routed shall be equipped with wayside PTC systems compatible with the onboard PTC systems installed on Amtrak locomotives.
9.8 Cab Signals

9.8.1. Carborne Aspect Display Unit

(a) The train control system shall include a unit for displaying speed and route permission information in the active operating cab of the Rolling Stock. The carborne display information shall be clearly visible in all lighting conditions in the cab.

(b) The information displayed shall be updated regularly such that the train operator is never shown a proceed aspect of higher speed than is safe at the location at which the aspect is displayed. Fault conditions both within the carborne equipment and associated with the car-to-wayside data transfer shall cause display of the most restrictive aspect.

(c) Each cab signal shall have only one indication (meaning/operating instructions), which is the same throughout the Rolling Stock fleet. The system shall have multiple cab rates, each used to indicate a different cab signal aspect.

9.8.2. Cab Signals for the DUS Rail Segment

The Concessionaire shall provide cab signals for the entire DUS Rail Segment except on tracks that are used exclusively by Heavy Rail Operators. Speed codes within the DUS Rail Segment shall be limited to a maximum of 15 MPH. A train berthing in a platform track shall receive the lowest speed command with the train operator being responsible to stop his train short of the bumping post.

9.8.3. Departure Test Loops at the CRMF

The train control system shall include departure test cab loops at entry points to the mainline from the CRMF. The test loops shall test the on-board signaling equipment of each Car that is re-entering equipped territory from a non-equipped area and prove that it is functioning correctly. Signal control circuits shall be arranged such that it is not possible to get a signal aspect to depart the CRMF without having first passed the appropriated departure test.

9.9 Track Switches and Turnouts

9.9.1. Mainline Track Switches and Turnouts

(a) Switches shall be dual control (motor driven/manual) switch machines, conforming to AREMA C&S Manual, 12.2.1 (Recommended Design Criteria and Functional Guidelines for Lockable Electric Motor Switch Operating Mechanism). Switch machines shall be equipped with operating rods, lock rods and point detectors. A helper rod assembly shall be provided for each turnout greater than #15 and an associated switch circuit controller shall be provided for the helper rod assembly on each turnout greater than #20.

(b) Switch heaters/snow melters shall be provided at all switch locations. The Concessionaire shall ensure that heaters are sufficiently rated and provide sufficient coverage of the switch points, rods, and stock rail to keep them free of ice and snow. Switch heaters shall operate automatically and manually. An indicator shall be provided at the control equipment enclosure and on the exterior of the equipment house to indicate that the unit is on.
9.9.2. Switch Machines on the DUS Rail Segment

Switch machines and switch heaters in the DUS Rail Segment shall be considered mainline track switches.

9.9.3. Switch Machines at the CRMF

(a) Switches that are on the mainline extending into the CRMF shall be considered mainline track switches.

(b) Switches within the CRMF shall be in accordance with Part 4.2.5 (Recommended Design Criteria for Switch Operating Mechanism for Yards) of the AREMA Communications and Signals Manual. Switches in the yard shall have three-position switch circuit controllers in accordance with Part 12.1.1 (Recommended Design Criteria for Switch Circuit Controller) of the AREMA Communications and Signals Manual.

9.10 Highway-Rail Grade Crossings

(a) The Concessionaire shall design, furnish, install and test the highway-rail grade crossing warning systems at locations where the commuter rail alignment and streets/highways intersect. At grade crossings where the commuter rail alignment and Parallel Railroad Tracks share the grade crossing, the Concessionaire shall install grade crossings in accordance with any applicable Railroad Agreement and Section 3 (Railroad-Related Work) of this Part B.

(b) Highway-rail grade crossing protections shall protect train movements in both directions on all tracks.

(c) Grade crossing warning system equipment layouts and control designs shall be submitted to RTD and the PUC. [CDRL #7B-17]

9.10.1. Warning Systems

(a) Grade crossing warning systems shall be designed in accordance with the requirements of applicable Law and the applicable standards of:

(i) MUTCD;

(ii) FHWA Railroad-Highway Grade Crossing Handbook;

(iii) Part 3.1.10 (Recommended Functional/Operating Guidelines for Interconnection Between Highway Traffic Signals and Highway-Rail Grade Crossing Warning Systems) of the AREMA Communications and Signals Manual;

(iv) Part 3.3.10 (Recommended Instructions for Determining Warning Time and Calculating Minimum Approach Distance for Highway-Rail Grade Crossing Warning Systems) of the AREMA Communications and Signals Manual; and

(v) U.S. Department of Transportation Highway-Railroad Grade Crossing Technical Working Group.
Warning devices for highway-rail grade crossings shall be installed, and at a minimum shall include gate arms and mechanisms, gate arm lights, LED flashing light units, operator indicators, electronic bells, signs, approach and island track circuits, standby/backup battery, and associated control circuitry as required. High wind guards and gate keepers shall be provided.

9.10.2. Design Requirements

(a) The design of each highway-rail grade crossing shall be determined based upon site specific requirements. Crossing designs shall be consistent with those measures necessary for the establishment of a quiet zone defined in 49 CFR 222.35, where designated in the Environmental Permits. Crossings equipped for quiet zones shall have constant warning train detection. Except as directed otherwise by PUC, the total warning time shall be 20 seconds, plus any additional warning time that may be required for clearance and/or traffic preemption. Where a station platform is within the start of a highway-rail grade crossing, location of the approach circuits shall take into consideration a station dwell time of 35 seconds.

(b) The Concessionaire shall perform an engineering analysis using a qualified traffic engineer to ensure that the Clearance Time and Exit Gate Clearance Time, where existing, are adequate for the conditions at each crossing. In addition, the traffic engineer shall ensure that the advance preemption time for those crossings interconnected with traffic signals is adequate. The Concessionaire shall submit a report of the engineering analysis to RTD for review. [CDRL #7B-18]

9.10.3. Near-Side Station Stops

In situations where a station stop occurs within the normal start for a crossing, a positive stop at the end of the station platform shall be enforced through the train control system. The gates shall be timed to start the pre-emption and warning cycle based on the anticipated dwell time and the train operating through the platform area at a defined reduced speed. The system shall avoid double activation of the warning cycle.

9.10.4. Second Train Warning Times

(a) Crossing starts for crossings not in single track territory shall have a second train phase of 10 seconds, ± 5 seconds preceding the normal start location for the crossing. During this second train phase, if the first train clears the crossing, and there is a second train within 10 seconds of the crossing, the gates shall not rise. A second train sign shall illuminate on each gate to indicate to the public that a second train is coming and the gates shall remain down until the second train clears the crossing.

(b) The second train sign shall be a blank out sign so that the wording cannot be read when the sign is not energized. There shall be a flashing element associated with the border of the sign to draw attention to the sign.

(c) Preemption warning time (PWT) shall run concurrently with the second train phase such that if the crossing where PWT is in effect is already activated, the traffic light preemption shall remain in effect until the second train clears the crossing.
9.10.5. Closed Circuit Televisions (CCTVs)

Each highway-rail grade crossing shall be equipped with a CCTV system comprising at least two cameras. Each camera installed at a crossing shall be equipped to operate on infrared light so that the images shall be clear, even in low light conditions, and shall be mounted such that the entire roadway protected by gates is visible in the image(s). Activity at the crossing shall be routed back to the Control Center and digitally recorded, with sufficient storage capacity for a minimum of 24 hours activity at each grade crossing.

9.10.6. Grade Crossing Equipment Failures

(a) Activation and operational failures of highway-rail grade crossing warning systems shall cause an alarm to be sent to the Control Center and the authorization to the approaching train to be reduced to the most restrictive signal. If crossing gates remain down for more than 2 minutes, an alarm shall be sent to the Control Center.

(b) Exit gates shall fail in the up position, unless directed otherwise by PUC.

9.10.7. Shared Grade Crossing Interface Circuits

At a minimum, the following interface circuits shall be provided at shared highway-rail grade crossings:

(i) Crossing Control (XR);

(ii) Gate Up (GPR);

(iii) Gate Down (GDR); and

(iv) Exit Gate Down (EGDR – if applicable).

9.10.8. Pedestrian Platform Access Crossing Warning

(a) Detection and warning of trains approaching and departing stations shall be provided in locations where the access to the platform is at-grade across the commuter rail tracks. Warning devices shall be as described in Section 6.4.3 (Pedestrian Platform Access Crossings) of this Part B.

(b) The Concessionaire shall coordinate details of the warning time and system design with RTD through the Safety and Security Working Group and Periodic Design Review Meetings.
10. **COMMUNICATIONS AND CONTROL SYSTEM**

10.1 **General Communications Requirements**

(a) The Communications and Control System (CCS) shall include the equipment and functionality necessary for the safe and reliable control and monitoring of systems and equipment at stations and on the wayside, communication with commuter rail and Railroad operating and maintenance personnel, and transmission of visual and audible announcements to Passengers.

(b) The CCS shall meet the service performance criteria requirements of Attachment 10 (*O&M Specifications*), and where appropriate, be designed to easily accommodate the future inclusion of North Metro Corridor services and the expansion of Northwest Rail Corridor services beyond South Westminster. The Concessionaire shall also provide systems for the exclusive use of RTD, as described in Section 10.8 (*Communications System for RTD Use*) of this Part B.

(c) The CCS shall comply with applicable Law and documents identified in Appendix 1 (*Regulations, Codes and Standards*) to this Attachment 7, and as specifically listed within this Section 10.

(d) The CCS shall include:

(i) a central monitoring and control system to allow dispatchers at the Control Center to remotely monitor and control trains, stations, passenger elevators, train control system equipment, communication equipment, the Fare System Equipment and TES equipment;

(ii) equipment interconnecting the Control Center with stations, signal equipment houses, communication equipment houses and cases, elevators, the Fare System Equipment, traction electrification system locations, and related systems equipment;

(iii) a CCTV video surveillance system enabling the Concessionaire's personnel at the Control Center to monitor and record activity at stations, pedestrian bridges, elevators, and parking facilities;

(iv) provision for images from the Concessionaire's cameras at the DIA station platform to be made available to the DIA security room for display;

(v) provision for a Passenger Information System (as described in Section 10.4 (*Passenger Information System*) of this Part B), controlled from the Control Center, enabling audible and visual text display of passenger information at stations;

(vi) radio systems capability for commuter rail operations and maintenance communications, and for Railroad dispatching and operational coordination;


(vii) telephone connectivity for voice communication from the Control Center to RTD, emergency responders, other commuter rail personnel and to outside personnel;

(viii) an emergency telephone system installed in elevators, passenger tunnels, rail tunnels, and on platforms (except DUS platforms, where RTD will provide and monitor the phones). These telephones will be monitored by Concessionaire personnel at the Control Center (except DIA platform phones, which shall be routed for monitoring by DIA personnel at the DIA security room);

(ix) a voice, data and video transmission system; and

(x) a fiber-optic cable and IP transmission network, and associated equipment cases, provided for the exclusive use of RTD.

10.2 Central Control System

The Concessionaire shall provide central control systems that enable the functions required under Section 2.4 (Operating Plan) and Section 8 (Security) of Attachment 10. The Control Center systems shall be capable of supporting operation of services on the Commuter Rail Network, and be readily expandable (through software modification and equipment additions, but without alteration or addition to the facility) for inclusion of the same functionality for operation of the Northwest Rail Corridor and the North Metro Corridor.

The Concessionaire shall monitor (and communicate opened (alarm) status to RTD) seven alarm data points per station from the Fare System Equipment and the RTD equipment cases described in Section 10.9.2.

Each dispatcher and dispatch supervisor work area shall be equipped with a multi-function, multi-line telephone. Each such telephone shall include autodial or 'hotline' capability to facilitate communication between the dispatcher and the following locations:

(a) RTD bus dispatch center;
(b) RTD light rail control center;
(c) RTD's security office at DUS;
(d) DIA's emergency operations center; and.
(e) CCD's emergency management office.

10.3 Radio System

(a) The Concessionaire shall provide the equipment to enable communication over RTD-provided talk groups necessary for commuter rail operations and maintenance, including:

(i) mobile radios for both revenue and non-revenue vehicles;
(ii) portable radios;
(iii) dispatcher radio consoles; and

(iv) amplification equipment to improve coverage as needed to meet the Concessionaire's radio communication needs, which shall be subject to approval by the consolidated Communications Network of Colorado.

(b) RTD will provide five talk groups on its voice radio system for the Concessionaire's use. Any poor coverage areas that do not meet the Concessionaire's requirements are the Concessionaire's responsibility to improve.

(c) Radio conversations initiated and received in the Control Center shall be recorded in accordance with applicable Law and Section 2.4 (Operating Plan) of Attachment 10.

(d) The Concessionaire shall provide in the Control Center the necessary radio equipment to enable dispatching of Heavy Rail Movements from DUS and for communication with Railroad dispatchers and engineers, as necessary to facilitate the hand-off of traffic between control territories.

(e) RTD will be responsible for the programming of all radios. If required, the Concessionaire shall provide to RTD the necessary over-the-air programming application for the selected model of radio.

(f) The Concessionaire shall establish an inventory of radios, which shall be made available for periodic audit by RTD.

10.4 Passenger Information System

The Passenger Information System shall enable the functions required for incident management; see Attachment 10 (O&M Specifications) and shall be compliant with ADA requirements and the following requirements.

10.4.1. Coverage Areas

The PA system in each station shall provide intelligible voice-grade announcement service for the following station areas:

(i) covered areas of each station platform;

(ii) platform entrances and exits; and

(iii) elevator lobby waiting areas.

10.4.2. Coverage Quality

The Concessionaire shall design the PA system and especially placement of loudspeakers so as to produce even sound levels at a height of 5 feet 0 inches above finished grade in all coverage areas with no more than a ±3 dB difference throughout any coverage area. System power, speaker ratings, and speaker quantity shall be adequate to meet the sound pressure level requirements shown below.
10.4.3. **Automatic Volume Control and Speech Processor**

Each station shall be equipped with an automatic volume control system that senses the ambient noise level and adjusts the station PA level to approximately 15 dB above ambient noise level. This criteria shall be met both when a train is, and when a train is not, in the station. Speech processing equipment shall be provided to improve intelligibility through the use of frequency shaping and dynamic range compression.

10.4.4. **Displays**

Variable message displays shall provide the capability of providing next train countdown and arrival information, as well as ad-hoc emergency or customer service information transmitted from the Control Center.

10.5 **Telephone System**

10.5.1. **Central Telephone System**

(a) The Concessionaire shall provide telephone systems as required for administration, operations and emergency communications on the Commuter Rail Network and at the Control Center.

(b) The system shall include provisions for recording all telephone conversations initiated and received in the Control Center, in accordance with Section 2.4 (*Operating Plan*) of Attachment 10.

10.5.2. **Emergency Telephones**

(a) The Concessionaire shall provide emergency telephones at stations (except DUS), parking facilities, pedestrian bridges and elevators in accordance with its Operating Plan as set forth in Section 2.4 (*Operating Plan*) of Attachment 10 and Section 14 of the RTD Commuter Rail Design Criteria.

(b) When activated by pushbutton, the emergency telephone shall automatically connect to a monitoring station at the Control Center, except for those telephones at DIA platforms. The DIA station platform emergency telephones shall be cabled by the Concessionaire to an interface point in the DIA concourse and programmed to connect to the DIA security center. DIA will provide dial tone for the telephones on the DIA station platform.

(c) Emergency telephones shall be constructed to a minimum NEMA 3R rating and be UL and FCC approved and ADA compliant. The phones shall be capable of off-site live monitoring of emergency conversations.

10.5.3. **Blue Light Telephones**

Blue light telephones shall be placed in tunnels where necessary to meet NFPA 130 requirements. On activation by pushbutton, the blue light telephones shall automatically ring down to a Concessionaire-staffed monitoring station at the Control Center.
10.6 Video Surveillance

10.6.1. General CCTV Requirements

(a) The Concessionaire shall provide a CCTV video surveillance system that meets the requirements of (or provides the performance and functional equivalent of) Section 14 of the RTD Commuter Rail Design Criteria and Section 8 (Security) of Attachment 10.

(b) The video surveillance system shall meet the capture, transmission and recording recommendations of APTA's Technical Recommended Practice for The Selection of Cameras, Digital Recording Systems, Digital High Speed Train Lines and Networks for Use in Transit Related CCTV Systems.

(c) The system shall provide full coverage, consistent with APTA SS-SIS-RP-002-08 (Recommended Practice for CCTV Camera Coverage and Field of View Criteria for Passenger Facilities), using a combination of fixed and movable cameras, of platforms, pedestrian bridges and tunnels, transition plazas, elevators and parking structures.

(d) The video from this system shall be stored and routed to the Control Center where monitoring facilities shall be provided. It shall be possible to view any of the video feeds real time at the Control Center. At any time at least 12 real time feeds per corridor shall be routed and displayed at the Control Center.

(e) The Concessionaire shall provide one security dispatch desk for each corridor at the Control Center that each include capability for monitoring of not less than six CCTV images, as well as radio and telephone access.

(f) The Concessionaire shall provide to RTD, through a network connection at DUS, the ability for view-only access to CCTV images from all cameras on the system.

10.6.2. DIA CCTV Requirements

In addition to storing, routing and monitoring the camera feeds at the DIA station platforms at the Control Center, the Concessionaire shall provide ± 1 Volt NTSC video of these camera feeds to a video bulk head at an interface point in the DIA concourse, to enable monitoring by DIA security personnel.

10.7 Equipment Grounding

All communications and central control equipment in this Section 10, including that to be operated and maintained by RTD, shall have grounding and surge protection sufficient to protect personnel and to avoid equipment damage from surges or lightning strikes.

10.8 Communications System for RTD Use

(a) The Concessionaire shall design, install, and configure an IP transmission network for RTD's exclusive use on the Commuter Rail Network in accordance with the requirements of this Section 10.8. RTD will maintain and operate this network.
(b) The IP transmission network shall have IP switches installed in RTD equipment cases at every station, including DUS station and DIA station, and at the CRMF.

10.9 RTD's IP Transmission Network

(a) At DUS the IP switches shall be installed in the RTD provided Data Center dedicated for that purpose. Conduit from the platform area to the Data Center will be provided by the DUS Infrastructure Contractor, as defined in Attachment 3 (The DUS Infrastructure).

(b) IP switches shall be installed in RTD equipment cases provided and installed by the Concessionaire, and shall meet or exceed the following requirements:

(i) one gigabit backbone transmission capacity over single mode fiber optic cable;
(ii) a minimum of 16 10/100 Mbps ports;
(iii) full wire speed capability on all ports simultaneously;
(iv) environmentally hardened with the ability to operate from -10 °F to 167 °F;
(v) simple network management protocol monitoring and reporting capabilities;
(vi) support for IGMP and IP multicasting and filtering;
(vii) IEEE 802.1 AB standard Link Layer Discovery Protocol;
(viii) support at least 6 port-based IEEE 802.1Q standard VLANs.
(ix) support IEEE 802.1W Rapid Spanning Tree protocol; and
(x) redundant power supplies and management modules.

10.9.1. RTD's Communications Fiber Optic Cable System

(a) The RTD communications fiber optic cable system shall meet the following requirements:

(i) Fiber strands shall be SMF-28e, suitable for both wet and dry installation, and of the highest quality, assuring durability for a forty (40) year design life.

(ii) The outer jacket shall be made of extruded, black, low-density, high molecular weight polyethylene capable of meeting material Type I, Class C, Category 5, Grade E5 of ASTM D1248.

(iii) Each cable shall be permanently identified as to the manufacturer and year of manufacture at not less than thirty (30) inch intervals.

(iv) Each outdoor cable shall be permanently marked with footage numbers embossed into the outer jacket at a minimum of twenty –four (24) inch intervals.
(v) The cable manufacturer shall have a minimum of five years of demonstrated background and 2,000,000 feet of fiber optic cable supplied and installed successfully.

(vi) Connectors shall comply with Telcordia GR-326.

(vii) Each cable shall meet or exceed the requirements of REA PE-90.

(viii) Each cable shall have a dielectric central member. The dielectric member shall be over-coated with black colored thermoplastic.

(ix) Cables shall have a tensile strength of six hundred (600) pounds, minimum.

(x) Wherever terminated or spliced, cables shall be fitted with connectors and supported in a fiber distribution enclosure. Each fiber distribution enclosure shall accommodate at least the termination of 75% and the splicing of 50% of all fibers entering and exiting it. Cables shall not be spliced in manholes or handholes.

(xi) Cables shall be designed to be moisture and dust resistant.

(xii) Fibers shall be installed in loose buffer tube, with color coding that conforms to ANSI/TIA/EIA 598-B.

(xiii) Fibers shall be colored with ultraviolet curable inks adhering to color coding of ANSI/TIA/EIA 598-B.

(xiv) Fibers shall be identical in design and construction, except for color coding.

(b) From DUS to DIA along the East Corridor, a 60-strand single mode cable shall be installed. The cable shall be terminated or spliced at RTD's direction at each station and at DUS. The Concessionaire shall assume that at a minimum at least 24 fibers will be spliced through and 24 each way terminated. In addition, four manholes shall be provided between DIA and 40th/Airport stations, at locations to be agreed with DIA, adjacent to (but outside of) the commuter rail right of way boundary closest to Peña Boulevard, from which lateral connections can be made into the cable.

(c) From DUS to Ward Road along the Gold Line, the IP transmission network shall have a 48-strand single mode cable. The cable shall be terminated or spliced at RTD's direction at each station and at DUS. The Concessionaire shall assume that at a minimum at least 12 fibers will be spliced through and 18 each way terminated.

(d) From DUS to South Westminster along the Northwest Rail Electrified Segment, a 48-strand single mode cable shall be installed. The cable shall be terminated at South Westminster and at DUS.

(e) The Concessionaire shall ensure that data exchange between the RTD IP Network that the Concessionaire shall provide and RTD's base network occurs at the DUS data room.
10.9.2. RTD Equipment Cases

The Concessionaire shall furnish and install equipment cases for RTD's exclusive use within 50 feet of each of the Commuter Rail Network station platforms (one case per station). The equipment cases shall meet or exceed the following requirements:

(a) Materials shall be new, in current production, free of corrosion, scratches, or other such defects.

(b) The equipment cases for East Corridor shall be a minimum of 5' H x 4'-6" W x 1' D. A segregated barrier shall be provided to divide the width of the communication case into two equal separate compartments. Front and rear doors shall be provided for each segregated compartment to allow access to the front and rear of equipment.

(c) For the Gold Line and the Northwest Rail Electrified Segment, the cases shall be a minimum of 5' H x 2'-6" W x 1' D.

(d) Each compartment shall have an EIA 19" rack installed the vertical length of the compartment.

(e) Each equipment case shall be identified by an embossed metal name plate on the outside of the door of the housing. Information on the name plate shall indicate the station name.

(f) Doors of the equipment cases shall be securely lockable and of a tamper-resistant design. Locks shall be installed to accept the keying furnished by RTD.

(g) For equipment cases installed along East Corridor only, two different locking systems shall be provided, one for each side of the segregated compartment.

(h) To the maximum extent possible, equipment cases shall be physically placed in a location without risk of receiving road or rail splash or debris that would damage, increase the maintenance interval, or reduce the life of the enclosure or the contained equipment.

(i) The equipment cases shall include provision (size, cutouts, power, etc.) for future addition of HVAC equipment to maintain the air temperature within the equipment case between 50 and 86 degrees Fahrenheit.

(j) To size the HVAC the Concessionaire shall assume that the heat load is a minimum of 4 times the heat output of the equipment in the case furnished by the Concessionaire.

(k) Equipment cases shall be installed in accordance with local codes for structural and seismic bracing. Case construction and installation shall be in accordance with the Concessionaire's grounding and power distribution plans.

(l) Equipment case bottom support mounting angles shall be provided on either side, level with the bottom edge of the door opening, for horizontal support and bolt attachment. In addition, side case supports shall be provided for the upper case bolt attachments.

(m) The equipment cases shall meet NEMA 4X standards, and shall be of unpainted aluminum construction with a minimum wall thickness of 0.125 inches. The
Concessionaire shall apply one coat of alkyd primer and at least two coats of alkyd resin industrial enamel for a dry film thickness of six mils to interior floors. Color shall be medium light gray No. 49 in accordance with ANSI Z55.1.

(n) Lights shall be installed inside the equipment cases. The fixtures shall be mounted so as to illuminate both the front and rear of all compartments in the equipment case. The fixtures shall not interfere with access to any equipment case component. The fixtures shall be controlled from a door-operated switch located at the front door. The fixtures power shall be switched "ON" when either door is opened. Power for the light fixture shall be supplied from the load side of a 15 amp breaker.

(o) Each equipment case shall have a smoke detector with an alarm contact.

(p) Each equipment case shall have door intrusion detectors with an alarm contact. The intrusion detection circuit shall be in series through all door contacts to provide one common intrusion alarm when either door is not completely closed.

(q) Each equipment case shall have high and low temperature contacts. Temperature instrumentation shall trigger the alarm when temperature reaches a set high and a set low temperature. These alarm contacts shall be adjustable in one-degree increments.

10.9.3. RTD Communications Power System

(a) Cases shall be furnished complete with appurtenances necessary to supply the power required for the case and its equipment. The Concessionaire is responsible for arranging and paying connection charges to all equipment cases.

(b) The communications power system shall be a nominal 120 Vac power system for the RTD equipment cases installed by the Concessionaire. The system shall be configured to allow future implementation of being backed by a UPS system.

(c) The communications power system shall be sized to accommodate four 20 amps breakers in each equipment case compartment. The Concessionaire shall furnish and install the four 20 amp breakers in each compartment.

(d) The Concessionaire shall furnish, install, and source a power strip from one of the 20 amp breakers in the compartment where the RTD IP switch is installed and use this power strip as a source to power the switch.

10.10 Communication and Control System Documentation

(a) The Concessionaire shall prepare and review at Periodic Design Review Meetings, the following CCS design items:

(i) subsystem functional descriptions and design architecture;

(ii) equipment product submittals;

(iii) cable submittals;
(iv) block diagrams for each major subsystem;

(v) station platform layouts showing communication systems devices;

(vi) layouts for cases/house;

(vii) grounding and power system design;

(viii) layouts for equipment racks;

(ix) a table of configurable settings;

(x) software requirements and design documents for software; and

(xi) operating manuals for software and hardware.

(b) The Concessionaire shall submit Final Design documentation of the CCS to RTD. [CDRL #7B-19]
11. **Fare System Equipment**

11.1 *Fare System Equipment Work*

(a) RTD is responsible for the procurement, installation, commissioning and maintenance of Fare System Equipment.

(b) The Concessionaire shall install the following for each set of Fare System Equipment:

   (i) foundation pads, as specified by RTD;

   (ii) power conduits and power cables, junction boxes and protective devices;

   (iii) conduits (with pull strings) for data cables routed from the Fare System Equipment locations to the communications transmission network interface point; and

   (iv) shelters over the equipment.

(c) Each station shall include locations for four sets of Fare System Equipment in the main entrances/plaza areas, under shelters. The locations shall be such that passengers must pass the equipment when both entering and exiting the platform area from each station access point, but that Passengers queuing at the Fare System Equipment do not impede the movement of other Passengers. RTD reserves the right to install only two sets of Fare System Equipment initially, depending on ridership and station layout.

(d) The Concessionaire shall coordinate with RTD where the Concessionaire's individual station designs present more than two primary entrance locations and additional locations for Fare System Equipment may be required.

11.2 *Fare System Equipment Submittals*

The Concessionaire shall submit to RTD conduit plans and power distribution plans that show the facilities provided for the Fare System Equipment at each station. Plans shall be of sufficient detail that they can be used directly by RTD's equipment installation contractor. [CDRL #7B-20]
12. **TRACTION ELECTRIFICATION SYSTEM**

12.1 **Scope of the Traction Electrification System**

The Concessionaire shall provide a Traction Electrification System (*TES*) for the East Corridor, Gold Line, Northwest Rail Electrified Segment, the CRMF and the DUS Rail Segment. In addition, the traction power supply system shall have sufficient output capacity to provide service on the North Metro Corridor, as defined in Section 12.1.2 (*Provision for North Metro Corridor*) of this Part B.

12.1.1. **Overall TES Requirements**

(a) The TES shall consist of an integrated electrical power supply and distribution system comprising the following major subsystems:

   (i) Traction Power Supply System (*TPS*);

   (ii) Traction Power Distribution System (*TPDS*), which includes the OCS; and

   (iii) Traction Power Return System (*TPRS*), which uses elements of other systems, such as running tracks and impedance bonds.

(b) The TES shall:

   (i) supply power (motive and auxiliary) to Rolling Stock that uses pantograph current collection with current return through the running rails, at 25 kV AC, single phase, 60 Hz;

   (ii) draw primary power from the Utility transmission network at 115 kV, 60 Hz;

   (iii) support operation of service of the same train consists and at the same design headways as the train control system set forth in Section 9.2.2 (*Headways and Block Layout*) above; and

   (iv) include two substations, one at Sandown and one at Argo, that provide power to all equipment fed from the TES.

(c) The TES topology shall conform to either a direct feed system, with power supply and distribution at 25 kV between overhead conductors and track rails, or to an autotransformer feeder system (*AFS*) utilizing 2 x 25 kV supply with one 25 kV polarity carried by wayside feeder conductors and the other by the OCS, or a combination thereof.

(d) Use of booster transformers within the TES is subject to RTD approval.

(e) Except as explicitly stated otherwise in this Section 12 and in accordance with RTD-approved variances, the Concessionaire's design and construction shall conform to the requirements of Section 9 of the RTD Commuter Rail Design Criteria.

(f) The TES shall comply with applicable standards in Appendix 1 (*Regulations, Codes and Standards*) of this Attachment 7.
12.1.2. Provision for North Metro Corridor

(a) Provision for North Metro Corridor within the TPS design shall be based on the alignment plans included as Reference Data Item No. 1NM and the following operational parameters:  

(i) Peak load point capacity for the peak hour based on forecast ridership in 2035 is 2200 Passengers; 

(ii) Peak period headways shall be 15 minutes; and 

(iii) Train size and configuration shall be calculated by the Concessionaire, consistent with the approach used for the Commuter Rail Projects.

(b) The TPS design shall include necessary provisions for the future implementation of the North Metro Corridor, which is not included in the Work but which may require addition of switchgear but shall not require significant modification to the base system equipment.

12.2 Traction Power Supply System

(a) The TPS shall receive bulk power from the power Utility Owner, transform it to utilization voltage levels, and then supply that power to the TPDS for delivery to the Rolling Stock and return that power via the TPRS to the TPS. The TPS shall include all necessary equipment from the primary power supply connection points at the power Utility to the connections with the TPDS and TPRS and for sectionalizing the TPDS. The TPS shall include the following facilities (as necessary):

(i) Traction Power Substations (TPSS) – to interconnect with Utility primary supply points and transform that supply to the TES distribution voltage level(s);

(ii) Autotransformer/Paralleling Stations (APS) – to parallel and sectionalize OCS sections;

(iii) Switching Stations (SWS) – to separate supplies from different TPSS phases; and

(iv) Auxiliary Power Supply Stations (APSS) – to transform power from the TPDS for the supply signal houses, track switch heaters and ancillaries (as necessary).

(b) The TPS shall monitor, control, sectionalize and protect the electrical elements of the TES. Circuit breaker switchgear for 25 kV shall be provided to protect OCS sections and traction transformers.

(c) The interface limits of the TPS, whether with power Utility or with other Concessionaire systems or subsystems may be adjusted by the Concessionaire to suit its design and the interconnection agreement with the power Utility. Requirements of regulatory bodies
including PUC, Federal Energy Regulatory Commission (FERC) and Western Electricity Coordinating Council (WECC) shall be satisfied.

12.3 Traction Power Distribution System

The Traction Power Distribution System (TPDS) shall include the Overhead Contact System (OCS) and (if included in the design approach) the Autotransformer Feeder System (AFS).

12.3.1. Overhead Contact System

The OCS shall consist of an arrangement of structures, support assemblies and conductors installed over the rail tracks that deliver the 25 kV single phase power supplied by the TPS to the pantographs of the trains.

12.3.2. Autotransformer Feeder System

If included, the AFS shall supply 25 kV power with polarity opposite to the OCS to each autotransformer. AFS conductors shall comprise bare aerial conductors on insulators, mounted on OCS structures connected to autotransformers at paralleling stations. AFS conductors and connections shall have capacity to carry traction currents and withstand fault current levels without damage.

12.4 Traction Power Return System

The TPRS shall utilize the running rails and include rail bonds, impedance and cross bonds, rail return cables and static wires.

12.4.1. Impedance Bonds

(a) Impedance bonds shall be installed in the running rails at:

(i) insulated rail joints to maintain electrical continuity for traction currents;

(ii) periodic intervals to ground running rails to the track static wire and for cross bonding tracks; and

(iii) TPSS, SWS and APS locations to return traction current from running rails to the ground return buses.

(b) The Concessionaire shall not directly connect signaled track rails to OCS poles.

12.4.2. Static Wire

(a) The TES shall use aerial bare static wires to carry traction current return and to ground OCS structures, including poles, except as required below. One continuous wire mounted on OCS poles and support assemblies shall be provided for each electrified track, for the length of the track. Where two electrified tracks are adjacent, the static wires may be combined into a single wire for center poles, headspans and portals. At stations, static wires shall be insulated from OCS structures to a minimum of 5 kV, and be electrically
connected to ungrounded un-energized parts of double insulated OCS support assemblies installed over station platforms.

(b) The static wire shall be electrically connected to the structures with a flexible bond of compatible material. Static wires of parallel tracks shall be cross-connected at overhead bridges, portals, impedance bonds, and at suitable intervals, using a conductor of the same type as the static wires.

(c) Static wires and their connections, including cross-connections, shall be sized to carry traction return currents and withstand fault current levels without damage. Static wires shall be located on OCS structures in accordance with the Insulation Coordination Study results set forth in Section 12.5.1.4 (Insulation Coordination Study) of this Part B.

12.5 Traction Electrification System General Requirements

(a) The TES shall perform under characteristic traction load conditions, which include:

(i) highly frequent short circuits to track rails and to ground;

(ii) axial and radial pulsating forces in equipment due to fluctuating traction loads;

(iii) heating from harmonics generated by the Cars; and

(iv) regenerated power flows from the trains back into the supply.

(b) The TES shall be designed in coordination with train harmonic characteristics on the traction power side, and regenerated power magnitudes and profiles, and shall control excessive harmonic levels and prevent resonances. The TES shall comply with the recommendations in EN50121-5 to prevent interference with facilities and systems of the commuter rail network and its environment.

(c) The TES design shall be coordinated with anticipated operational and maintenance procedures and practices and shall address:

(i) dimensioning of OCS equipment to permit maintenance of OCS wiring on one mainline track while any adjacent mainline track is in operation;

(ii) operation of track maintenance equipment under OCS;

(iii) the presence of trains from other Heavy Rail Operators on tracks crossing or adjacent to the commuter rail tracks; and

(iv) provision of procedures, tools and equipment for OCS maintenance staff to make portions of the system safe for other staff to work nearby.

(d) The TES shall be designed to meet applicable Fire Department codes.
12.5.1. TES Design Studies

(a) The Concessionaire shall perform the following studies (as further defined below) prior to detailed design of the TES:

(i) Computer-Aided Traction Power Load Flow Study

(ii) Utility Impact Study (Unbalance, Harmonics, Power Factor, Flicker)

(iii) Electromagnetic Interference (EMI) Study

(iv) Insulation Coordination Study

(v) Systemwide Grounding and Bonding Study

(vi) Short Circuit and Relay Coordination Study

(vii) Arc Flash Hazard Study

(viii) Transient Recovery Voltage (TRV) Study

(b) For each study, the Concessionaire shall review with RTD at Periodic Design Review Meetings and, in accordance with applicable requirements of any and all necessary interconnection and maintenance agreements with the Utility, submit to the power Utility:

(i) a statement of the scope of each study before commencing the study;

(ii) a draft report at Preliminary Design; and

(iii) a Final Design report incorporating comments of RTD and the Relevant Authorities.

(c) The Concessionaire shall perform any additional power studies required by any Utility or any Relevant Authority.

12.5.1.1 Traction Power Load Flow Study

(a) The Concessionaire shall use a computer program with a demonstrated track record in modeling of 25 kV traction power designs to perform a traction power load flow study to confirm the capability of the TPS to perform within acceptable performance levels under normal and contingency conditions. It shall confirm the suitability of location of traction power substations, switching station, and paralleling stations and the required ratings of the TPS equipment, conductors and cables. As design progresses, input assumptions shall be replaced with actual system characteristics.

30 NOTE: See Reference Data Item No. 3S.
(b) At a minimum, the study shall be performed for the following contingencies under 2035 peak period operations (assuming no regeneration by trains):

   (i) Normal condition, all substations and paralleling stations in service;

   (ii) Single contingency:

   (iii) Any one autotransformer/paralleling station out of service at a time;

   (iv) Any one transformer at the substation out of service; or

   (v) Any one section of OCS and feeders (for autotransformer (AT) system) between two consecutive interlockings or between two autotransformer/paralleling stations out of service at a time; and

   (vi) Double contingency:

      (A) Any two substation transformers out of service;

      (B) Two autotransformer/paralleling stations (not consecutive) out of service at a time; or

      (C) One autotransformer/paralleling station and one section of OCS out of service at a time.

(c) The system performance determined from the study for opening day service shall be verified by test.

(d) The study shall include and take into account the load resulting from implementation of the North Metro Corridor.

12.5.1.2 Utility Impact Study

(a) The power Utility Owner has performed a utility impact study for the Commuter Rail Network.

(b) The Concessionaire shall pay all costs for any power Utility Owner to repeat its utility impact study if the power Utility Owner determines that the Concessionaire's design is significantly different from RTD's preliminary design. If the repeated utility impact study determines that any parameters, (such as harmonic distortion, unbalance, power factor and flicker at the point of common coupling, and possible resonance with Utility equipment) exceed the power Utility Owner's acceptable limits, the Concessionaire shall provide suitable mitigation measures within the TES in accordance with Section 36.1 (Concessionaire Proposed Change) of the Agreement.

(c) The Concessionaire shall pay any and all costs for the power Utility Owner to repeat the utility impact study to test such mitigation measures.
12.5.1.3 EMI Study

(a) The EMI study shall determine the inductive and capacitive effects of single-phase alternating current traction loads on the trackside installations of signaling, telecommunications, other buried or overhead communications circuits running parallel to the railroad tracks, and whether any mitigation is required.

(b) The following limits, specified in ITU-T Recommendation K.68 (Operator responsibilities in the management of electromagnetic interference by power systems on telecommunication systems), shall be used to determine the need for mitigation:

(i) normal – 60 V

(ii) short circuit condition – 430 V

(c) These limits may be changed only by mutual agreement with the owners of impacted Utilities.

(d) The study shall determine the effect of capacitive coupling in metallic objects in the vicinity of the electrified track. Mitigation measures shall be determined by mutual agreement with the owners of impacted Utilities.

(e) High frequency emissions from the substations shall be compliant with EN50121-5.

12.5.1.4 Insulation Coordination Study

(a) The Concessionaire shall perform an insulation coordination study using an RTD approved industry standard computer program, such as Electromagnetic Transients Program (EMTP). The study shall determine the location and ratings of surge arresters for the TPS and TPDS, to coordinate with the basic impulse levels (BILs) specified for various equipment.

(b) Surge arresters shall be required along the OCS at periodical intervals, at overhead bridges with low clearances, at the trackside gantry at the traction power supply facilities, at the transformer terminals and at the indoor switchgear. The study shall determine the adequacy of the specified BIL of the equipment, and, if the study determines such level is inadequate, the Concessionaire shall increase the quantity of surge arresters.

12.5.1.5 Systemwide Grounding and Bonding Study

(a) The systemwide grounding and bonding study shall determine the requirements for grounding and bonding of the Commuter Rail Network and existing infrastructure that may be affected by the Commuter Rail Network. The study shall include traction power supply facilities, catenary structures, overhead structures, underbridges, and wayside structures paralleling electrified tracks, such as fences, and any other potentially impacted assets. The study shall also consider the Commuter Rail Network connections with the Central Corridor Extension Project and the I-225 LRT Project for control of transferred potentials and stray current mitigation.
(b) The systemwide grounding and bonding study shall determine the effect of the potential rise on the LRT running rails and shall determine mitigation measures for maintaining the total rise, from both LRT and Concessionaire’s operations, below 70 Volt, except for excursions up to 90 Volt when the LRT experiences operational anomalies, such as an outage at a traction power substation. The Concessionaire shall, in coordination with the RTD, implement such mitigation measures including, where necessary, at or in the vicinity of the affected LRT terminal station.

(c) The systemwide grounding and bonding study shall determine:

(i) rail potential rise under normal and fault current magnitude at worst locations;

(ii) the location of impedance and drain bonds, grounding of static wire, and the need for counterpoise wire (in addition to the grounding grid) at traction power facilities and along the right-of-way in order to limit the rail potential rise to safe limits per IEEE Standard 80 under normal and short circuit conditions;

(iii) the voltage rise at bridges in the event of catenary-to-bridge and feeder-to-bridge faults (for AT system); and

(iv) modifications necessary to any Utility pipes (water and gas) attached to bridges.

12.5.1.6 Short Circuit and Relay Coordination Study

The Concessionaire shall perform a short circuit and protective relay study using the single line diagram. Equivalent utility grid impedance data shall be obtained from the power Utility.

The study results shall be used to develop the relay setting philosophy and provide relay setting calculations for the feeder and catenary circuits, high voltage circuit breakers, transformers and the autotransformers.

The following types of protective relays shall be provided at a minimum:

(a) overcurrent protection for 115 kV circuit breakers with backup protection for 25 kV breakers;

(b) overcurrent and impedance protection for trolley and feeder circuit breakers at substations. Impedance relays shall be immune to the magnetizing currents of autotransformers;

(c) reverse power current protection for 25 kV incomer breakers to prevent reverse flow of power due to phase-to-phase faults. Distinguish the faults from return of regenerated power;

(d) bus differential protection for 25 kV buses; and

(e) overcurrent, differential, high winding temperature, high oil temperature and low oil level protection for transformers and autotransformers.
12.5.1.7  Arc-Flash Hazard Study

The Concessionaire shall perform an arc-flash hazard study for all indoor switchgear. Assumptions for the study shall be based on the short circuit current magnitude determined in the short circuit study. The study shall provide calculated incident energy at various distances from the equipment and identify the calculated flash protection boundaries. The study shall address the requirements of 29 CFR, NFPA 70E, NEC and IEEE Standard 1584, and shall result in recommendations for use of personnel protection equipment and appropriate labeling of equipment.

12.5.1.8  Transient Recovery Voltage Study

(a) The Concessionaire shall perform a transient recovery voltage (TRV) study for high voltage and 25 kV circuit breakers and switchgear, using industry-accepted transient analysis software, such as the Electromagnetic Transients Program (EMTP). The study report shall include the following results:

(b) voltage versus time plots;

(c) TRV peak value in kV; and

(d) time to reach TRV peak value in microseconds.

12.6  Traction Power Supply System Requirements

12.6.1  TPS Arrangement

(a) The TPS shall be arranged such that, for non-contingency outage conditions and for any single contingency outage condition, it shall maintain voltage at train pantographs within the limits necessary for trains to achieve design performance within the voltage regulation limits of the power Utility.

(b) The TPS shall, for any double contingency outage condition, maintain voltage at train pantographs within the limits necessary for trains to achieve safe train movements, with reduced speed and performance, if necessary.

(c) The TPS shall monitor, control, sectionalize and protect the electrical elements of the TES.

(d) The TPS shall, under the continuous and cyclic loads imposed by train loads and by the expected short circuit duties, maintain TES equipment, conductor and cable temperatures and stresses within their ratings to:

   (i) realize the design life of TES equipment and conductors; and

   (ii) maintain code-mandated or otherwise necessary electrical clearances.

(e) Regenerated power from trains shall be returned to the utility grid to the extent it is not consumed by other trains on the Commuter Rail Network and where agreed by the power
Utility. Protective relays shall differentiate between returned power and reverse power flow due to phase-to-phase faults between two supply sections.

(f) The physical primary power connection point to the Utility shall be at the Utility's substation fence line, unless directed otherwise by the Utility. Metering shall occur at transmission line voltage, on the high side of the traction transformer, unless directed otherwise by the Utility. The Concessionaire shall execute any and all necessary interconnection and maintenance agreements with the Utility, subject to RTD approval.\textsuperscript{31}

12.6.2. Sectionalizing

(a) TPS sectioning shall allow isolation and de-energization of parts of the TPDS to permit planned maintenance, to isolate faulted sections, and to permit flexible operation during outages and system emergencies.

(b) OCS conductors and their autotransformer feeder conductors (where provided) shall be sectionalized together with 2-pole circuit breakers and disconnect switches.

(c) The CRMF shall be sectioned from the mainline and shall have separate relay protection so as not to affect the mainline in the event of a fault in the CRMF.

(d) At DUS, OCS in the platform area shall include sectionalizing of each track, suitable to allow safe overhead maintenance of the station structure.

(e) The Concessionaire shall prepare and review at Periodic Design Review Meetings schematic sectioning diagrams showing diagrammatically the relative location of all tracks, interlockings, wayside signals, Passenger stations, and substations. The diagrams shall indicate, using single lines and symbols:

- each electrified track with its phase breaks and sectioning points;
- each unwired track, including turnouts;
- each circuit breaker and disconnect switch and its normal position (open or closed); and
- normal method of operation (motorized or hand-operated) for each disconnect switch.

12.6.3. Substations

(a) Substations, encompassing traction power substations (TPSS), autotransformer/paralleling stations (APS), and switching stations (SWS), shall be located within the right of way identified in Attachment 2 (\textit{Description of Sites and Schedules of Site Availability}), subject to confirmation of the suitability of these locations by the traction power load flow study.

\textsuperscript{31} NOTE: See Reference Data Item No. 3S.
(b) Sandown substation shall be capable of fully redundant operation. It shall comprise two identical halves, with each half able to supply one half of the TES under normal operating conditions, or the complete TES in contingency conditions. The layout shall enable maintenance activity on one half while the other half remains in service.

(c) Argo substation shall supply one half of the TES, or the complete TES in contingency conditions, and have only one feed and one step-down transformer.\(^{32}\)

(d) Each TPSS shall be capable of supplying power to all corridors of the Commuter Rail Network, the North Metro Corridor, the CRMF and the DUS Rail Segment in the event of complete failure of the other TPSS.

(e) Local and remote monitoring and control shall be provided for substations and for motor-operated switches. Interlocking between equipment shall be local and neither interlocks nor local equipment controls shall depend on the availability of centralized or remote controls. Safety interlocks shall be fail-safe. Emergency shutdown switches shall be provided at each substation location, subject to approval of the fire department with jurisdiction.

(f) Substations shall be protected against lightning in accordance with IEEE 998. Equipment buildings shall be protected in accordance with NFPA 780. Direct lightning strike protection of any incoming and outgoing overhead lines into substations shall be provided.

(g) Physical security for each substation shall include vandal resistant security lighting, non-scalable perimeter protection to a minimum of 8 feet in height, and locks.

(h) Equipment sites and buildings shall be designed to be free from damage by storms of 500-year frequency. Buildings shall have industrial grade HVAC systems that maintain temperature between 40ºF and 104ºF. Battery systems, controls and relay panels shall be installed indoors, away from arcing parts.

(i) Substation operations shall comply with state and municipal noise regulations. Screening shall be provided, as specified in the Environmental Permits.

(j) The Concessionaire shall be responsible for obtaining permits and approvals necessary for the routing of power cables between the Utility interconnection point and the TPSS, and between the TPSS and the TPDS equipment in the alignment, regardless of whether such cable routing is overhead or underground.

12.6.4. TPS Design Documentation

(a) The Concessionaire shall prepare, and review at Periodic Design Review Meetings, final designs of traction power equipment, including the following:

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(i) Power Utility interface including metering and SCADA connection to the power Utility, if required by the final design;

(ii) high voltage circuit breakers and disconnect switches including surge arresters, as required by the final design;

(iii) traction transformers;

(iv) traction power switchgear/circuit breakers and disconnect switches;

(v) autotransformers;

(vi) auxiliary transformers;

(vii) instrument transformers;

(viii) protective relaying, local and remote controls, and local and remote metering;

(ix) surge protection including arresters, shield wires and lightning masts;

(x) auxiliary power supply system for the traction power facilities and for wayside locations where auxiliary power is required;

(xi) a comprehensive list of remote monitoring signals and data points;

(xii) procedure for locking and tagging for maintenance, including concurrence by the power Utility as required; and

(xiii) fault localization and isolation procedure.

(b) The Concessionaire shall include product data, including ratings and dimensions, for TPS equipment and cables in the materials for review at the Periodic Design Review Meeting.

12.7 Traction Power Distribution System Requirements

12.7.1. Power Distribution Design

The OCS shall be designed to permit operations of randomly marshaled multiple-unit train consists and to minimize sparking from pantograph current collection and consequent wear from the resultant differing pantograph separations, traveling at the maximum authorized speed.

(a) The Concessionaire shall perform engineering studies for each style of OCS, autotransformer feeder wire and static wire to be used on the TES, that determine:

(i) conductor types and sizes in coordination with the traction power study;

(ii) wire for non-electrical purposes;

(iii) conductor and wire tension under the various climatic conditions, and relative to strength and code requirements;
(iv) maximum tension length;

(v) lateral displacement of in-running wiring spans;

(vi) maximum stagger for curved and tangent track, and for designed range of contact wire heights;

(vii) wiring support spacing and registration spacing;

(viii) pantograph security analysis (also known as residual width analysis);

(ix) conductor clearances to ground, rail, other conductors, adjacent objects and other circuits;

(x) hanger dimensioning parameter values;

(xi) dynamic performance of mainline catenary; and

(xii) pantograph clearance envelope for normal and maximum contact wire heights.

(b) The Concessionaire shall prepare, and review at Periodic Design Review Meetings, the results of these studies as the OCS Performance Design Definition.

12.7.2. OCS Route Design

(a) A route design shall be prepared to determine the physical arrangement of each tension length of OCS. The route design shall take into consideration such design features as fixed locations for phase breaks, insulated overlaps, station crossovers, low clearance buildings and bridges, and any infrastructure features preventing the placement of wiring terminations. Each tension length shall have a unique identification number within RTD OCS installations.

(b) Phase breaks are required between different electrical phases in the OCS, at substations and at switching stations. Phase break design and location shall incorporate a coordinated design approach for the OCS, the Rolling Stock pantograph and the trackwork that protects against arc or fault current damage.

(c) The OCS wires of individual mainline tracks shall be routed to service only one track of that route. Crossover wires shall not be an essential part of a mainline track. Insulated overlaps shall not be installed over tracks within platform areas.

(d) The results of the OCS route design shall be documented on a Master Overlap Chart and shall be subject to review at Periodic Design Review Meetings.

12.7.3. Clearance Study

(a) A clearance study, showing plan and profile of OCS and feeders, shall be made for each overhead bridge and structure.
(b) A pantograph clearance envelope shall be developed for application on superelevated tracks.

12.7.4. OCS Supports

12.7.4.1 General

The OCS along the mainline and in the yards shall be supported and registered by cantilever assemblies attached to poles. Where poles are not appropriate, the OCS shall be supported by portal structures, building attachments, bridge attachments or retaining wall attachment brackets. The OCS support design shall meet the following requirements:

(a) Placement of OCS supports shall take into consideration the train operator's line of sight to wayside signals.

(b) To the extent practicable, OCS supports shall not be mounted on the undersides of overpasses, over underpasses, or on station platforms.

(c) Where two adjacent wired tracks are supplied by two separately switchable circuits, the wiring shall not be supported by cantilever assemblies mounted on a single common pole or drop pipe.

(d) Where adjacent wire span lengths differ, the longer span shall not be more than 150% of the length of the adjacent span.

(e) Live conductors and live support assemblies shall not be installed above platforms or buildings.

(f) The design of foundations for supporting structures and guy anchors shall be based on the structure loading calculations and soil data.

(g) OCS supports shall be arranged so as to permit maintenance of OCS wiring on one mainline track while the adjacent mainline track is in operation.

(h) OCS metallic fittings and equipment not intentionally energized shall be effectively grounded. There shall be no electrically floating wire or component.

(i) Any hardware assembly not required to be located above pantographs shall be positioned horizontally outside the pantograph operating envelope, irrespective of height.

12.7.4.2 Environmental Mitigation

The Environmental Permits include specific commitment to architectural (tubular) OCS support poles through the single track section in Olde Town, Arvada, which shall be painted consistent with the requirements of the City of Arvada. The Concessionaire shall comply with these mitigation requirements during the design phase and consult with the City of Arvada regarding the equipment design.
12.7.4.3 DUS Rail Segment

Foundations for OCS supports in the DUS Rail Segment will be designed and installed by the DUS Infrastructure Contractor pursuant to the DUS Infrastructure Agreement. The DUS Rail Segment also has clearance restrictions that require special design attention, as set forth in Attachment 3 (The DUS Infrastructure). The Concessionaire shall complete the OCS design for the DUS Rail Segment and provide all necessary equipment not provided by the DUS Infrastructure Contractor.

12.7.5. Catenary Hangers

Catenary hangers for standard spans shall be factory manufactured, not field cut. For spans with no physical constraints, the normal hanger assembly design shall have a minimum dimension that permits up to three inches of field adjustment. The Concessionaire shall develop a procedure for implementing field adjustments up to a maximum of three inches.

12.7.6. Structural Load on Live Fittings

In addition to application of maximum safe working loads for support and registration assemblies, minimum load criteria shall be established for energized assemblies that mitigates charging sparks at loose joints. The criteria shall consider permanent loads and reverse wind loads. The Concessionaire shall demonstrate at Periodic Design Review Meetings the application of the criteria in selection of pole spacing and contact wire stagger in the OCS design.

12.7.7. Bridges and Buildings over the Track

A clearance study of OCS, ATF and static wires shall be undertaken for each bridge (both new and existing) and each building over the track. The effects on each track shall be analyzed separately. The resulting design shall include a plan and profile of OCS, ATF and static wires.

12.7.8. Flash Screens

(a) Flash screens shall be installed above the track where the OCS passes under any reinforced concrete bridge or building structures in order to protect such structures from damage due to electrical arcing from the OCS or a pantograph. Flash screens and the base of the OCS supports shall be insulated from the structure to a voltage level determined by the Grounding and Bonding Study. Flash screens shall be designed for easy and efficient removal and reinstallation to enable bridge inspections.

(b) Where OCS and AFS conductors pass under other types of structures, the Concessionaire shall determine the necessity for flash screens, and for the need to insulate them from the supporting structure.

(c) Flash screens shall be grounded to the static wire. The surface of each screen closest to the contact wire shall be substantial enough not to be punctured by an arc, or require immediate replacement following an arc. Flash screens shall be treated as grounded structural objects for clearance and grounding purposes.
(d) The Concessionaire shall negotiate permission for any equipment to be attached to bridges or building structures owned by third parties, except where such permission is already granted by the Inter-Governmental Agreements.

12.7.9. Protective Screening

(a) When the OCS and/or feeder wire is constructed below a new or existing bridge, building, or structure, screening and fencing shall be erected to physically separate the TPDS wires from human reach. The overpass screening and/or fencing shall be constructed to protect Rolling Stock and wiring from vandals dropping objects from above.

(b) Horizontal screens shall have a smooth sloping upper surface sheet and be shaped to allow falling objects to slide towards trackside. Horizontal screens shall be designed to support the weight of a trespasser. Vertical screen shall be designed and placed to discourage trespassers gaining hand hold or foot holds.

(c) In cases where any energized OCS component or passing Rolling Stock pantograph has less than 10 feet separation from pedestrian reach, a solid barrier or panel shall be placed alongside or over the OCS between the energized component and pedestrian access to deter access to the energized component, and to prevent vandalism.

12.7.10. Chemical Treatments

Sections of the route adjacent to roads will be treated with chemicals such as magnesium chloride and salt that deter ice. In such localities, a polluting spray environment may settle and adhere to OCS equipment including insulators. Materials selection and creepage distances shall be specified appropriately.

12.7.11. Protection of Animals and Bird Species

The service area is frequented by various animal and bird species identified for protection under Federal codes. The Concessionaire shall incorporate appropriate requirements from the applicable codes and other related guidelines into the design and installation of the OCS for protection of animals and birds.

12.7.12. Shop Track Safety

(a) Shop tracks shall be provided with interlocked arrangements consisting of disconnect switches coordinated with train entry derails, warning equipment, train top access, and machinery such as overhead cranes and lifting jacks. These requirements shall protect and warn maintenance staff from approaching or touching ungrounded wiring above Rolling Stock and from the risk of moving Rolling Stock bridging section insulators. Designs and procedures shall be in compliance with NESC Rule 444 and Rule 445.

(b) Each such design shall be site specific and developed in coordination with written safety procedures, equipment and features developed and approved for such operations.
(c) For shop tracks equipped with both Car jacks and OCS, safety equipment and procedures shall be devised to prevent Rolling Stock being lifted off the grounded rail while the OCS is energized.

(d) Shop track designs and procedures shall be reviewed at Periodic Design Review Meetings pertaining to the CRMF.

**12.7.13. OCS Design Documentation**

(a) The Concessionaire shall prepare the following design documentation for review at Periodic Design Review Meetings:

(i) non-site-specific drawings comprised of technical data sheets, general arrangement drawings, structure and span drawings and assembly drawings showing typical OCS support structures, and support layouts for wiring arrangements at overlaps, midpoints, crossovers, phase breaks, etc.;

(ii) wiring layout plans in a preliminary form prior to the final design detailing to show at a minimum OCS poles, OCS wires, AFS wires, static wires, bridges, and values and dimensions for stagger, contact wire height, and minimum bridge clearances;

(iii) general arrangement drawings showing major groups of assemblies of multiple structures and spans; and

(iv) OCS site-specific design drawings showing construction specific equipment types, layouts, detailed arrangements and installation details.

(b) The design documentation shall include product data, ratings and dimensions for all OCS equipment and cables.

**12.8 Traction Power Return System Requirements**

(a) Power return circuits shall maintain rail voltage at safe levels. Step and touch potentials of rails, equipment, structures and trackside facilities shall be within IEEE Standard 80 limits under normal operating and fault conditions.

(b) The Concessionaire shall provide over-voltage protection for the OCS and equipment of a type that will prevent grounding of the energized circuit during catastrophic failure of surge arresters (including dead short circuit). Transformers, cable terminations and cable-to-overhead transitions shall be protected in addition to the substation and paralleling station gantries.

**12.9 Grounding and Bonding**

(a) The Concessionaire shall ground and bond structures and buildings in and immediately adjacent to the Eagle Project as determined necessary by the Grounding and Bonding Study.

(b) The grounding and bonding shall include:
(i) OCS supports, including:
   (A) those attached to or installed under bridges; and
   (B) those attached to buildings and bridges under or over which traction conductors are installed;
(ii) fences and metallic structures including exposed pipes paralleling the electrified tracks; and
(iii) metallic objects on the train stations and in the vicinity of electrified tracks.

c) The grounding and bonding shall cover utility and other pipes attached to overhead bridges, fences installed on overhead bridges and their wing walls and other objects identified by the Grounding and Bonding study and by the Concessionaire's field survey.

12.10 TES Submittals

The Concessionaire shall submit to RTD for compliance review final versions of TPS and OCS design documentation, including design study reports, route overlap charts, site plans, equipment layout and general arrangement plans, and control schematics. [CDRL #7B-21]
13. **SYSTEMWIDE ELECTRICAL REQUIREMENTS**

13.1 **General Systemwide Electrical Requirements**

(a) The Work under this Section 13 shall be performed in accordance with the requirements of applicable Law, the NEC, manufacturers' recommendations, and the requirements of this Attachment 7.

(b) Section 12 (*System-wide Electrical Design*) of the RTD Commuter Rail Design Criteria shall be applied to systemwide electrical Work for the Eagle Project, except where specified otherwise in this Section 13 and as otherwise approved pursuant to Section 5.7 (*RTD Commuter Rail Design Criteria*) of Part A.

(c) The Concessionaire shall use products that meet the requirements of the referenced standards. Material and products shall be new and unused. Like items shall be products of a single manufacturer.

(d) The Concessionaire shall locate and install equipment so that it will be readily accessible to operation and maintenance personnel.

(e) The Concessionaire shall prepare complete sets of sealed shop drawings prior to the start of installation. The Concessionaire shall maintain and keep current a set of as-built drawings. Deviations from shop drawings shall be shown in detail. The as-built drawings shall include a ductbank routing plan and a schedule of ducts and raceways.

(f) As an alternative to routing in ductbank, fiber-optic cable may be routed in direct-buried conduit, provided that redundant data paths are provided to all equipment fed by this means.

13.2 **Systemwide Electrical Scope for RTD Use**

Without reducing or otherwise altering the general requirements of this Section 13.2, the Concessionaire shall provide fiber-optic cable for RTD's use primarily supported from the OCS support poles (in lieu of mainline ductbank and conduit) as described in Section 4 (*Traction Electrification System*) of Volume 2 (*Clarifications*) of Part C (*Responses to RTD Clarification Questions*) of Book 2 (*Technical Proposal Clarifications*) of the Final Proposal contained in the Concessionaire's Proposal.

(a) The Concessionaire shall provide in each commuter rail corridor an independent 7 x 16mm color-coded multi-celled microduct conduit for the exclusive use of RTD to support the RTD equipment defined in Sections 10 (*Communications and Control System*) and 11 (*Fare System Equipment*) of this Part B. Each RTD microduct conduit may be incorporated into the Concessionaire's corridor mainline ductbank. RTD's mainline microduct conduit shall share the Concessionaire's manhole/handhole system along each corridor except at station platforms. RTD's mainline microduct conduit shall be physically protected, racked, and clearly labeled as it passes through each manhole. Mainline ductbanks shall intersect at an interface manhole located in the throat area of the DUS Rail Segment.
(b) The Concessionaire shall provide a readily accessible handhole (the RTD Interface Handhole) near each platform, exclusively for RTD. The RTD Interface Handhold shall serve as an interface between RTD's mainline microduct conduit and its equipment case at each station. Each handhole shall be sized to accommodate spare coils of fiber optic cable in addition to the mainline microduct and platform conduits.

(c) The Concessionaire shall provide a raceway system at each station connecting the RTD Interface Handhole to the RTD equipment case. The Concessionaire's raceway system shall also be connected to the RTD Interface Handhole. The Concessionaire shall provide raceway connections between the locations of RTD controlled equipment at each station and the RTD interface handhole.

(d) RTD's ductbanks shall be presented for inspection by RTD before placing concrete encasement. The Concessionaire shall notify RTD ten days before placing concrete. RTD reserves the right to require minor changes in location of raceways or equipment.

(e) Ductbanks may use elbows with a minimum radius of 48 inches provided that wire pulled through elbows of less than six feet are not pulled by a steel cable.

13.3 Grounding

(a) The Concessionaire shall ground metallic structures and buildings as determined by the Grounding and Bonding Study described in Section 12.5.1.5 above and as specified in Section 12.9 (Grounding and Bonding) of this Part B.

(b) Manholes and handholes shall be grounded. In each manhole and handhole all metallic components including covers and cover mounting frames, metallic raceway grounding bushings, cable racks and inserts shall be grounded.
Part C

ROLLING STOCK REQUIREMENTS

1. SCOPE AND RESPONSIBILITIES

The Concessionaire shall provide Rolling Stock in accordance with the requirements of this Attachment 7.33

1.1 General Requirements for the Rolling Stock

(a) Rolling Stock shall be capable of reliably providing revenue service in accordance with the operational requirements defined in Attachment 10 (O&M Specifications), including run times, Passenger carrying capacity and the loading standards, as set forth in Sections 2.1 (Service Delivery Requirements) and 2.2 (Maximum Allowable Running Times) of Attachment 10. The Concessionaire shall determine the quantity of Cars required, the train consist configuration and the fleet delivery schedule.

(b) Cars for use on the Commuter Rail Network shall be EMUs and shall not use articulated Cars or trucks.

(c) Rolling Stock shall be suitable for commuter rail operation on both dedicated track and track shared with freight trains at speeds up to 79 mph.

(d) Rolling Stock shall be configured for bidirectional operation in the most efficient arrangement possible while still providing the required level of service capacity, reliability and availability. Trains shall be capable of normal service operations in consists of up to 8-Car length and train-to-train rescue of up to 16-Car length.

(e) Rolling Stock shall be designed and built to comply with the Applicable Requirements and with the standards and recommended practices of the following authorities, agencies and organizations:

   (i) FRA and FTA;

   (ii) the USDHS;

   (iii) APTA;

   (iv) AAR;

   (v) the State of Colorado;

   (vi) the EPA;

33 NOTE: See DTP-ATC-011 (Rolling Stock Requirements) and DTP-ATC-027 (Rolling Stock Optimization) in Section E (Alternative Technical Concepts) of Volume 3 of the Technical Proposal contained in the Concessionaire's Proposal.
(vii) NFPA; and

(viii) OSHA.

(f) Where there is a conflict between any of the above mentioned requirements (including Applicable Requirements), the most restrictive requirement shall apply.

1.2 Responsibilities of the Concessionaire

1.2.1 Rolling Stock Design

(a) The Concessionaire shall ensure the proper interrelation, functioning and system integration of all Rolling Stock systems and their interrelationships with other parts of the Car, the Commuter Rail Network and its maintenance shops, equipment, and infrastructure.

(b) The Concessionaire shall submit to RTD design documentation necessary to demonstrate to RTD that the Rolling Stock meets the requirements of the Agreement. The Concessionaire shall demonstrate through the relevant Concessionaire Design Submittals (or through other means acceptable to RTD) for each unique Car type that its Rolling Stock design accounts for each performance, safety, comfort, operation and testing requirement demonstrated in RTD's draft Rolling Stock Technical Specification.

1.2.2 Interface Management

(a) The Concessionaire shall coordinate the design and construction of Rolling Stock so as to ensure the Rolling Stock is compatible with the Commuter Rail Network in all respects necessary for operation and maintenance of the Rolling Stock and the Commuter Rail Network, including:

(i) the CRMF layout, facilities and equipment;

(ii) alignment geometry and clearances;

(iii) trackwork layout and rail profile;

(iv) station platform dimensions and platform edge interfaces;

(v) TES parameters;

(vi) train control track occupancy shunt resistance parameters and carborne equipment; and

(vii) communications radio equipment.

(b) The Concessionaire shall ensure that Rolling Stock complies with the requirements of Section 2.6 (Electromagnetic Compatibility) of this Part C, as well as meeting project EMC criteria, as defined in Section 6 (Electromagnetic Compatibility) of Part A.

(c) The Concessionaire shall ensure Rolling Stock design is coordinated with the Steep Grade Hazard Analysis required in Section 1.2 (Alignment) of Part B. Any proposed variances in Rolling Stock design and performance from design and performance
assumptions stated in the Steep Grade PHA\(^3^4\) to which FRA has concurred shall be submitted to RTD for approval and FRA for concurrence in accordance with Section 1.2.1 (Steep Grade Hazard Analysis) of Part B. Rolling Stock performance on steep grades shall be demonstrated through testing.

1.2.3. Mock-ups and Samples

(a) The Concessionaire shall participate in and provide samples and mock-ups of the Rolling Stock design options specified in Item (b) below for public meetings with regard to public elements of the Rolling Stock, as further defined in Section 9 (Public Information Program) of Attachment 9.

(b) Such design options shall include at least three options of each of the following, each in accordance with Sections (c) and 1.2.4 below:

(i) interior and exterior renderings, color schemes and patterns;

(ii) seating, including frame, pad and cloth choices; and

(iii) design and location of handholds, handrails and stanchions within the Cars, including samples. [CDRL #7C-01]

(c) The Concessionaire shall submit the three design options of each mock-up and sample to RTD. RTD will, for each mock-up or sample, select one of the three submitted design options, or a composite combination of the design options to be the Final Design for the Rolling Stock.

(d) The Concessionaire shall not be entitled to any additional compensation as a result of RTD's selection of any design option or any combination of design options.

1.2.4. Artist's Renderings and Color Samples

(a) The Concessionaire shall submit interior and exterior overlays and "photo realistic" renderings showing three different color schemes applied to the interior and exterior of the Cars and in accordance with Section 2.5 (Visual Identity and Branding) of Part A. The Concessionaire shall provide digital images in color and monochrome, and one color board for each rendering. [CDRL #7C-02]

(b) The Concessionaire shall submit with each rendering a schedule of decorative materials required to implement the rendering including material specification and a physical sample for each such material. The schedule shall include each type of plastic, upholstery material, fabric, paint, floor covering, ceiling panel, interior liner, gasket, and trim, and shall identify the proposed use and location of each material. [CDRL #7C-03]

1.2.5. Seating Mock-up

The Concessionaire shall submit sample production prototypes of each seat type proposed for the Rolling Stock in the form of a mock-up conveying all aspects of the seat design. The mock-up

\(^{34}\) NOTE: See Reference Data Item No. 5RR.
shall include a sufficient number of rows of each type of transverse mounted seats, bulkhead seats and longitudinal mounted flip-up seats, to demonstrate the relationship of the seats to the side wall, to the aisle and to each other, and to allow evaluation of Passenger comfort. The mock-up shall include a representative sample of each type of seat and each cloth choice. [CDRL #7C-04]

1.2.6. Pilot Cars

At least one of each unique Car type shall serve as a Pilot Car (together, the Pilot Cars), provided that at least one minimum operable train consist is included within the Pilot Cars. Production of the Pilot Cars shall precede production of other Cars at every stage of production. RTD reserves the right to examine each assembled and completed part of the Work on each Pilot Car before it is concealed or similar work is undertaken on the production Cars. This procedure shall be continued until each Pilot Car is complete and ready for delivery.

1.2.7. Testing

The Concessionaire shall perform or ensure the performance of all Rolling Stock tests, in accordance with Part D (Verification and Demonstration) of this Attachment 7. Certificates of inspection and testing, and approvals required by Relevant Authorities shall be secured by the Concessionaire and copies maintained as part of the safety certification documentation required in Section 8.4 (Safety and Security Certification) of Attachment 9.

1.3 Rolling Stock Drawings

1.3.1. Drawing Database

The Concessionaire shall maintain, or shall ensure that the Rolling Stock Supplier maintains, an indexed drawing database, revisions of which shall be submitted to RTD on no less than a quarterly basis until the final Car enters revenue service. [CDRL #7C-05]

1.3.2. Concessionaire's Drawings

(a) The Concessionaire shall, within 90 days after the Phase 1 Effective Date, review complete and comprehensive arrangement drawings of each Car type at a Periodic Design Review Meeting. The arrangement drawings shall be dimensioned and shall include the floor plans, reflected ceiling plans, equipment arrangement, equipment compartments, cab layouts, interior longitudinal sections of both sides of the Cars, exterior side elevations of both sides of the Cars, elevation views of both ends of the Cars, and sufficient transverse half-sections or full-sections through the Car to show all variations in cross-section, such as at windows, doors, and door pockets.

(b) The Concessionaire shall submit a Final Design drawing set that shall include general arrangements, layouts and interface plans for each major Car element, system and subsystem. [CDRL #7C-06]

1.3.3. FRA Safety Compliance Drawings

The Concessionaire shall submit to RTD detailed design drawings of Rolling Stock safety appliances required by 49 CFR 38 and 49 CFR 231. The drawings shall reference applicable sections of such regulations, indicate the manner of attachment to the Car and cross-reference actual dimensions to those required in such regulations. [CDRL #7C-07]
1.3.4. **As-Built Drawings**

(a) The Concessionaire shall submit to RTD for review a list of as-built drawings for the Rolling Stock [CDRL #7C-08]:

(i) within 60 days after completion of the Pilot Cars,

(ii) upon completion of the last Car, and

(iii) again after completion of any modifications.

(b) The Concessionaire shall maintain such as-built drawings as Record Documents in accordance with Section 2.5 (Record Documentation and Record Drawings) of Attachment 9.

(c) The as-built drawings shall include:

(i) drawings of assemblies, subassemblies, and arrangements of the Cars, as finally manufactured and modified;

(ii) detailed drawings of such assemblies, subassemblies, and arrangements;

(iii) a complete bill of materials for such assemblies, subassemblies, and arrangements;

(iv) a final integrated electrical schematic, a wiring diagram, and a wire list defining wiring and electrical apparatus;

(v) final schematic piping and connection diagrams illustrating the piping layout and apparatus; and

(vi) approved detailed Rolling Stock Supplier and Subcontractor drawings.

1.3.5. **Car History Books**

(a) The Concessionaire shall require the Rolling Stock Supplier to prepare and submit to the Concessionaire an electronic copy of the Car history book for each Car.

(b) Each Car history book shall provide the following information:

(i) Car number, type, and class;

(ii) a written report of each test performed on the Car and its apparatus;

(iii) bar codes or serial numbers of each component;

(iv) weight of Car as delivered, including weight ticket with Car number and date;

(v) wheel and axle mounting records and charts;

(vi) heat numbers and mill reports for wheels and axles;
(vii) mill reports for other materials;

(viii) main reservoir certificates;

(ix) duplicate FRA F 6180-49A forms;

(x) details of approved Changes, engineering changes, and deviations incorporated into the Car;

(xi) details of repair and rework modifications that are specific to one or more Cars but not to all Cars;

(xii) a copy of each test report log sheet for all tests performed on equipment on the Car; and

(xiii) Car dimension record sheets.

(c) The Concessionaire shall submit to RTD an electronic copy of one Car history book, which will be selected by RTD at random within 30 days of the date the subject Car is accepted for revenue service. [CDRL #7C-09]
2. **DESIGN CRITERIA**

2.1 **Rolling Stock Design Parameters**

Rolling Stock shall conform to the following requirements:

(a) Cars shall be fully compatible with all other elements of the Commuter Rail Network;

(b) except where full-width operator cabs are provided, end doors shall allow Passengers and crew to pass between coupled Cars, with suitable safety and environmental protection;

(c) there shall be four side entry door openings, two per side, located nominally at the 1/4 and 3/4 points along the carbody length (or other arrangement subject to RTD approval and demonstration that Passenger ingress/egress for such arrangement can meet safety requirements and dwell times);

(d) seating shall be in a predominantly 2 + 2 configuration with a continuous, ADA-compliant aisle running at a minimum between all doorways and wheelchair locations;

(e) Cars shall be capable of operating within the clearances defined in Section 1 (*Clearances and Alignment*) of Part B, on the trackwork provided for the Commuter Rail Network, and within the following limitations:

   (i) Minimum radius of track horizontal curve with Cars coupled: 250 feet

   (ii) Maximum superelevation for Car design: 6 inches

   (iii) Minimum frog number crossover between tracks on 12' 0" centers with Cars coupled: No. 8

   (iv) Facing No. 8 turnouts in "S" curve arrangement with a minimum of 5 feet of tangent between switch points with Cars coupled

   (v) Minimum radius of vertical curve with Cars coupled: 2,000 feet

   (vi) Minimum radius of vertical curve with Cars coupled:

       (yard, no Passengers, suspension components at their bottom-most limits, wheels at their smallest diameter, at 10 mph) 1,600 feet

(f) Cars shall be capable of operation at maximum allowable speed on track which meets minimum requirements of the FRA's track safety standards set forth in 49 CFR 213, Class 1 up to and including Class 4 track; and

(g) Cars shall be designed for a normal revenue service maximum speed of 79 mph.
2.2 Car Characteristic Requirements

(i) Car length (nominal over coupler pulling faces) 85 feet
(ii) Truck center spacing (nominal) 59 feet 6 inches
(iii) Minimum height of ceiling above floor 7 feet, 0 inches
(iv) Minimum height of low ceiling above floor (not more than 30% of passenger area) 6 feet, 6 inches
(v) Minimum bi-parting side door clear opening width 50 inches
(vi) Minimum door clear opening, height 6 feet, 6 inches
(vii) Minimum aisle width between doorway vestibule, clear 32 inches
(viii) Minimum seat width 18 inches
(ix) Minimum seat pitch 32 1/2 inches
(x) Minimum hip-to-knee space between non-facing seats 30 inches

2.3 Weight Requirements

(a) The Concessionaire shall develop and provide for review at the first Periodic Design Review Meeting to address Rolling Stock, a weight and balance program, including details of weight difference between ends of the Car and the lateral imbalance, and a test procedure and report for determining the center-of-gravity for each Car type. Such weight and balance program shall be updated no less than quarterly as the design progresses with current weight estimates.

(b) The Concessionaire shall maintain Car weights within those weights specified in Attachment 19 (Concessionaire’s Proposal). For weight calculations, passenger weight shall be assumed to be 165 lbs/person.

(c) Car weights shall be classified as follows:

\textbf{AW0} Empty Car operating weight;
\textbf{AW1} AW0 weight plus full seated passenger load and train crew;
\textbf{AW2} AW1 weight plus standees at one Passenger per 2.7 sq. ft. of available floor space (structural mean fatigue load, propulsion and dynamic braking performance load);
\textbf{AW3} AW1 weight plus standees at one Passenger per 1.8 sq. ft. of available floor space (friction braking performance load); and
\textbf{AW4} (structural design load, not contemplated for revenue operation) either 105% of AW3; or AW1 weight plus standees at one Passenger per 1.35 sq. ft. of available floor space.
2.4 Dynamic Performance / Operating Requirements

2.4.1 General Performance Requirements

(a) The Concessionaire shall demonstrate via simulation that the proposed Rolling Stock will meet the minimum service standards required in Attachment 10 (O&M Specifications) taking into account end-of-route turn times, required headways and service levels, and any pertinent track-occupancy issues in its calculations.

(b) The Concessionaire shall submit a report (the Rolling Stock Performance Report) demonstrating the Rolling Stock's ability to comply with the performance requirements contained in Attachment 10 (O&M Specifications), the run time and energy consumption requirements of Attachment 19 (Concessionaire's Proposal) and the requirements of this Part C. [CDRL #7C-10]

The Rolling Stock Performance Report shall include:

(i) simulations of round trip operation showing speed, distance, time and energy consumption characteristics on each corridor;

(ii) description of the propulsion, auxiliary and braking systems, their theory of operation and performance calculations; and

(iii) details of the control theory for any energy management schemes utilized.

(c) The Concessionaire shall review preliminary design documentation leading to the completion of the Rolling Stock Performance Report and the Duty Cycle Report detailed in Section 2.4.5 at Periodic Design Review Meetings.

2.4.2 Service Braking

The service braking system shall produce a nominal net rate of 2.5 mphps when measured with an inertial accelerometer at speeds from 50 mph to zero mph.

2.4.3 Emergency Braking

The emergency braking system shall produce a nominal net rate of 3.0 mphps when measured with an inertial accelerometer at speeds from 50 mph to zero mph.

2.4.4 Dynamic Braking

The Cars shall have an electric dynamic brake system and automated controls to blend dynamic and friction braking. The Concessionaire shall select the level of dynamic brake performance based on the propulsion system design, but not to exceed the service brake performance requirements set forth in Section 2.4.2 above.

2.4.5 Duty Cycle

(a) The Rolling Stock and all its systems shall be capable of continuous normal service operation over the Commuter Rail Network loaded to AW2.
(b) The Concessionaire shall provide to RTD a report (the Duty Cycle Report) that demonstrates that all systems are capable of such continuous normal service operation within their respective rated thermal, electrical and mechanical values, as well as details of the equipment failure scenario duty cycles that can be tolerated, as further defined below. [CDRL #7C-12]

(c) The Duty Cycle Report shall specify the capabilities of the Rolling Stock in equipment failure scenarios, for each anticipated operating consist length, to:

(i) continue service operations unassisted,

(ii) proceed out of service unassisted, and

(iii) rescue another disabled train consist, each within the full rated values of the propulsion and brake systems and without damage to any equipment. This definition shall include details of maximum duration for such failure scenario conditions, acceleration capabilities for each scenario, any speed restrictions (including those dictated by 49 CFR 238.15(d)) and any other special operating conditions for each failure scenario.

(d) The Concessionaire shall test the Rolling Stock to prove the normal and rescue duty cycle capabilities specified in the Duty Cycle Report.

(e) The friction brakes shall be capable of providing all of the service braking required at any speed or Car load, if the electric brakes fail.

2.4.6. Jerk Limiting

Changes in tractive effort shall be jerk limited. The jerk limit rate shall be software-adjustable between 1.0 mphpsps and 3.0 mphpsps, and shall initially be set to 1.5 mphpsps, plus or minus 10%.

2.4.7. Ride Quality

Rolling Stock shall provide a consistent high quality ride performance in accordance with ISO 2631-1:1997. The Concessionaire shall demonstrate compliance using validated modeling software and testing. The Concessionaire shall submit the results of all such models and tests to RTD based on operating on track of both Class 3 and Class 4 standards.

2.5 Noise and Vibration Requirements

2.5.1. Noise Criteria

(a) The noise environment created by the Car shall comply with the standards set forth in 40 CFR 201 and 49 CFR 210. Where conflicts exist between such standards and this Attachment 7, the most restrictive requirement shall apply.

(b) Unless otherwise indicated, noise level shall be defined by the latest version of ANSI S1.4 as weighted sound pressure level measured by the use of a metering characteristic and weighting A, B, or C as defined in ANSI S1.4. The unit of noise level shall be decibels (dB), and the reference pressure shall be 20 micropascals.
(c) The Concessionaire shall submit a report (the *Rolling Stock Noise Calculations Report*) detailing the estimated noise levels developed during the Car design process and demonstrating that the design will meet the requirements of this Section 2.5. [CDRL #7C-12]

(d) The Concessionaire shall maintain the Rolling Stock Noise Calculations Report throughout the design process and test the performance estimates therein.

### 2.5.2. Interior Noise Levels

#### 2.5.2.1 Cab Noise Levels

(a) The noise level exposure in the cab during normal operation shall not exceed 75 dBA for 12 hours exposure per day. The absolute upper noise level limit, including operation of air horns, bell, or air brake exhaust, shall be 115 dBA.

(b) Noise measurements shall be made using a sound level meter and measurement technique conforming, at a minimum, to the requirements of subparagraphs (d) and (e) of 49 CFR 229.121.

(c) A badge plate, permanently affixed to the rear cab wall with stainless steel hardware, shall state the successful compliance with the cab level noise requirements of 49 CFR 229.121 and 49 CFR 210.29.

#### 2.5.2.2 Passenger Area Noise Levels

(a) For a completely assembled and operating Car (or minimum operable consist) moving at any speed up to 79 mph on welded rail with tangent, at-grade, ballast and tie track, with all auxiliaries operating simultaneously at normal conditions and with the Car (or consist) operating in any specified mode of acceleration, deceleration, or coasting, the noise level in the Car's interior without passenger load, measured at any location within the passenger area of the Car, shall not exceed 75 dBA.

(b) With the same Car (or consist) at rest immediately following the preceding test and with only the lights, air conditioning, and ventilating equipment operating, the noise level in the Car's interior measured at any location shall not exceed 70 dBA. Measurements, their locations, and the instrumentation used shall be the same as those set forth in item (a).

### 2.5.3. Wayside Noise

Exterior noise, when measured on a horizontal plane five feet above the height of the Car floor, shall conform to the following requirements:

(a) **Stationary:** On a station platform with no canopy or vertical obstruction, with all doors and windows open, and all auxiliary systems including the air compressor and HVAC system in operation, the noise level shall not exceed 75 dBA at eight feet from the track centerline for any location along either side of the Car.

(b) **Moving:** In open country (a line section without intervening or nearby structures or objects which might block or reflect noise) on continuously welded rail with all auxiliary systems operating normally, the noise level shall not exceed 85 dBA at 50 feet from the
track centerline at 79 mph for any operating condition (power, brake or coast), and shall not exceed 73 dBA for any operating condition when operated between 0 and 30 mph.

(c) Moving: On a station platform with no canopy or vertical obstruction, with the Car accelerating or decelerating at low speeds (between 0 and 15 mph) with brakes fully or partially applied in the case of deceleration, the noise level shall not exceed 78 dBA at eight feet from track centerline.

2.5.4. Vibration Criteria

(a) Equipment mounted anywhere on the Car, carbody, or trucks shall not cause vertical or horizontal vibrations anywhere on the Car floor, walls, ceiling panels, and seat frames in excess of:

(i) 0.10 inch peak-to-peak amplitude between 0 and 1.4 Hz,

(ii) 0.01 g peak acceleration between 1.4 Hz and 14 Hz, and

(iii) 0.045 inches per second peak vibration velocity for the frequency range above 14 Hz.

(b) Car equipment shall be designed to operate without damage or degradation of performance when subjected to vibration and shocks encountered during normal service at all speeds up to 10% above maximum running speed. Carbody-mounted components and equipment shall be designed and tested to withstand continuous vibrations in accordance with the International Electrotechnical Commission's Publication No. 61373 (1999) – Railway Application – Rolling Stock Equipment - Shock and Vibration Tests (IEC 61373).

2.6 Electromagnetic Compatibility

2.6.1. General Requirements

(a) Cars shall be electromagnetically compatible within themselves, with other trains operating on the Commuter Rail Network, with signal systems, with communications systems, and other electronic equipment and with equipment owned and operated within EMI range of the Commuter Rail Network. The Cars shall not be capable of any operation that causes unsafe conditions in the signal systems.

(b) Rolling Stock compliance with the requirements of this Section 2.6 shall be included within the Concessionaire's overall EMC Control Plan and EMC Test Program, as set forth in Section 6 (Electromagnetic Compatibility) of Part A and in accordance with the APTA PRESS Standard for the Development of an Electromagnetic Compatibility Plan SS-E-010-98.

(c) Rolling Stock shall meet the requirements of this Section 2.6 under any operating condition.

2.6.1.1 Induced Emissions

The induced emissions shall not exceed the following limits per Car when measured per UMTA-MA-06-0153-85-8 suggested test method:
(a) 100 millivolts from 0 to 500 Hz; and

(b) 20 millivolts from 501 Hz to 20 kHz.

2.6.1.2 Conducted Emissions

The conducted emissions shall not exceed the following limits when measured per UMTA-MA-06-0153-85-6 suggested test method:

(a) 0.9 amp from 90 Hz to 205 Hz; 

(b) 0.3 amp from 206 Hz to 355 Hz; and

(c) 0.038 amp from 356 Hz to 20 kHz.

2.6.1.3 Radiated Emissions

The radiated emissions shall not exceed the following limits when measured per UMTA-MA-06-0153-85-11 suggested test method at 50 feet from track centerline. Emission limits are on a plot of dB microvolts per meter per Megahertz (dBuV /m/MHz) versus log frequency.

(a) At 14 kHz, the lower limit, a level of 120 dBuV/m/MHz;

(b) A straight line from 120 dBuV/m/MHz at 14 kHz to 75 dBuV/m/MHz at 200 MHz; and

(c) A straight line from 75 dBuV/m/MHz at 200 MHz to 90 dBuV/m/MHz at 3 GHz.

2.6.1.4 Cab Signal Interference

Car-mounted components shall be tested both in a laboratory and on the Commuter Rail Network. The cab signal interferences must not exceed any of the following limits when measured at the output of the track receiver coils in terms of equivalent rail amps:

(a) 300 milliamps from 90 Hz to 105 Hz;

(b) 150 milliamps from 240 Hz to 260 Hz; and

(c) the train control susceptibility level as measured per laboratory test (statically at a signal hut).

2.6.2. Subsystem EMC Requirements

(a) In addition to Car level EMC limits, each electronic sub system on the Cars shall be subjected to laboratory EMI/EMC tests per IEC or IEEE standards that include the following:

(i) radiated emissions;

(ii) conducted emissions;

(iii) radiated immunity (20 V/m);
(iv) conducted radio frequency immunity;

(v) electrical fast transients;

(vi) surges; and

(vii) fluctuations, dips, and short interruptions of voltage supply.

(b) The Concessionaire shall develop a detailed test procedure for each of these tests to a recognized IEC or IEEE standard.

2.7 Equipment Configuration / Redundancy

Equipment configuration shall provide fault tolerance and back-up capabilities such that failure of any one system or piece of equipment on an individual Car or train consist does not leave any Car in the consist without lighting, heating (in cold ambient conditions) or air conditioning (in warm ambient conditions), and does not require withdrawal of a Car from service for any reason.
3. **CARBODY STRUCTURE**

3.1 **General Carbody Requirements**

(a) The carbody structure shall comply with FRA regulations, and APTA Standards and Recommended Practices relevant to carbody structure for passenger rail.

(b) The natural frequency of the carbody under AW3 load, and rigidly supported at the bolsters, shall be not less than 2.5 times the natural frequency of the Car's secondary suspension system.

(c) Each carbody shell structure shall be water tested.

(d) Sealants shall not be used at any location on the Car structure.

3.2 **Carbody Strength**

The strength of the carbody shall equal or exceed the requirements of both 49 CFR 238, Subpart C and the APTA Manual of Standards and Recommended Practices for Passenger Rail Equipment, Construction and Structural Standards & Recommended Practices.

3.3 **Stress Analysis**

The Concessionaire shall certify that the carbody structure and all appurtenances comply with the requirements of APTA PRESS Standard for the Design and Construction of Passenger Railroad Rolling Stock SS-C&S-034-99.

3.4 **Carbody Structural Submittals**

3.4.1. **Structural Design Load Report**

(a) The Concessionaire shall submit a report (the *Carbody Compliance Report*) demonstrating compliance with the requirements of 49 CFR 238 and APTA PRESS Standard SS-C&S-034-99, Rev. 2, and detailing the characteristic deformation of the carbody structural assembly. [CDRL #7C-13]

(b) The Carbody Compliance Report shall detail the carbody performance capability with regard to static vertical load, fatigue load, end sill load, end underframe load, coupler anchorage loads, collision post and corner post loads, anticlimber loads, structural sill and cross beam loads, side wall loads, diagonal jacking and lifting eyes, truck to carbody attachment, carbody bolster and bolster anchor brackets, equipment support loads and roof loads.

3.4.2. **Collision Energy Management and Survivability Analysis Report**

The Concessionaire shall submit a report (the *Collision Energy Management and Survivability Analysis Report*) consistent with the requirements of APTA PRESS Standard SS-C&S-034-99, Rev. 2, identifying the contributions made by the coupler and each structural member, to collision energy absorption within the carbody. The Collision Energy Management and Survivability Analysis Report shall specify the level of collision energy management necessary to ensure compliance with the safety of Passengers during a collision as required by the Hazard
Identification Analysis and Resolution Process set forth in Section 8.3 (Hazard Management) of Attachment 9. [CDRL #7C-14]
4. CARBODY FEATURES

4.1 Industrial Design

The Concessionaire shall develop the overall concept design of the Car and its arrangement so as to optimize the function and appearance of the Car for the mutual benefit of RTD and Passengers.

4.2 Train Egress Calculation

(a) The Concessionaire shall submit a calculation (the Train Egress Calculation) that shall provide the time to evacuate passenger loads for AW1, AW2 and AW3 (including wheelchair Passengers), based on the arrangement of seats, doors, and any interior steps on the Rolling Stock; and shall provide justification that this duration is reasonable and in accordance with Good Industry Practice for service operations and emergency scenarios. The calculation shall consider both egresses at stations and on the wayside. [CDRL #7C-15]

(b) The Train Egress Calculation shall be used for determining dwell times at intermediate stations, as may be included in planning the Operating Timetable.

4.3 Accessibility Provisions

4.3.1 General

(a) The Rolling Stock shall comply with all applicable Federal regulations pertaining to Passenger accessibility, including 49 CFR 27, 49 CFR 37 and 49 CFR 38. Passenger accessibility to Rolling Stock shall be documented in the Accessibility Plan and Compliance Report as set forth in Section 5.1 (Accessibility) of Part A.

(b) Rolling Stock design features and recommended maintenance practices shall be consistent with maintaining the car floor height at doorway thresholds within the tolerances required by applicable Law, relative to the platform height, consistent with (or equivalent to) the approach defined in RTD's Approach to Achieving Level Boarding for the Commuter Rail System.35

4.3.2 Accessible Seats

At least two sets of priority seating shall be provided near the side entry doors. These seats shall be folding seats or otherwise as necessary to accommodate mobility device restraint, bicycle parking, and/or oversized luggage.

35 NOTE: See Reference Data Item No. 2RS.
4.4 Interior Construction

4.4.1 Thermal Insulation

Heat transfer through the carbody, using the Car's own heaters, shall not exceed 700 Btu/Hr/degree Fahrenheit under normal operating conditions, at an ambient temperature of zero degrees Fahrenheit.\textsuperscript{36}

4.4.2 Acoustic Insulation

A vibration and sound damping material shall be applied to inner surfaces of all areas of the structural shell, including sub-floor pans, ends, roof, and side frames.

4.4.3 Interior Finish

(a) The attachment of interior appurtenances shall meet the requirements of APTA PRESS SS-C&S-006-98, (Attachment Strength for Interior Fittings for Passenger Railroad Equipment).

(b) The interior of the Car, including the operator's cab, shall be pleasing in appearance, shall have a design which minimizes the number of components, and shall be free of sharp corners or edges. Design shall emphasize integration of components, maintainability, Passenger and operator safety, aesthetics, and cleanability. Surfaces requiring paint are not permitted. Materials shall be resistant to graffiti and shall be readily cleanable with standard cleaning materials and solutions.

(c) Linings and structure of the Car interiors shall be assembled in a manner that eliminates any possibility of squeaking once installed and shall be mounted so as to accommodate the dynamics of vehicle movement without transmitting stress to the liners. Where linings cover apparatus requiring maintenance, they shall allow ready access for removal and replacement of such apparatus.

(d) The design and layout of interior linings shall minimize the size and number of seams and moldings. Edges and corners of linings and panels shall have adequate radii to facilitate cleaning. Window masks shall be sloped to eliminate dirt collection and liquid pooling. The colors of moldings on all exposed surfaces shall be coordinated with the colors of the other materials in the Car.

(e) Visible interior fasteners shall be minimized and shall be tamper-proof.

4.5 Passenger Seats

(a) The seats installed throughout each Car shall be two-passenger, transverse, fixed-type seats except as necessary to comply with requirements of applicable Law or the Agreement or as otherwise approved by RTD. Transverse seats shall include fixed

\textsuperscript{36} NOTE: See DTP-ATC-024 (Rolling Stock Thermal Insulation) in Section E (Alternative Technical Concepts) of Volume 3 of the Technical Proposal contained in the Concessionaire's Proposal.
armrests at both the aisle and carbody sides of the seats, but not in the center, between seats.\textsuperscript{37}

(b) Seats, seat components, seat attachments to the carbody, armrests, and all other seat related items shall comply with the requirements of, and be tested in accordance with, APTA Standards SS-C&S-016-99 and SS-C&S-011-98, and 49 CFR 238.

4.6 Doors

The Concessionaire shall provide design documentation for review at Periodic Design Review Meetings that defines details of each door and door system on the Cars and demonstrates how the designs meet the requirements of this Section 4.6 and provides functionality and reliability for the Rolling Stock in accordance with such requirements of this Section 4.

4.6.1 Side Doors

(a) Cars shall be equipped with side doors for primary Passenger boarding and unloading. These doors shall be of bi-parting, sliding pocket or plug design and shall contain a rectangular window of FRA Type II glazing.

(b) Side doors shall provide proper strength and rigidity to sustain a concentrated load of 200 pounds applied perpendicularly to the plane of the door at the center of the front edge over a 16-square inch area. The side door shall sustain such load with a maximum deflection of 1/4 inch, and without permanent set, while the door is freely supported at both ends.

4.6.2 Collision Post Doors

(a) Except where a full-width operator's cab is provided, a hinged collision post door shall be provided at the end of each Car which shall close off the space between the collision posts. The collision post door shall contain a rectangular window of FRA Type I glazing and a lock operated by an operator key.

(b) Collision post doors shall provide proper strength and rigidity to sustain a concentrated load of 200 pounds applied perpendicularly to the plane of such door at the center of the front edge over a 16-square inch area.

(c) A weather seal shall be applied to all four edges (top, bottom, and both sides) of each collision post door and the jam suitable to prevent air, rain, snow, and noise from entering the carbody between the end door and door frame of a lead Car traveling 79 mph against a 35 mph head wind.

4.6.3 Automatic Passenger Counters

(a) Rolling Stock shall be fitted with an automatic passenger counting (APC) system. The APC system shall be either the INIT (IRMA) infrared system which contains both active

\textsuperscript{37} \textit{NOTE:} See DTP-ATC-023 \textit{(Passenger Seat Arm Rest Arrangement)} in Section E \textit{(Alternative Technical Concepts)} of Volume 3 of the Technical Proposal contained in the Concessionaire's Proposal.
and passive sensors, or the IRMA time-of-flight laser sensors, compatible with the APCs installed on RTD's buses and light rail vehicles. The APC equipment shall be fitted at every Passenger doorway and shall include all necessary interconnecting power and signal cabling, sensors, apertures in door surrounds, power supplies, download media, data transfer, mounting brackets, antenna, and all components necessary to provide a complete operating system. The system shall provide an accuracy of better than 95% for 700 Passengers.

(b) The Concessionaire shall implement an INIT APC garage server at the CRMF for downloading data collected by the APCs on the Rolling Stock using IEEE 802.11ab/g or 802.11n standard and Wi-Fi Protected Access (WPA2) security standard with AES encryption and 802.11i security standards. Data from the garage servers shall then automatically transfer this data to RTD in the INIT APC standard format using secure FTP server (SFTP), not FTPS, through the Concessionaire's own secure broadband internet connection to RTD’s SFTP server at least once per day.

4.7 Windows

All exterior windows of the Car shall meet the requirements of 49 CFR 238.221 and 223.

4.8 Car End Equipment

4.8.1. Buffer Assembly

Cars shall have a buffer foot plate and face plate at each end. Such face plate shall accept the diaphragm and be free to move in a direction parallel to the length of the Car to the extent required for track curvature. It shall be guided and held against the face plate of a mating Car by a tubular side stem and compression spring arrangement. A sound-deadening material shall provide both deadening and low friction non-lubricating capabilities to the tubular side stem rod guides. The buffers shall not bind during normal train operation.

4.8.2. Diaphragms

(a) Except where an operator's cab is provided (as set forth in Section 5 Operator's Cab below), the Concessionaire shall provide diaphragms at each end of each Car to enable Passengers and train crew to move between Cars within a train consist while protected from the exterior environment.

(b) Diaphragms shall provide a tight seal and shall exclude water ingress and drafts under the full range of normal operating conditions. Diaphragms shall be made of cloth reinforced molded neoprene tubes clamped to the structure.

(c) The Concessionaire shall review at Periodic Design Review Meetings design documentation providing details of diaphragm design, size, arrangement, and installation, as well as any necessary exterior coating.

4.8.3. Inter-Car Barriers

(a) Both ends and both sides of each Car shall be equipped with inter-Car barriers that comply with the requirements of 49 CFR 38.109 and shall be designed to prevent individuals from inadvertently falling between Cars from high-level boarding platforms.
(b) Inter-Car barriers shall maintain constant contact with the inter-Car barrier of the adjoining Cars under all conditions and requirements.

(c) Inter-Car barriers shall be fully retractable and lockable so as not to present a hazard when either on the front or rear of a train, when coupled to a Car not equipped with the barrier assemblies, or when being moved or stored as a single Car.

(d) Inter-Car barriers shall function in a safe and satisfactory manner under all operating conditions encountered throughout the Commuter Rail Network.

(e) The Concessionaire shall review at Periodic Design Review Meetings details of the design, arrangement, and installation of the inter-Car barriers.

4.9 Over-Window Luggage Racks

The Concessionaire shall provide over-window luggage racks in high ceiling areas, which shall include longitudinal and lateral restraints for stowed articles. The racks, including attachments to the carbody, shall have an ultimate strength sufficient to comply with the requirements of 49 CFR 238.233 and APTA Standard SS-C&S-006-98.

4.10 Lettering, Signs and Numbers

4.10.1. General Identification Requirements

(a) The Concessionaire shall provide decals and signs on Rolling Stock in accordance with applicable Law and this Section 4.10. Signage, decals, graphics, plates, numbers, and instructions for egress/access of Passengers shall each comply with 49 CFR 27, 37, and 38, APTA PRESS Standards SS-PS-002-98 and SS-PS-004-99.

(b) The Concessionaire shall provide an active Low Location Exit Path Marking system as defined in APTA PRESS Standard SS-PS-004-99.

4.10.2. Destination Signs

The Concessionaire shall provide Cars with:

(a) interior, lighted destination signs, visible from each location in the passenger seating area. Such signs shall indicate the train route and direction of travel;

(b) exterior, lighted destination signs on the cab-end of each Car and near each side door; and

(c) an electronic destination sign system on each Car. Such system complying with applicable Law including the requirements of ADA, 49 CFR 38, IEEE 1477, IEEE 100-1996, IEEE 1473, and IEEE 1482.

4.10.3. Route Map Frames

The Concessionaire shall provide a rectangular, one-piece frame with no visible welds or seams sized to accept standard 21 x 33-inch route maps on the bulkheads of each Car. The color and finish of such frames shall be in accordance with the color scheme selected by RTD in accordance with Section 1.2.3(b) above.
4.11 Exterior Styling

4.11.1. Exterior Graphic Package

The Concessionaire shall provide and apply an exterior graphics package to the carbody. The exterior graphics package shall include all FRA and APTA required and recommended signage, the RTD logo, and any decals within the approved exterior color scheme.

4.11.2. Car Number Sign

The Concessionaire shall provide exterior, lighted Car number signs on the cab-end of each cab Car. Such signs shall comply with 49 CFR 229.11.

4.12 Emergency Equipment

Each Car shall have emergency equipment, including:

(a) auxiliary portable lighting that complies with 49 CFR 239;
(b) a pry bar complying with the requirements of 49 CFR 239; and
(c) one 20-pound, A/B/C rated, dry chemical fire extinguisher, marked with "PROPERTY OF RTD" in 1-inch high letters on the extinguisher case.

4.13 Safety Appliances

Safety appliances shall conform to applicable Law, including applicable requirements of 49 CFR 231.29 and 231.12. Hand holds and safety appliances shall be within static outline of the carbody.

4.14 Horn

The Concessionaire shall provide each cab-Car with a roof-mounted horn at the cab end, protected from ingress of snow and rain. The horn sound level shall comply with applicable Law including the requirements of 49 CFR 229.129.

4.15 Bicycle and Oversize Luggage Storage

(a) Space shall be provided in each Car, at two locations on each Car, adjacent to the passenger doors, for shared storage of bicycles and oversized luggage. Each location shall accommodate two bicycles. The storage configuration shall provide for quick storage and removal of the bicycle with a minimum of manipulation of the bicycle on board the Car. Once stored, the bicycle mounting hardware shall restrain the bicycle in compliance with the strength requirements of 49 CFR 238.233.

(b) A decal shall be applied adjacent to each bicycle storage location presenting instructions for the storage and removal of the bicycle.

4.16 Fuse/Torpedo Container

The Concessionaire shall provide a container for carrying fuses and torpedoes compliant with 49 CFR 229.119(f).
5. **OPERATOR'S CAB**

5.1 **General Cab Requirements**

(a) The Concessionaire shall provide an operator's cab at the front of each cab Car, with the operator located on the right side of the Car. Each cab shall have a locking door.

(b) Each operator's cab shall be identical with the exception of related controls specific to the Car type. Each cab shall be equipped with an operator's console and all equipment necessary for the operation of the train. The cab and operator's console shall be ergonomically compatible with adults from the 5th-percentile female to the 95th-percentile male.

(c) The Concessionaire shall comply with the requirements of applicable Law, including 49 CFR 229 and 238 and the guideline of DOT/FRA/ORD-98/03 Human Factors Guidelines for Locomotive Cabs.

5.2 **Cab Controls**

(a) The cab shall contain all controls and apparatus necessary for operating a train. Operating controls shall be placed within the normal reach of the operator in the seated position.

(b) The cab console shall be illuminated for day and night operation without causing reflections on the windshield. The console light shall be located so as to properly illuminate all switches and gauges necessary for train operation and shall be controlled by a dimmer switch.

(c) The cab area shall be equipped with all functional capabilities necessary for operating the train, including windshield wipers, washer, and defroster/defogger; an opening side window; operator HVAC; left-side observer's seat; warning and safety devices; and all switches, pushbuttons, controls, and indicators required for operation of the train in accordance with the Agreement.

5.3 **Cab Design Collaboration**

The Concessionaire shall establish a process of collaboration in the detailed design of the cab to meet the needs of the Concessionaire and the requirements set forth in the Agreement and ensure that representatives of the Rolling Stock Supplier and the O&M Contractor participate. No later than the conclusion of the Preliminary Design of the cab, the Concessionaire shall invite RTD to attend and participate in meetings where cab design documentation is under collaborative review.
6. **HEATING, VENTILATION AND AIR CONDITIONING**

6.1 **System Requirements**

(a) The Rolling Stock shall have an integrated heating, ventilation and air conditioning system (**HVAC**).

(b) The HVAC system in each Car shall consist of roof-mounted modular HVAC units that are physically interchangeable between Cars. The modular HVAC units shall be complete with fans, heating, and cooling apparatus, associated ductwork and accessories, and HVAC electrical and pressure controls. Floor-level mounted electric heaters separate from the modular HVAC unit may be included as part of, and controlled by, the complete HVAC system.

(c) The cooling system shall start and operate without damage at any time when the exterior temperature is 45°F or above.

(d) The entire HVAC system shall be designed to ensure personal safety and shall comply with UL Standard 1995, ASHRAE Standard 15, and OSHA requirements. The HVAC system shall meet the performance requirements and design criteria for the HVAC are listed in Figure 6.1.

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**Figure 6.1 – HVAC Design Criteria**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Temperature (Summer)</td>
<td>93°F Dry Bulb (DB), 60°F Wet Bulb (WB)</td>
</tr>
<tr>
<td>Ambient Temperature (Winter)</td>
<td>-4°F DB</td>
</tr>
<tr>
<td>Elevation</td>
<td>Design 5330 feet</td>
</tr>
<tr>
<td>Passenger Load</td>
<td>Not less than 450 Btu/hr per person with 50% SHR AW2 Passenger Load as specified under TP02</td>
</tr>
<tr>
<td>Maximum Relative Humidity</td>
<td>Within the summer comfort zone limits as defined by ASHRAE Standard 55-2004</td>
</tr>
<tr>
<td>Fresh Air</td>
<td>Not less than 6 cfm/Passenger and sufficient to maintain positive interior pressure</td>
</tr>
<tr>
<td>Total Air Flow</td>
<td>Sufficient to meet the internal temperature, humidity, and Car pressurization requirements of Part C and the Final Design</td>
</tr>
<tr>
<td>Car Body Heat Transmission</td>
<td>In accordance with the Concessionaire's carbody and insulation design to meet the requirements of Attachment 7 (Design, Construction, and Rolling Stock Requirements)</td>
</tr>
<tr>
<td>Lighting Load</td>
<td>Total wattage of interior lights adjusted for ballast efficiency</td>
</tr>
<tr>
<td>Solar Load</td>
<td>In accordance with ASHRAE calculation methods</td>
</tr>
<tr>
<td>Supply Air to Interior Air Temperature Differential</td>
<td>20°F maximum under normal operating conditions</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>Miscellaneous Equipment</td>
<td>In accordance with Concessionaire's design data and shall include, but is not limited to, blowers and other heat producing equipment</td>
</tr>
</tbody>
</table>

6.2  **Required Interior Conditions**

6.2.1. **Interior Temperatures for Ambient Design Conditions**

The initial set points for heating and cooling shall be 72°F. The cooling set point shall be adjustable by software from 70°F to 80°F; the heating set point shall be adjustable by software from 65°F to 75°F.

6.2.2. **Interior Temperatures at Other than Ambient Design Conditions**

At ambient temperatures between 93°F and 110°F, the interior temperature shall be as the system will provide, but not higher than the set point or the ambient dry bulb temperature minus 20°F, whichever is warmer.

At ambient temperatures below 10°F, the interior temperature shall not be less than 65°F above the ambient temperature.

6.3  **HVAC Performance Report**

The Concessionaire shall submit a report (the *HVAC Performance Report*) demonstrating compliance with the requirements of this Section 6. [CDRL #7C-16]

The HVAC Performance Report shall include:

(a) calculation of heating requirements and distribution;

(b) calculation of air exchange requirements;

(c) calculation of air conditioning requirements and distribution;

(d) analysis of air flow around the passenger area; and

(e) detailed descriptions of each major equipment item, including their designs and operating details.
7. **LIGHTING SYSTEMS**

(a) The Concessionaire shall provide a lighting scheme with an emphasis on indirect lighting of the passenger seating areas. Light fixtures shall be integrated into the Car interior to provide the light at the reading plane while also illuminating adjacent ceiling panels.

(b) The Car lighting shall include the following:

1. passenger area fixtures;
2. vestibule fixtures;
3. cab lights;
4. head and auxiliary lights;
5. marker lights;
6. emergency lights;
7. disaster lights;
8. exterior door open indicator lights above each doorway;
9. platform illumination lights; and
10. low location exit path marking.

(c) The lighting system shall neither produce an objectionable glare nor dim rapidly due to the collection of dirt on fixtures. Fixtures shall permit easy cleaning and renewal of lamps, shall be free of rattles and shall not generate noise during normal static and dynamic operation. Fixtures shall allow for cleaning, maintenance, and parts replacement without disassembly of interior panels.
8. PROPULSION AND DYNAMIC BRAKING

8.1 Propulsion and Dynamic Braking System Documentation

The Concessionaire shall provide documentation for review at Periodic Design Review Meetings describing the propulsion and dynamic braking system. Such documentation shall include:

(a) design drawings, calculations and narrative descriptions of the overall system architecture, major components and subsystems;

(b) a comprehensive analysis of how the system design meets the applicable requirements of this Part C, including operating capabilities under failure scenarios;

(c) a description of the traction interlock operation and the interface of the master controller and the no motion detection signal, as set forth in Section 8.2 (Traction Control) below;

(d) a detailed description of the wheel slip/slide system as set forth in Section 8.5 (Wheel Slip / Slide) below; and

(e) odometer operation and reset means as set forth in Section 8.6 (Odometer) below.

8.2 Traction Control

(a) Propulsion control shall be arranged to modulate propulsion system tractive effort efficiently.

(b) Traction control interface characterization shall be in accordance with IEEE STD 1475-1999 for Type III interfaces as specified therein.

(c) Cars shall be equipped with traction interlocks that can inhibit propulsion tractive effort, initiating whenever a side door is unlocked or open and whenever any Car in the consist is connected to wayside auxiliary power.

8.3 Direction Control

(a) The propulsion system shall apply propulsion and electric braking tractive effort as required by trainline direction commands.

(b) The propulsion controls shall continuously monitor the validity of trainline direction commands and shall inhibit accelerating tractive effort whenever an invalid trainline direction command is received and train speed is below 3 mph.

8.4 Load Weigh Compensation

(a) Tractive effort shall be adjusted in proportion to actual Car weights, ranging between AW0 and AW2, to achieve consistent performance.

(b) The load weighing feature implemented by the propulsion control logic shall not be affected by dynamic end-to-end or side-to-side weight transfer in motoring or braking.
8.5 Wheel Slip / Slide

(a) The propulsion system shall include a wheel slip/slide detection and correction system providing adhesion control that ensures at least 85% of the theoretically available adhesion is obtained by the Cars.

(b) Malfunction of the wheel slip/slide detection and correction system shall not result in loss of braking on any axle.

8.6 Odometer

Each Car shall be equipped with an odometer to measure Car mileage as part of the propulsion system. It shall not be possible to reset the odometer except by special means.

8.7 Pantograph

Pantographs shall be configured for spring-raise/pneumatic-lower or electrical-lower operation with damping to the extent needed to ensure proper tracking. The final pantograph design shall consider the overhead contact system design, specifically system mass, damping, and dynamic response. The Concessionaire shall ensure that the two systems have compatible designs and shall perform a dynamic analysis to demonstrate pantograph tracking and stability.

8.8 Lightning Protection

Cars shall be suitably equipped for maximum protection from transient voltages caused by lightning strikes, circuit breaker operation, or wayside equipment.

8.9 Safety Grounding

All equipment on the Car shall be safety-grounded to the Car structure.
9. **AUXILIARY POWER SYSTEM**

9.1 Auxiliary Power System Requirements

(a) The auxiliary power system shall consist of an auxiliary inverter, low voltage power supply, low voltage distribution network, battery charger, and battery. Each subsystem shall be designed to safely and reliably meet the duty cycle necessary to support the Rolling Stock systems in normal and abnormal operating conditions.

(b) The low voltage distribution network shall comply with applicable requirements of 49 CFR 238.115, and the crashworthiness requirements and post-crash operational requirements affecting the low voltage distribution network set forth in APTA-SS-E-013-99.

9.2 Auxiliary Power System Documentation

The Concessionaire shall review at Periodic Design Review Meetings documentation of the auxiliary power system. Such documentation shall include:

(a) design drawings, calculations and narrative descriptions of the overall system architecture, major components and subsystems; and

(b) a comprehensive analysis of how the system design meets the applicable requirements of this Part C, including operating capabilities under failure scenarios.
10. **TRUCKS AND SUSPENSION**

10.1 **Truck and Suspension Requirements**

(a) Trucks and suspension components shall be service-proven in heavy rail commuter applications and designed in accordance with the guidelines set forth in APTA RP-M-009-98, Rev. 1. The Concessionaire shall demonstrate through design, analysis, and testing that the trucks conform to relevant AAR, APTA and FRA requirements, specifications, standards and recommended practices and the requirements of this Section 10.

(b) Trucks shall be suitable for operation over the entire range of operating speeds and wheel wear on the Commuter Rail Network. Trucks shall provide a comfortable ride at all speeds in accordance with the ride quality requirements of Section 2.4.7 above. Truck design shall prevent "hunting" of the truck, while at the same time allowing the Cars to negotiate all specified curves without causing excessive flange or rail wear.

(c) Mechanical safety connections shall be installed between the carbody and truck to meet design load transfer requirements. A positive means shall be provided to raise the truck with the carbody when the Car is lifted.

(d) The Car shall safely negotiate FRA track classes 1 through 4, at speeds up to the class-specific maximum allowable operating speed for passenger equipment.

(e) Truck layout and design drawings and supporting documentation shall be prepared and reviewed at Periodic Design Review Meetings, including:

   (i) the Truck Assembly Finite Element Analysis Report set forth in Section 10.2 below; and

   (ii) the Suspension Behavior Calculation set forth in Section 10.3 below.

10.2 **Truck Assembly Finite Element Analysis Report**

The Concessionaire shall prepare a report (the *Truck Assembly Finite Element Analysis Report*) that shall demonstrate the capabilities of the truck with regard to static and fatigue strength of the truck frame, bolster (if used), equipment mounting brackets, and axles; and shall detail the predicted and designed static and dynamic loads, and the margins of safety for the truck frame, bolster (if used) and axle.

10.3 **Suspension Behavior Calculation**

The Concessionaire shall prepare a calculation (the *Suspension Behavior Calculation*) that shall detail the findings of an analysis, using a validated mathematical model, of the quasi-static and dynamic behavior of the Rolling Stock to demonstrate good ride characteristics and stability, curving and safety against derailment.
11. **AIR SUPPLY AND FRICTION BRAKE SYSTEMS**

11.1 **General**

(a) The brake system shall include both friction braking and dynamic braking.

   (i) During normal operations, the friction and dynamic braking systems shall blend, with dynamic braking taking precedence, to share duty and energy dissipation. The service friction brake shall be used during deceleration to supplement dynamic braking at high-speed, high-load conditions, and when the train speed falls below the dynamic braking fade-out point.

   (ii) If the dynamic brake fails partially or completely or if electric brakes are cutout, the friction brake system shall be capable of providing 100% braking effort and dissipating all braking energy without the benefit of dynamic braking.

(b) The service and emergency friction braking shall be provided with a protected air supply from separate reservoirs for each Car. Supply reservoirs shall have sufficient capacity for three emergency stops without supply from the main reservoir.

(c) The main air reservoir capacity shall satisfy the following requirements:

   (i) With the main reservoir and supply reservoirs on each Car at the compressor cut-in pressure, each Car shall have a volumetric capacity capable of supplying all systems with sufficient air, and with the brake system working normally, to make five consecutive full service braking applications and releases with an AW3 load without initiating an emergency application due to low air pressure. After the five consecutive full service braking applications, it shall be possible to make one normal load-weighed emergency application with an AW3 load.

   (ii) A train of any length with 50% of the compressors inoperable shall be capable of making a stop from 79 mph using service friction brakes only with an AW3 load, on rail that will support an average adhesion level no greater than 0.085 and under active adhesion management control from a full service brake request, without initiating an emergency brake application due to low air pressure. It shall be assumed that the slide activity begins when the main reservoir pressure is at the compressor cut-in point.

   (iii) The volumetric capacity of the main and supply reservoirs shall be sufficient to allow a Car with AW0 load and with the main reservoir at the compressor cut-in point to load to AW3 in a station, depart the station and apply a full service brake at 15 mph without causing an emergency brake application due to insufficient air, including the air needed to brake the Car and to fill air springs to the AW3 Car load. The air compressor shall be inoperative for the duration of this scenario.

(d) No single-point failure shall cause loss of more than 25% of the friction braking capability on a minimum operable train consist.

(e) All failures causing reduced friction braking capability shall be automatically annunciated to the operator. System shutdowns and false indications shall be minimized.
(f) The Concessionaire shall include a failure mode, effects, and criticality analysis (FMECA) of the friction brake system in failure mode in the Rolling Stock Performance Report as set forth in Section 2.1 (*Rolling Stock Design Parameters*) above.

11.2 Air Supply and Friction Brake System Documentation

The Concessionaire shall prepare documentation of the air supply and friction brake system for review at Periodic Design Review Meetings that includes:

(i) design drawings, calculations and narrative descriptions of the overall system architecture, major components and subsystems;

(ii) a comprehensive analysis of how the system design meets the applicable requirements of this Part C, including operating capabilities under failure scenarios (including those required for the Steep Grade Hazard Analysis);

(iii) a description of the control interface between friction and dynamic braking and the blending methodology.

11.3 Braking Functionality

11.3.1. Service Brake Application

(a) Service friction braking shall be controlled on a per-truck basis. Load-weighing, blending, and adjustment for speed taper shall be determined by the friction brake system itself with appropriate interface signals from propulsion logic. Blending shall be accomplished on a per-truck basis.

(b) Service friction brake application and release shall be jerk-limited.

(c) Service brake cylinder pressure shall be automatically maintained against leakage. Service brake cylinder pressure shall be maintained indefinitely, provided that control power is available to the brake equipment and at least one compressor on a minimum operable train consist is functional.

11.3.2. Emergency Brake Application

(a) Emergency braking shall be controlled on a per-Car basis. Emergency brake application shall be irrevocable before zero speed.

(b) If a load-weigh system fault or an error resulting in an apparent weight of less than AW0 occurs, the emergency brake cylinder pressure shall not be less than the AW0 value. If an actual or apparent load-weigh signal above AW3 occurs, the emergency brake cylinder pressure shall be increased above the AW3 value in proportion to the actual or apparent load-weigh value.

(c) Emergency brake cylinder pressure shall be automatically maintained against leakage. Emergency brake cylinder pressure shall be maintained indefinitely, provided that at least one compressor on a minimum operable train consist is functional.
(d) Wheel slide shall be controlled in emergency braking when initiated by any means other than the console emergency brake mushroom switch. When initiated by the console emergency brake mushroom switch, wheel slide control shall be disabled.

11.3.3. Load Weigh Control

(a) Each Car shall be equipped with a load weigh control that estimates the current Car weight and interfaces with the propulsion and friction brake controls to adjust tractive and braking effort to maintain consistent maximum acceleration and braking rates as the Car varies between AW0 and AW2 weights. If the Car weight exceeds AW2, the maximum acceleration and braking rates may decrease linearly in proportion to the ratio of actual Car weight to AW2 weight.

(b) In emergency braking, load weigh control shall be provided on a per-truck basis to adjust emergency brake cylinder pressure in order to provide an essentially constant emergency brake rate regardless of passenger loading. Any failure of the load weigh control, either through loss of power or signal disruption, shall not affect the application of a basic, uncontrolled emergency brake rate.

11.3.4. Wheel Slide Detection/Correction Control

(a) A wheel slide protection system (the WSPS) shall be provided on each Car to protect against synchronous and differential wheel slide in motoring and braking. The WSPS shall detect spins and slides, whether they are random or synchronous, under all adhesion conditions and speeds.

(b) Whenever the coefficient of adhesion is 0.05 or greater, the efficiency of the wheel slip system shall be at least 80% in braking over the speed range between maximum and approximately 5 mph.

(c) With an adhesion level of 0.05 or greater, the stopping distance shall not increase by more than 20% over that obtained when slide correction is not required.

(d) Wheel slide efficiency shall be the ratio of the actual braking rate to the theoretical braking rate from an initial speed (entry speed) to a lower speed. The theoretical rate is that which is obtained by continuously utilizing the available track adhesion. Efficiency shall be calculated over the slide-affected portions of operation only.

11.3.5. Parking Brake

Each Car shall be equipped with a spring-applied, pneumatically-released parking brake system with a total force sufficient to hold a Car loaded at AW3 on a 5% grade indefinitely. Calculations used for grade holding capability shall assume a static coefficient of friction of 0.35 for disc braking unless the disc manufacturer's coefficient is less, in which case the lower value shall be used. Parking brake force analysis shall be provided as part of the brake system description set forth in Section 11.2 (Air Supply and Friction Brake System Documentation) above.
12.  **CARBORNE COMMUNICATIONS SYSTEMS**

12.1  **Description**

(a)  The Concessionaire shall provide a complete and functional communication system for each Car, comprised of the following components:

   (i)  a PA system, which shall:

      (A)  permit the train operator and crew to make announcements to Passengers,

      (B)  permit the train crew to make announcements to and to page other train crew members,

      (C)  accommodate recorded or digitized human speech messages for announcements or other passenger information in accordance with the requirements of 49 CFR 38,

      (D)  interface announcements with the interior destination sign for visual broadcasting, and

      (E)  record all PA announcements made on each Car;

   (ii) a crew intercom system, which shall permit private two-way intercommunication between any two or more communication control panels within the train;

   (iii) a passenger emergency intercom system, which shall provide capability for Passengers to communicate with the train crew members and train operator;

   (iv) a train radio system, which shall permit two-way radio communication between the train operator and other trains and wayside installations;

   (v)  a destination sign system, compliant with the requirements of 49 CFR 38; and

   (vi) a Passenger information/automatic station identification system which shall:

      (A)  inform Passengers of the approaching station, current station, and any other audio or visual messages that RTD wishes to make; and

      (B)  give information in the form of PA announcements and visual displays.

(b)  The communications equipment shall not pose any health hazard to the public, Passengers, or train crew and shall be in strict compliance with applicable Law, including FRA, AAR and FCC regulations, and state and Federal guidelines, including 49 CFR Part 220 (*Railroad Communications*). Exposure to radio frequency emissions shall conform to IEEE C95.1, Table 2.

(c)  The Concessionaire shall provide documentation of the communications system and its major components for review at Periodic Design Review Meetings that includes:

   (i)  a narrative description of the overall system architecture; and
(ii) a comprehensive analysis of how such system design meets the requirements of this Part C.

12.2 Video Surveillance and Recording System

(a) The Concessionaire shall provide on each Car or minimum operable train unit a video surveillance and recording system, including cameras, a digital video recorder (DVR), CCTV controller and other necessary ancillary equipment.

(b) Each Car shall be equipped with interior color surveillance cameras mounted in such locations as that provides for complete (100%) coverage of the passenger area including boarding/door areas. Video quality shall be at a resolution to provide identification and description of incidents and Passengers throughout the Car. An additional color camera (or cameras, as necessary) shall be mounted in the cab to provide a wide angle front view covering both sides of the Car.

(c) Images from all cameras shall be fed to an onboard DVR that stores data on a removable hard drive or similar media. The hard drive shall be hot-swappable by trained personnel during normal non-revenue maintenance work. The hard drive may then be physically moved to the CRMF for data backup and archival. In addition, each DVR shall be equipped with or connected to a wireless communications link that, within the limits of the CRMF yard, may be queried and used to download the data for backup and archival.

(d) Recording from each camera shall be at a minimum of 15 frames per second. The DVR shall have a minimum storage capacity of 72 hours based on all cameras recording at 15 frames per second per camera. The DVR shall automatically record whenever the Car is powered. The DVR shall be securely installed in a locked cabinet, keyed differently from other locks on the Car to prevent unauthorized access, tampering, and theft.

(e) Details of the surveillance and recording system design and equipment shall be included in the communications system documentation reviewed by the Concessionaire in accordance with Section 12.1(c).
13. **OPERATIONAL SAFETY SYSTEMS**

13.1 **General**

(a) The Rolling Stock and its safety systems shall comply with the requirements of applicable Law, including the Rail Safety Improvement Act of 2008 and current FRA Regulations 49 CFR 229, 236 and 238, the requirements of Section 9 (*Train Control System*) of Part B, and the standards of APTA, IEEE, and the AREMA Communications and Signals Manuals.

(b) For the safety and normal operation of the train, each of the major systems specified herein shall provide safety and normal functionality independent of one another. The shared input and output signals shall be isolated in such a manner that any failure within any one system shall not affect the operation of the other systems.

(c) The Concessionaire shall prepare documentation of each operational safety system defined in this Section 13 for review at Periodic Design Review Meetings, in sufficient detail to demonstrate compliance with each of the requirements set forth in paragraph (a) of this Section.

13.2 **Positive Train Control System**

Each minimum operable train consist shall be fitted with a PTC system compliant with the Rail Safety Improvement Act of 2008 and Section 9 (*Train Control System*) of Part B. The PTC system including the automatic train control (ATC) system as set forth in Section 13.3 below shall include a control unit, an onboard display unit in each cab, and propulsion and brake system interfaces. The display unit shall be located in the cab adjacent to the windshield but not obstructing the operator's normal forward view. Interfaces with the propulsion and brake system shall, at minimum, allow the cab signal system as set forth in Section 9.8 (*Cab Signals*) of Part B to cut out tractive effort and apply a penalty brake.

13.3 **Automatic Train Control System**

(a) The ATC system shall consist of the following elements:

(i) A cab signal system, which shall be based on the wayside signal system, and shall provide safe train operation under the control of the train operator but with automatic enforcement of the train speed limit imposed by the wayside signal system.

(ii) A vital aspect display unit located on the train operator's console which shall continuously display the cab signal aspect, the actual train speed, an overspeed indicator, ATC cutout, and other indicators related to the ATC status.

(b) The ATC system shall provide positive stop at required interlocking home signals.

(c) An overspeed condition shall be detected either by a change of code or by exceeding the authorized speed by 3 mph. Overspeed detection shall cause an alarm to sound and the overspeed indication shall be lit steadily on the ADU. The operator shall have five seconds to either initiate the minimum brake application (MBI) and achieve 0.5 mph/s deceleration rate or a maximum brake (MB) by achieving 1.6 mph/s rate. If MBI is achieved in the first five seconds, an additional five seconds shall be allowed for the
brake system to achieve MB or to reduce the speed below the allowed speed. If the operator fails to achieve these conditions in the allowed time, a penalty brake application shall occur, the alarm shall continue to sound, and the overspeed indicator shall continue to flash. Once the system senses that an underspeed condition has been achieved, it shall release the penalty brake request and the operator shall be able to recover from the penalty brake by moving the master controller to idle position. If the overspeed condition is caused by a more restrictive aspect change, the brake application of MBI and MB as explained above shall forestall the penalty brake application but it shall be necessary for the operator to acknowledge the alarm, before releasing the brakes to avoid an unrecoverable penalty brake application.

13.4 Alerter System

(a) Each operator's cab shall be equipped with an alerter system consisting of both visual and audible alarms to monitor the train operator's movements and determine enforcement requirements.

(b) The alerter system shall monitor absence of a defined action by the operator followed by alarm signal and penalty brake application. The system shall be reset by detection of a defined action by the train operator. In accordance with 49 CFR 238.237, the Concessionaire shall submit the system design criteria for alerter timing. [CDRL #7C-17]

(c) The location of the audio and visual alarms shall be reviewed as part of the cab design in accordance with Section 13.1(c) above.

13.5 Event Recorder System

(a) The event recorder system (ERS) shall consist of a main recorder unit, crash hardened memory module, airbrake manifold and any other interface modules that receive monitored signals from other systems on the train.

(b) One ERS shall be provided on each Car. The Concessionaire may provide one ERS per minimum operable train consist if minimum functionality and signal integrity are maintained. The ERS shall be a stand-alone device, independently operated, and powered from the Car's low voltage power supply. The ERS shall be a solid-state microprocessor-based unit. The data storage memory module shall be FRA- and IEEE-compliant. The system shall include any required sensors, transducers, pressure switches, power supplies, and isolation module.

(c) The ERS shall operate continuously as long as battery trainline power is at a sufficient voltage level to operate the event recorder unit.

(d) The ERS shall record, at minimum, the data elements shown in Figure 13.5 or an equivalent set of data elements providing at least the same level of train system status, subject to RTD's approval.
Figure 13.5 – Event Recorder Data Elements

<table>
<thead>
<tr>
<th>Data Elements/Source/Type</th>
<th>Signal Name</th>
<th>Signal source</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Signal Name</td>
<td>Signal source</td>
<td>Type</td>
</tr>
<tr>
<td>1</td>
<td>Distance</td>
<td>Derived</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Time/Date/Year</td>
<td>Internal</td>
<td>Default</td>
</tr>
<tr>
<td>3</td>
<td>Direction/Forward</td>
<td>Trainline</td>
<td>Digital</td>
</tr>
<tr>
<td>4</td>
<td>Direction/Reverse</td>
<td>Trainline</td>
<td>Digital</td>
</tr>
<tr>
<td>5</td>
<td>Master Controller Position</td>
<td>Handle Position Switch 1</td>
<td>Digital</td>
</tr>
<tr>
<td>6</td>
<td>Master Controller Position</td>
<td>Handle Position Switch 2</td>
<td>Digital</td>
</tr>
<tr>
<td>7</td>
<td>Master Controller Position</td>
<td>Handle Position Switch 3</td>
<td>Digital</td>
</tr>
<tr>
<td>8</td>
<td>Master Controller Position</td>
<td>Handle Position Switch 4</td>
<td>Digital</td>
</tr>
<tr>
<td>9</td>
<td>Master Controller Position</td>
<td>Handle Position Switch 5</td>
<td>Digital</td>
</tr>
<tr>
<td>10</td>
<td>Brake Pipe Pressure</td>
<td>Air Brake Monitoring</td>
<td>Analog</td>
</tr>
<tr>
<td>11</td>
<td>Brake Cylinder Pressure</td>
<td>Air Brake Monitoring</td>
<td>Analog</td>
</tr>
<tr>
<td>12</td>
<td>Dynamic Brake</td>
<td>Control Stand</td>
<td>Analog</td>
</tr>
<tr>
<td>13</td>
<td>Main Reservoir Pressure</td>
<td>Air Brake Monitoring</td>
<td>Analog</td>
</tr>
<tr>
<td>14</td>
<td>Emergency Brake Application (master controller)</td>
<td>Air Brake Monitoring</td>
<td>Digital</td>
</tr>
<tr>
<td>15</td>
<td>Emergency Brake Application (other)</td>
<td>Air Brake Monitoring</td>
<td>Analog</td>
</tr>
<tr>
<td>16</td>
<td>Brakes Applied Summary Trainline</td>
<td>Air Brake Monitoring</td>
<td>Analog</td>
</tr>
<tr>
<td>17</td>
<td>Brakes Released Summary Trainline</td>
<td>Air Brake Monitoring</td>
<td>Analog</td>
</tr>
<tr>
<td>18</td>
<td>Headlights</td>
<td>Switch Contact</td>
<td>Digital</td>
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<tr>
<td>19</td>
<td>Auxiliary Light</td>
<td>Switch Contact</td>
<td>Digital</td>
</tr>
<tr>
<td>20</td>
<td>Horn Activation</td>
<td>Switch Contact</td>
<td>Digital</td>
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<tr>
<td>21</td>
<td>Car Unit Number</td>
<td>Local ID Plug</td>
<td>Digital</td>
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<tr>
<td>22</td>
<td>Traction Current</td>
<td>Traction Current Monitoring</td>
<td>Frequency (4)</td>
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<tr>
<td>23</td>
<td>Ttractive Effort</td>
<td>Local Signal</td>
<td>Analog (4)</td>
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<tr>
<td>24</td>
<td>Alerter Acknowledgement</td>
<td>Switch Contact</td>
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<td>Alerter Penalty</td>
<td>Local Signal</td>
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<td>Alerter Alarm</td>
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<td>Relay Contact</td>
<td>Digital (2)</td>
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<td>28</td>
<td>Door Closed Summary Trainline</td>
<td>Trainline</td>
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<td>29</td>
<td>Parking Brake</td>
<td>Local Switch</td>
<td>Digital</td>
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<td>30</td>
<td>Emergency Wheel Slide Deactivated</td>
<td>Switch Contact</td>
<td>Analog</td>
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<tr>
<td>31</td>
<td>Cab Signal Aspect</td>
<td>Local signal</td>
<td>Digital</td>
</tr>
<tr>
<td>32</td>
<td>PTC Related Functionality</td>
<td>Local signal</td>
<td>Digital</td>
</tr>
</tbody>
</table>

(e) In addition to the requirements of Section 13.5 (d), the ERS shall have provision for:

(i) ten spare isolated digital channels;
(ii) four spare analog channels; and

(iii) two spare frequency channels.

### 13.6 Speed Sensing System

(a) A speed sensing system shall be provided consisting of speed sensors, a signal conditioning amplifier, a speedometer drive signal, and an odometer.

(b) The speed sensing system shall monitor wheel rotation via gear mounted sensors. The output signal shall be used for alerter, event recorder, odometer, door controls, propulsion control, braking control, wheel slip/slide protection, and the Car network.

(c) The odometer electronics shall be isolated from alerter and event recorder systems. The odometer mileage display shall be located in an equipment locker and shall be readable through a window in its cover without any obstructions. The same signal shall be connected to the network for recording the odometer mileage at the Car system level diagnostic system.
14. **TRAINLINES AND DATA NETWORKS**

14.1 **General**

(a) Cars shall include all hardware and software necessary to allow command, control, and diagnostic information to be sent and received between Cars in a consist and between systems on a Car.

(b) Trainline components shall be designed to ensure proper, full performance operation of trainlined functions for all anticipated train lengths in all operating modes. It shall be possible to operate or perform any trainlined function from any cab within the train.

(c) Trainlines shall consist of:

   (i) discrete signals for selected signals; and

   (ii) digital data networks for communication, monitoring, and diagnostic data and for all other trainlined control signals.

(d) The Concessionaire shall prepare and review at Periodic Design Review Meetings documentation of the trainline approach, defining which functions are implemented using discrete trainlines and which use the data networks. Documentation shall include:

   (i) a description of the data networks architecture, control response times and failure scenarios; and

   (ii) equipment details and the coupling arrangement between Cars.

(e) The Concessionaire shall demonstrate previous service experience for each control signal proposed to be networked, to confirm the safety and reliability of this approach.

14.2 **System Architecture**

14.2.1. **General**

(a) Control of Car systems shall be by means of a Car data network (the CN) and discrete Car and trainline interfaces.

(b) Trainlined data signals other than discrete trainlines shall be transmitted between Cars over a redundant fault-tolerant train network (the TN). The TN shall provide at least two independent end-to-end paths connecting all train network nodes throughout the length of the train, such that any number of failures in one of the independent paths does not affect normal train operation.

(c) Real-time diagnostic data from microprocessor-based systems shall be transmitted continuously from each system's local diagnostic and test system to the central diagnostic system over the CN. CN capacity shall be such that transmission of diagnostic and monitoring data does not degrade network performance to the point where system response time requirements are not met.
14.2.2. Security of Car Control and Communications Systems

Car communication and control systems shall be secured against unauthorized access and attack, both from the Car itself and from the wayside when the Car is in revenue service and when the Car is out-of-service for maintenance or storage in accordance with Good Industry Practice.

14.3 Global Positioning System Receiver

If the Concessionaire provides Global Positioning System (GPS) receivers for PTC and/or for train to wayside communications, there shall be an antenna on each cab Car. Such GPS receivers shall be equipped with a Wide Area Augmentation System (WAAS) and differential beacon capability. The system shall utilize the GPS mode with the lowest dilution of precision available at each moment in time.
15. **MONITORING AND DIAGNOSTICS**

(a) Each Car shall include an integrated Monitoring and Diagnostic System (an MDS). The MDS shall be a physically-distributed, functionally-integrated system which monitors signals and events within the Car and within selected subsystems on the Car and stores the collected subsystem, Car, and train data in non-volatile memory within the selected subsystems, at a central data storage point on the Car, and in computer systems located at the CRMF.

(b) The Concessionaire shall provide each Car with a Local Diagnostic and Test System (LDTS) for each intelligent subsystem and with a central diagnostic system, which shall integrate the individual LDTS of the various subsystems and sensors on the Car.

(c) The Concessionaire shall review at Periodic Design Review Meetings documentation of the MDS. Such documentation shall include a narrative description and technical details of the overall system architecture and major components, including functionality locally and in the operator’s cab.

(d) The MDS shall record data identifying the approximate location of the train on the system whenever failure events occurred.
16. MATERIALS AND WORKMANSHIP

16.1 General

(a) Materials and workmanship shall be in accordance with the requirements of applicable Law and Good Industry Practice.

(b) The Concessionaire shall ensure that Materials Safety Data Sheets (MSDS) are prepared for materials used in the fabrication of the Cars, including lubricants but excluding non-hazardous metallic materials. Information in each MSDS shall be in a form compliant with ANSI Z400.1-2004.

16.1.1. Quality

The Concessionaire shall ensure through the Quality Management System set forth in Section 7 (Quality Management) of Attachment 9 that all aspects of the Rolling Stock are in conformance with the design, materials, and workmanship requirements defined in this Attachment 7.

16.1.2. Prohibited Materials

The following materials are prohibited from use on the Cars:

(a) PVC;

(b) asbestos;

(c) cadmium (except in batteries);

(d) lead (including in paint and coatings, except for electronics solder);

(e) PCBs;

(f) carcinogenic materials as listed by the ACGIH;

(g) CFC and HCFC compounds;

(h) urethane foam;

(i) materials listed in 29 CFR 1910.9; and

(j) materials and products identified by any state agency, Federal agency, or the ACGIH as containing toxic properties or emitting toxic products of combustion or materials and products generally recognized to have highly toxic products of combustion.

16.2 Flammability, Smoke Emission and Toxicity Requirements

16.2.1. General

(a) All combustible materials used in the construction of the Cars shall satisfy the flammability, toxicity and smoke emissions requirements of 49 CFR 238.103, and this Section 16.2, and the standards of NFPA 130. In the case of any conflict between such requirements, the most restrictive requirement shall prevail.
(b) The Concessionaire shall comply with all provisions of 49 CFR 238.103 (c), Fire Safety Analysis for Procuring New Passenger Equipment, and APTA RP-PS-005-00, Fire Safety Analysis of Existing Passenger Rail Equipment. The Concessionaire shall submit a Fire Safety Analysis (the Fire Safety Analysis) of the design and materials of construction of the Car, as described in Section 16.2.6 below.

(c) The Concessionaire shall submit to RTD, or ensure that the Rolling Stock Supplier submits, test reports from an independent laboratory indicating successful testing and demonstrating compliance with such requirements. Testing shall be conducted after the Phase 1 Effective Date and on a production batch of material intended to be used on the Car. Each laboratory shall have tested a standard test sample no greater than 30 days prior to performing the tests, the results of which shall be submitted to RTD.

16.2.2. Flammability and Smoke Emission.

The Concessionaire shall submit to RTD for approval a list of materials intended to be used in the Car that are not, in the Concessionaire’s opinion, combustible. [CDRL #7C-18] The Concessionaire shall test combustible materials used in Cars to demonstrate compliance with the requirements set forth in 49 CFR 238.103 and NFPA 130.

16.2.3. Floor Assembly Fire Resistance Testing Criteria

The Concessionaire shall test the floor assembly in accordance with ASTME 119 to demonstrate a thirty minute endurance rating.

16.2.4. Toxicity

Materials used in Car construction, except for materials used in small parts such as knobs, rollers, fasteners, clips, grommets, and small electrical parts that would not contribute significantly to fire propagation or to smoke or toxic gas generation and are distributed throughout the Car, shall be tested for toxicity using Boeing Specification Support Standard BSS-7239. Materials shall comply with the following maximum toxic gas release limits (ppm):

- Carbon Monoxide (CO) 3,500 ppm
- Hydrogen Fluoride (HF) 200 ppm
- Nitrogen Dioxide (NO₂) 100 ppm
- Hydrogen Chloride (HCL) 500 ppm
- Hydrogen Cyanide (HCN) 150 ppm
- Sulfur Dioxide (SO₂) 100 ppm

Tests shall be conducted in flaming mode after 240 seconds using a National Bureau of Standards smoke density chamber for sample combustion. Gas sampling may be conducted during the smoke density test.

16.2.5. Electrical Fire Safety

Electrical equipment, wiring and apparatus shall conform to the standards of NFPA 130, Section 8.
16.2.6. Fire and Toxicity Protection Program Report

The Concessionaire shall submit to RTD a report (the Fire and Toxicity Protection Program Report) that shall demonstrate compliance with the applicable requirements and standards as set forth in this Section 16.2. The report shall include: [CDRL #7C-19]

(a) a fire safety analysis, as defined in Section 16.2.1(b) above;
(b) a description of design in specific areas of fire risk;
(c) a list of materials to be used for floor and interior fittings;
(d) fire load calculations, as appropriate; and
(e) a fire and toxicity test plan.

16.3 Software and Software Systems

The Concessionaire shall ensure that the Rolling Stock Supplier is responsible for the overall design and for the integration of individual Rolling Stock software systems into the complete system in accordance with the requirements of this Section 16.3.

16.3.1. Software Systems Requirements

Subsystem software shall be designed and documented by the supplier of such software and the Rolling Stock Supplier shall review the designs and test the completed systems. The Rolling Stock Supplier's process for software review and testing shall be reviewed and audited by the Concessionaire and software documentation shall be subject to review by RTD in accordance with Section 3.3 (RTD Design Review) of Attachment 9.

16.3.2. Software Documentation

(a) Software documentation shall be in accordance with IEEE Standard P1558-2004, Standard for Software Documentation for Rail Equipment and Systems (IEEE 1558) and with the additional requirements set forth within this Section 16. Software documentation shall use a type-5 system as defined within the IEEE 1558 standard.

(b) The Concessionaire shall ensure that the Rolling Stock Supplier maintains the following software documentation, each as described in this Section 16.3:

(i) Software Project Management Plan (SPMP);
(ii) Software Verification and Validation Plan (SVVP); and
(iii) Software Requirements Traceability Matrix (SRTM).

(c) The scope of the documents maintained by the Rolling Stock Supplier in accordance with paragraph (b) and the Software Configuration Control Plan maintained by the Concessionaire in accordance with Section 16.3.6 below shall cover the entire software development for the Cars. The SVVP shall describe the integration of the subsystems to cover the requirements of the entire system.
(d) A Software Verification and Validation Report (SVVR) shall be prepared with each software release documenting the Concessionaire's verification and validation activities as required by Section 16.3.1.

16.3.3. Software Project Management Plan

(a) The SPMP shall describe:

   (i) monitoring of supplier activities to assure development tasks are completed and delivery requirements are met for each development phase from concept development to warranty support; and

   (ii) the procedures used to conduct software quality audits for suppliers and subcontractors.

(b) The SPMP shall include:

   (i) a schedule identifying the key tasks defined for software development, the timing and interrelationships between tasks, and the allocation of time and resources, realistically addressing issues raised by internal reviews, Concessionaire reviews, or by RTD; and

   (ii) detailed descriptions of the metrics to be used to monitor and control the software project including monitoring project progress on intermediate tasks and triggering management corrective actions with sufficient time to assure required deliveries are met.

16.3.4. Software Verification and Validation Plan

(a) The SVVP shall require internal peer reviews of each version of the documents and source code. For each review the SVVP shall also state the version of the items reviewed as well as the versions of related documents used in the review, which may include documents that the subject item was reviewed against such as a software requirements specification or related interface specifications used in the review of a software design description. Such review reports shall list, for each verification and validation task, the type of review, the participants, the date, the versions of all items used in the review, and issues arising from the review.

(b) The SVVP shall require reviews of each design or source code change prior to test and release, summaries of which shall be in the SVVR.

(c) The SVVR shall include test report summaries and shall identify the version of the software configuration item tested, the test plans, and the versions of any additional items used in the test.

16.3.5. Software Requirements Traceability Matrix

(a) The SRTM shall cross-reference the requirements of the Agreement and the Rolling Stock Supplier's design documentation to the software verification test procedures. The SRTM shall include one table for each software configuration item and within each table there shall be a right of way for each requirement. The columns shall include a unique identifier for each individual requirement, a short description of the requirement, the
reference to the corresponding design description, and the reference or references to the software validation tests. Since the references are dependent on the version of the documents referenced, the specific versions of all referenced documents must be stated for each table.

(b) Each reference to a document shall specify the location of the pertinent text to a sufficiently specific section so that the reader easily and unambiguously understands the intention.

16.3.6. Software Configuration Control Plan

The Concessionaire shall develop, implement and maintain a plan (a Software Configuration Control Plan) for tracking software changes relative to Cars, portable test equipment, and bench test equipment. The Concessionaire shall include in the plan a database management system capable of maintaining the history of all software and status changes making it possible to determine which versions currently resides in which equipment, on which cars, and also which versions were used in the past. The database management system shall be capable of generating various reports showing the configuration of a typical Car system in terms of software history and status, and also the configuration of the fleet in a report capable of determining the exact software configuration of a particular operating train on a car-by-car basis.
Part D

VERIFICATION AND DEMONSTRATION

1. Verification Program

1.1 Verification Requirements

(a) The Concessionaire is responsible for comprehensively demonstrating compliance of the Work with the requirements of the Agreement. Verification shall encompass design, procurement, fabrication, assembly, construction, installation, inspection, integration, testing and commissioning. Verification may be achieved through analysis, inspection or testing.

(b) The Concessionaire may provide draft versions of any verification and testing submittal defined in this Part D for review at Periodic Design Review Meetings prior to submission of the final forms of such submittal to RTD.

1.2 Contract Compliance Verification Matrix

(a) The Concessionaire shall develop a matrix (the **Contract Compliance Verification Matrix or CCVM**) identifying how each technical requirement of the Agreement is to be met and allocating a verification action to each such requirement. Each verification action shall include a forecast completion date, which shall be consistent with dates for the associated activity shown on the Current Baseline Schedule as set forth in Section 2.6.3 (Project Schedules) of Attachment 9. Where appropriate, cross reference shall be made to the System Testing and Commissioning Plan and to other relevant Concessionaire Design Submittals. The Concessionaire shall submit the CCVM to RTD for approval.

[CDRL #7D-01]

(b) The Concessionaire shall maintain the approved CCVM throughout the Design/Build Period, shall record completion and approval of each verification action in the CCVM, and shall submit updates to RTD for review not less than every three months until each requirement has been verified.

1.3 Verification through Analysis

Where the Concessionaire provides analysis as a means of verifying compliance with technical requirements, the Concessionaire shall specifically identify the submittal as "Analysis of Requirements Compliance" and include the applicable CCVM cross reference and Agreement reference on the submittal title page.

The Concessionaire shall ensure that each verification analysis is verified and agreed by a reviewer with appropriate expertise that is independent of the design entity preparing such verification analysis. RTD reserves the right to request and review analyses identified as the means of compliance verification.
1.4 Verification through Inspection

Where the Concessionaire intends to provide inspections as a means of verifying compliance with technical requirements, the Concessionaire shall prepare specific inspection procedures that identify the applicable CCVM cross reference, and the methodology through which the inspection demonstrates compliance. The Concessionaire shall conduct each inspection in accordance with the inspection procedures and shall document the results in an inspection report.

The Concessionaire shall ensure that each inspection procedure and inspection report is reviewed and accepted by a suitably qualified reviewer that is independent of the design entity preparing such verification analysis. RTD reserves the right to request and review any inspection procedures and reports identified as the means of compliance verification.
2. **SYSTEM TESTING AND COMMISSIONING**

The Concessionaire is solely responsible for carrying out necessary testing and commissioning of project elements required to ensure and demonstrate that the Concessionaire-operated Components and all their elements are safe, functional and reliable, and meet all Revenue Service Commencement Requirements related to system performance, prior to the relevant Revenue Service Commencement Date. Specific tests identified in this document shall be included in the Concessionaire's test program. Testing shall also include those tests specifically required by Relevant Authorities, and shall cover infrastructure, systems and Rolling Stock.

2.1 **System Testing and Commissioning Plan**

(a) The Concessionaire shall develop a plan (the *System Testing and Commissioning Plan*), which details all tests to be carried out, the scheduled test date and location of the test, the function to be tested and/or requirement to be demonstrated, and the party responsible for the testing. [CDRL #7D-02]

(b) The System Testing and Commissioning Plan shall differentiate between:

(i) testing to demonstrate functional design compliance and performance verification (qualification tests);

(ii) testing for acceptance of each component, subsystem and system (acceptance tests);

(iii) testing of integrated systems (integration tests); and

(iv) demonstration of the performance of major parts of, and the entirety of the Concessionaire-operated Components (demonstration tests).

The System Testing and Commissioning Plan shall include by reference the System Performance Demonstration Plan defined in Section 4.1 below.

(c) The System Testing and Commissioning Plan shall detail how the Concessionaire will manage the test program and the resources to be applied during testing and commissioning. It shall include:

(i) the program, sequence and schedule for all testing and commissioning;

(ii) control and monitoring processes for the progression of the testing and commissioning;

(iii) methods for reporting on completed tests;

(iv) testing documentation control procedures;

(v) the process for managing non-conformances and re-testing;

(vi) management of safety during testing and commissioning, including training of staff and contingency provisions; and
(vii) the formal procedures for the transition from commissioning personnel to operations and maintenance personnel and fulfilling the Revenue Service Commencement Requirements.

(d) The Concessionaire shall reissue the System Testing and Commissioning Plan monthly once testing has begun, updating information as test scheduling is confirmed and tests are carried out, and annotating which tests RTD will witness and for which tests reports shall be submitted to RTD.

(e) The Concessionaire shall, at least three months before the last Final Completion Date, submit to RTD for approval a final version of the System Testing and Commissioning Plan, recording all testing carried out, functions and performance demonstrated, reports produced and approved; and third party approvals, permits, certificates and authorizations for the start of revenue service.

2.2 Rolling Stock Testing

(a) The Concessionaire and its Rolling Stock Supplier shall perform a comprehensive testing program to demonstrate that the Rolling Stock meets the requirements of applicable Law and of this Attachment 7. The test program shall include RTD-required tests as set forth in Section 2.5 below and in Part C (Rolling Stock Requirements) of this Attachment 7. As applicable, test submittals shall be provided for each unique Car type.

(b) For testing specifically required in the Agreement, RTD may accept previous test reports in lieu of new testing in its sole discretion, where the Concessionaire can demonstrate to RTD that the equipment testing and the service application (including environmental conditions) were the same as for this Work. At its discretion, the Concessionaire may consider the application of previous test reports and/or service history records in lieu of other new testing, but only where equivalency of such previous testing means the definition stated above.

(c) Rolling Stock test procedures, the conduct of Rolling Stock tests and the pre-revenue service acceptance test plan shall be in accordance with 49 CFR 238.111.

(d) The Concessionaire shall develop, during the design phase, a Rolling Stock test matrix listing tests to be performed within the Rolling Stock test program, which shall form part of the overall System Testing and Commissioning Plan (see Section 2.1 (System Testing and Commissioning Plan) of this Part D). The test matrix shall be updated regularly to accurately capture any changes to program scope or direction.

2.3 Test Procedures and Reports

(a) Each test procedure shall clearly identify the function and performance that it is intended to verify (including pass/fail criteria) and shall include appropriate cross references to applicable section(s) and items within the CCVM, the System Testing and Commissioning Plan and the Agreement.

(b) No test shall be performed by any Project Contractor or Subcontractor without a test procedure that has been approved by the Concessionaire. Testing performed by Project Contractors and Subcontractors shall be witnessed by the Concessionaire.
(c) Tests to be performed by the Concessionaire or the O&M Contractor shall not be performed without a test procedure that has been approved by RTD. [CDRL #7D-03]

(d) Any test found to have been performed without an approved test procedure shall be repeated in the presence of an RTD witness, and the associated test report shall be reissued.

(e) Test reports shall be prepared for all tests performed, regardless of the outcome. The Concessionaire shall submit reports of integration tests and demonstration tests, as defined in Section 2.1 above.

2.4 RTD Test Witnessing

In response to the submittal of any System Testing and Commissioning Plan, RTD will provide the Concessionaire with its anticipated plan to witness certain testing and to require review of certain test procedures and test reports. RTD reserves the right to witness any and/or all tests, and to require submission of any and/or all test procedures and reports. [CDRL #7D-04]

2.5 RTD-Required Testing for Rolling Stock

The Concessionaire shall incorporate the following test titles into the Concessionaire's test program for the Rolling Stock unless an alternative verification method is agreed by RTD. The Concessionaire shall define the scope and magnitude of these tests in order to fully demonstrate compliance with the requirements of this Attachment 7.

(a) Component and System Type Testing

   (i) Carbody Interior Materials Tests
   (ii) Window Tests
   (iii) Flammability, Smoke and Toxicity Emission Tests
   (iv) Door Panel
   (v) Door System Endurance Test
   (vi) Heating, Ventilation and Air Conditioning
   (vii) Coupler, Drawbar, and Draft Gear Tests
   (viii) Auxiliary Power, LVPS, Battery and Battery Charger
   (ix) Truck Frame Static Load Test
   (x) Truck Frame Fatigue Test
   (xi) Truck Frame Weld Inspection
   (xii) Truck Primary Suspension Tests
(xiii) Carbody Static Structural Tests
(xiv) ATC and Safety Control Equipment
(xv) Seat Frame and Cushions

(b) Car Level Type Testing
   (i) Clearance Tests
   (ii) Roll Angle Tests
   (iii) Trainline and Inter-Car Tests
   (iv) Door Operation Tests
   (v) Heating, Ventilation and Air Conditioning:
       (A) Fresh Air Ducts Tests
       (B) System Air Flow Tests
       (C) Climate Range Tests
   (vi) Lighting Tests
   (vii) Air Supply Unit Air Quality Qualification
   (viii) Brake Shoe and Disc Pad Force Tests
   (ix) Parking Brake Tests
   (x) Truck Equalization and Stability Tests
   (xi) Electromagnetic Emissions Tests and Limits
   (xii) Communications System Tests
   (xiii) Closed Circuit Television (CCTV)
   (xiv) Destination Sign and Interior Message Display Tests
   (xv) Auxiliary Power System/LVPS/BCS
   (xvi) Primary Power System

(c) Dynamic Type Testing
   (i) Noise and Vibration Tests
   (ii) Performance Tests
(iii) Acceleration Tests
(iv) Friction Brake Deceleration Tests
(v) Dynamic Brake Deceleration Tests
(vi) Blended Brake Tests
(vii) Wheel Slip Tests
(viii) Route Performance
(ix) Ride Quality Tests
(x) Electrical Interference Tests (EMI)
(xi) Signal System Tests

(d) Pre-Delivery (Car Routine) Testing
   (i) Watertightness Tests
   (ii) Weight
   (iii) Piping Tests
   (iv) Car Wiring Tests
   (v) Wiring Continuity Test
   (vi) Insulation Resistance Tests
   (vii) High Potential Tests
   (viii) Grounding
   (ix) Trainline Tests
   (x) Low Voltage DC Supply Tests
   (xi) Primary Power System
   (xii) Door Tests
   (xiii) HVAC Tests
   (xiv) Headlight, Marker Light, and Auxiliary Light Tests
   (xv) Communication Systems Tests
   (xvi) Pneumatic System and Friction Brake/Parking Brake Tests
(xvii) Leveling Tests

(xviii) Lubrication Checks

(xix) Safety Devices

(xx) Propulsion Control Systems

(xxi) ATC and Safety Control Equipment

(xxii) Load Weigh System

(xxiii) Monitoring and Diagnostics Systems

(e) Acceptance for Revenue Service Testing

(i) Car Performance Test

(ii) Operational Tests
3. **INTEGRATION TESTING**

The Concessionaire shall perform integration testing to demonstrate the correct operation and full functionality and performance of subsystems and systems together, in accordance with an approved integrated testing program. The integrated testing program shall be consistent with the System Testing and Commissioning Plan and shall include prerequisite testing for the subsequent system performance demonstration program.

3.1 Integrated Testing Program Plan

(a) The Concessionaire shall submit to RTD a plan (the *Integrated Testing Program Plan*), which shall include: [CDRL #7D-05]

   (i) a list of all integration tests to be performed;

   (ii) the interfaces and functions that are to be proven by the integration tests;

   (iii) requirements conformance to be proven, cross-referenced to applicable parts of the Agreement and the CCVM; and

   (iv) the integrated testing schedule.

(b) Integrated testing shall, at a minimum, include testing of:

   (i) Control Center equipment integration and operation;

   (ii) Rolling Stock gauging and interfacing with the track geometry and clearances;

   (iii) CRMF shop equipment installation and operation;

   (iv) grade crossing installation, activation and operation;

   (v) switch, signal, and train control system operation;

   (vi) communications systems operation;

   (vii) passenger information systems;

   (viii) emergency and safety related equipment interfaces, such as overspeed protection, bumping posts and alarm systems; and

   (ix) all electrical, mechanical, pneumatic and hydraulic installations.
3.2 Integrated Testing Procedures and Reports

(a) At least 3 months prior to the scheduled date of each integrated test, the Concessionaire shall submit the integrated testing procedures and test report forms to RTD. [CDRL #7D-06]

(b) Test reports shall be submitted within 21 days after completion of each integrated test. [CDRL #7D-07]
4. **SYSTEM PERFORMANCE DEMONSTRATION**

4.1 **System Performance Demonstration Plan and Procedures**

(a) The Concessionaire shall prepare and submit for RTD's review and approval, a plan (the *System Performance Demonstration Plan*) demonstrating the Concessionaire's approach to performing the system performance demonstration program and verifying the readiness of the Concessionaire-operated Components and operating and maintenance personnel for revenue service. [CDRL #7D-08]

(b) Following approval of the System Performance Demonstration Plan, the Concessionaire shall submit procedures (the *Performance Demonstration Testing Procedures*), which shall include the processes for performing the tests, recording and analyzing the performance data, and reporting on the readiness of the Concessionaire-operated Components for the relevant Commuter Rail Service. [CDRL #7D-09]

(c) Prior to each Revenue Service Commencement Date, the Concessionaire shall perform the demonstration tests on the relevant Concessionaire-operated Components in accordance with the submitted procedures. These tests will be witnessed by RTD.

4.2 **System Performance Demonstration Program**

4.2.1. **Goals of the System Performance Demonstration**

(a) As the culmination of the integrated test program, the Concessionaire shall perform a comprehensive demonstration (the *System Performance Demonstration*), the objective of which is to test the complete integrated Commuter Rail Network, including subsystems, operating personnel and operating procedures; and to confirm readiness for entry into revenue service. The System Performance Demonstration shall include:

(i) testing of anticipated normal and abnormal revenue service operations;

(ii) simulation of failure and emergency scenarios, to test failure management procedures and personnel readiness for revenue operations; and

(iii) testing required by Project Third Parties and Relevant Authorities.

(b) The System Performance Demonstration shall demonstrate the readiness of the Concessionaire to provide safe and reliable passenger service to the required service pattern, and ensure that the Concessionaire-operated Components are achieving sufficient reliability for sustainable service by:

(i) familiarizing the operating and maintenance staff with the operation of the integrated system;

(ii) exercising and validating the operating schedules and procedures; and

(iii) exercising and confirming the operating reliability of the subsystems in simulated operating scenarios.
4.2.2. Prerequisites for System Performance Demonstration

No test forming part of the System Performance Demonstration shall begin until:

(i) the elements required for the specific test have successfully completed their applicable qualification, acceptance and integration tests;

(ii) the associated test reports have been issued to, and (where applicable) approved by, RTD; and

(iii) personnel involved in performing the testing have completed the necessary training and qualification processes required for operating the system.

4.2.3. Features of the System Performance Demonstration

(a) Testing shall be conducted in a progressive manner, incrementally increasing the size and complexity of the network being operated until an entire Commuter Rail Project is under test.

(b) The Concessionaire's System Performance Demonstration Plan shall identify the manner in which testing will progress and shall at a minimum demonstrate the following:

(i) the ability to achieve maintenance plans and schedules through a maintainability demonstration;

(ii) the ability to dispatch trains from the CRMF as required for scheduled morning roll-out;

(iii) the operation of limited line segments (in various locations) that includes stations, grade crossings and service turnback;

(iv) the operation of any single track line segments at scheduled peak period headways, including minor disturbances/delays to some trains;

(v) the operation of each remote terminal station and DUS, with trains arriving and departing according to scheduled peak period headways, including minor disturbances/delays to some trains;

(vi) the simulated service operation of each entire Commuter Rail Project, at off-peak and then at peak period headways;

(vii) the performance under abnormal and emergency scenarios, included rescue of a failed train, partial loss of power supply, and recovery of service after a major disruption; and

(viii) the simulated service operation of both corridors concurrently at full scheduled service levels.
(c) For any corridor already in revenue service, testing of simulated service on any other corridor shall not interfere with the Concessionaire's ability to maintain required service standards on such corridor in revenue service.

4.2.4. Performance Data and Duration

(a) The Concessionaire shall use the System Performance Demonstration:

   (i) to collect operating data and evaluate system reliability, availability and the maintainability of performance; and

   (ii) to demonstrate that a process to collect, evaluate and validate the operating data has been properly established.

(b) The full System Performance Demonstration for each Commuter Rail Project shall last at least 21 days, with a minimum of 10 consecutive hours of operation each day, including transitions between peak and off-peak service that represent a full weekday operation.

(c) The System Performance Demonstration shall continue until the relevant Commuter Rail Project has achieved the Availability Ratio required by the Revenue Service Commencement Requirements, as defined in Section 28.2(a)(iv) of the Agreement.

(d) Concurrently with the System Performance Demonstration or as an integrated part of the System Performance Demonstration, the Concessionaire shall operate the relevant Commuter Rail Project for 20 hours each day for 14 consecutive days in order to acclimatize personnel and communities to normal service levels.

4.3 System Performance Demonstration Reports

(a) During the System Performance Demonstration, the Concessionaire shall prepare and submit to RTD on a daily basis status reports on the progress of the demonstration testing and a summary of each incident that occurs causing a reduction in the performance metrics. [CDRL #7D-10]

(b) During the System Performance Demonstration, the Concessionaire shall prepare and submit to RTD status reports on a weekly basis that provide a complete summary of testing progress, identify trends in performance issues and describing corrective actions that are being implemented to improve system performance. [CDRL #7D-11]

(c) Once the System Performance Demonstration has successfully met the required Availability Ratio defined in Section 28.2(a)(iv) of the Agreement, a complete test report shall be prepared and submitted within 21 days of test completion. [CDRL #7D-1]

(d) If the threshold requirement has not been met after the initial 21 days of the System Performance Demonstration, the Concessionaire shall prepare and submit a draft report, identifying the reasons for failing to achieve the milestone and a corrective action plan.
4.4 Rolling Stock Distance Accumulation

(a) Revenue service may not begin on any Commuter Rail Service until the Rolling Stock has cumulatively run a minimum of 25,000 Car miles. No Car shall enter revenue service until such Car has accumulated a minimum of 1,000 miles of test running.

(b) The Concessionaire shall prepare a report (a Distance Accumulation Report) recording the mileage run by Car, by day and by Commuter Rail Project, for each Car once the threshold value set forth in paragraph (a) is attained for that Car and prior to that Car entering revenue service.
Part E

OPERATIONS AND MAINTENANCE RESPONSIBILITIES
DURING THE DESIGN/BUILD PERIOD

1. GENERAL RESPONSIBILITIES

The Concessionaire is responsible for the care and upkeep of each Site from the time that the Concessionaire receives Vacant Possession of such Site until the End Date. The Concessionaire shall also maintain in good working order the assets of the Commuter Rail Network as they are installed and commissioned by the Concessionaire. In addition and as detailed in this Part E, the Concessionaire shall commence certain activities during the Design/Build Period that are also, and more evidently, elements of the Commuter Rail Services during the Operating Period. The Concessionaire is responsible for the provision of personnel, materials and equipment necessary for the performance of the Design/Build Period service activities set forth in this Part E.

1.1 Care and Up-keep of Sites

1.1.1. Site Access

(a) Immediately upon possession of any Site, the Concessionaire shall implement processes and physical barriers to control access to each Site in accordance with the Security Management Plan developed in accordance with Section 8.5 (Site Security Program) of Attachment 9.

(b) For Sites that contain buildings, access control shall ensure that those entering the building are provided appropriate orientation regarding evacuation procedures and, where necessary, are provided with appropriate personal protective equipment.

(c) For Sites that have active construction activity, access shall only be provided to those having completed suitable safety training, possessing the required personal protective equipment, or under appropriate supervision or escort. Site access shall not be unreasonably withheld for RTD personnel and other personnel authorized to enter.

1.1.2. Site Security

(a) Immediately upon possession, the Concessionaire shall establish appropriate security for each Site in accordance with Section 8.5 (System Security Program) of Attachment 9. Security shall be maintained regardless of whether or not the Site is actively being used by the Concessionaire and coordinated with RTD.

(b) If a Site facility or asset becomes a target for vandalism, security shall be increased in accordance with the Security Management Plan developed in accordance with Section 8.5 (System Security Program) of Attachment 9 such that incidents are reduced or eliminated.
1.1.3. Site Maintenance

(a) Immediately upon possession of any Site, the Concessionaire shall establish appropriate maintenance activities for each Site. Maintenance shall comply with applicable Law and the requirements of the Agreement. Sites shall be kept generally neat and clean, as appropriate to their location and condition at the time of possession.

(b) The Concessionaire shall repair any damage from vandalism in a timely manner in accordance with the Security Management Plan developed in accordance with Section 8.5 (System Security Program) of Attachment 9. Graffiti shall be removed or remediated within 24 hours of its discovery.

1.2 Operations and Maintenance Services

The Concessionaire shall perform operations and maintenance services for all actively operational elements of the Sites in its possession and other such items as included in the Work within this Part E. These services shall include:

(a) with respect to the DUS Rail Segment the requirements set forth in Section 2 (DUS Rail Segment) of this Part E including:

(i) dispatching of passenger services, freight trains, and any other traffic entering the DUS Rail Segment, including manual operation of track switches;

(ii) maintenance of the DUS Rail Segment infrastructure, or portions thereof, provided to or installed by the Concessionaire, including areas subject to public access and use; and

(iii) reporting, as required by FRA and PUC regulations, associated with the dispatching and maintenance of the rail facilities, and

(b) with respect to the Commuter Rail Projects and the CRMF the requirements set forth in Section 3 (Commuter Rail Corridors and CRMF) of this Part E including:

(i) maintenance of grade crossing warning systems on corridors shared with Railroad operations for which the Concessionaire is responsible from the time that any Concessionaire Work has commenced on such grade crossing warning systems;

(ii) maintenance of grade crossing warning systems on corridors serving commuter rail exclusively, after commissioning of the relevant equipment provided under the Agreement;

(iii) maintenance of the Commuter Rail Network or portions thereof provided to, or installed by, the Concessionaire including areas subject to public access and use, bus stops and parking facilities at passenger stations, and security cameras and lighting as available and installed; and

(iv) reporting, as required by FRA and PUC regulations, associated with the grade crossings and commuter rail testing.
2. DUS RAIL SEGMENT

2.1 Dispatching

(a) From the later of the Actual DUS Access Date and the Guaranteed DUS Access Date, the Concessionaire shall be responsible for the operation and dispatching of Heavy Rail Movements, maintenance trains and other traffic that may, from time to time, also require access to the DUS Rail Segment. At that time, the DUS Rail Segment trackwork will include manual switches, for which the Concessionaire shall be responsible for route setting.

(b) Dispatching shall be performed in accordance with the requirements of applicable Law and Attachment 10 (O&M Specifications), and the General Code of Railroad Rules (GCOR). The Concessionaire shall submit to RTD dispatching procedures sufficient to cover the activities to be performed in the Design/Build Period. [CDRL #7E-01]

2.2 Maintenance

The Concessionaire shall maintain all elements of the DUS Rail Segment which it possesses or on which it has constructed and installed any component of the DUS Systems. Assets in operation during the Design/Build Period shall be maintained in accordance with maintenance requirements defined for the Operating Period in Attachment 10 (O&M Specifications).

2.3 Reporting

(a) The Concessionaire shall submit to RTD maintenance reports, consistent with those required in the Operating Period as defined in Attachment 10 (O&M Specifications). [CDRL #7E-02]

(b) The Concessionaire shall submit to RTD dispatching reports consistent with those required during the Operating Period pursuant to Attachment 10 (O&M Specifications) for any dispatching conducted during the Design/Build Period. [CDRL #7E-03]
3. **COMMUTER RAIL CORRIDORS AND CRMF**

3.1 **Maintenance**

(a) The Concessionaire shall maintain all elements of the Commuter Rail Projects and the CRMF for which it received Vacant Possession or on which it has constructed and installed any element of a Commuter Rail Project. The Concessionaire shall ensure that maintenance procedures are developed, as required and as defined in Attachment 10 (*O&M Specifications*) in advance of the start of the associated maintenance responsibility. The Concessionaire's obligations with respect to the DUS Rail Segment shall commence on the Actual DUS Access Date in accordance with Section 2.4 of the Agreement and Attachment 3 (*The DUS Infrastructure*).

(b) The Concessionaire shall maintain assets in operation during the Design/Build Period in accordance with the maintenance requirements defined for the Operating Period in Attachment 10 (*O&M Specifications*), including facilities, systems and Rolling Stock used for their intended function during integrated testing and the System Performance Demonstration defined in Part D.

(c) The Concessionaire shall continue the operation of grade crossing warning systems at existing highway/rail grade crossings throughout the Design/Build Period, except for any closures approved by Relevant Authorities during the installation and testing of upgrades to such systems.

(d) Sites, facilities and installed assets shall remain free of graffiti and damage from vandalism. Any such occurrences shall be rectified within the response times defined in Attachment 10 (*O&M Specifications*).

(e) If any Site under the maintenance responsibility of the Concessionaire, or a portion of such Site, is being shared with another user, then the Concessionaire shall ensure that such operations of the other user are able to continue at all times. Examples of such Sites include existing Park-n-Ride facilities used by RTD bus patrons and areas in use as legitimate public access paths. The Concessionaire shall be responsible for prompt snow and ice removal and other activities necessary to maintain public safety at these Sites in accordance with the requirements of Attachment 10 (*O&M Specifications*).

3.2 **Reporting**

The Concessionaire shall provide to RTD maintenance reports, consistent with those required in the Operating Period, as described in Attachment 10 (*O&M Specifications*). [CDRL #7E-04]
Part F

THIRD PARTY OPTIONS TO THE DESIGN/BUILD SCOPE

1. 40TH AVENUE GRADE SEPARATION PROJECT

1.1 General Scope

(a) Subject to inclusion of the 40th Avenue Grade Separation Project as part of the Work in accordance with Section 28.6(b)(i) of the Agreement, the Concessionaire shall design and construct a commuter rail bridge over 40th Avenue, after the roadway has been lowered by the Sand Creek Metropolitan District (SCMD) (the 40th Avenue Grade Separation Project).

(b) RTD shall provide to the Concessionaire Final Design of the lowered roadway and ensure construction of the lowered roadway has been completed by the SCMD Access Date. The Concessionaire may not commence any construction activities in the area that impede the construction of the roadway lowering by SCMD or its contractors prior to the SCMD Access Date.

1.2 Specific Requirements

(a) The Concessionaire shall perform the Work with respect to the 40th Avenue Grade Separation Project consistent with the 30% design shown in the East Corridor Final Environmental Impact Statement, and in accordance with the terms defined in the Inter-Governmental Agreement between RTD and SCMD as set forth in Attachment 21 (Inter-Governmental Agreements) and Section C of Volume 2 of Attachment 19. The Concessionaire is not required to make any modification to the traffic signalization layout at the intersection of 40th Avenue and Airport Boulevards.

(b) The Concessionaire shall coordinate with SCMD regarding the design of the commuter rail bridge, which shall meet the requirements of Section 5 (Bridges and Structures) of Part B.

1.3 Design Documentation

The Concessionaire shall submit to RTD Contract Data relating to the design of the grade separation at 40th Avenue in accordance with the provisions of this Attachment 7 and Attachment 6 (Contract Data Requirements). [CDRL #7F-01] The Concessionaire shall coordinate design development with RTD and SCMD and other applicable Project Third Parties.
2. **CCD STORM SEWER DRAINAGE PROJECT**

2.1 **General Scope**

(a) Subject to inclusion of the CCD Storm Sewer Drainage Project as part of the Work in accordance with Section 28.6(b)(i) of the Agreement, the Concessionaire shall design and construct Segment 3 of the storm drainage facilities from 40th Avenue and Blake Street to 40th Avenue and York Street (the *CCD Storm Sewer Drainage Project*).

(b) The design of the CCD Storm Sewer Drainage Project is subject to approval by CCD and shall be (i) consistent with and shall integrate with a major drainage outfall from approximately 40th Avenue and Blake Street to the South Platte River (*CCD Drainage Segments 1 and 2*), which CCD Drainage Segments 1 and 2 will be designed and constructed by CCD in accordance with CCD's Storm Drainage Design and Technical Criteria Manual, and (ii) in accordance with Section C of Volume 2 of Attachment 19.

2.2 **Specific Requirements**

The Concessionaire shall design and construct the Work with respect to the CCD Drainage Project in accordance with CCD's Storm Drainage Design and Technical Criteria Manual and CCD's designs for CCD Drainage Segments 1 and 2 and in compliance with the Inter-Governmental Agreement between RTD and CCD governing the design, construction and operation and maintenance of the storm sewer improvements.

2.3 **Design Documentation**

The Concessionaire shall produce and submit to RTD Contract Data relating to the design of the CCD Storm Sewer Drainage Project in accordance with the provisions of this Attachment 7 and Attachment 6 (*Contract Data Requirements*). [CDRL #7F-02] The Concessionaire shall coordinate design development with RTD, CCD and other applicable Project Third Parties.
3. **PEÑA BOULEVARD BRIDGE PROJECTS**

3.1 **Peña Boulevard Base Bridge Project**

(a) Subject to inclusion of the Peña Boulevard Base Bridge Project as part of the Work in accordance with Section 28.6(b)(i) of the Agreement, the Concessionaire shall design and construct a structure over Peña Boulevard (the **Peña Boulevard Base Bridge Project**) for operation of the Commuter Rail Network immediately east of E-470 in accordance with the location and design set forth in the 30% design plans and the requirements of Section 5 (**Bridges and Structures**) of Part B.  

(b) The Concessionaire shall perform the Work with respect to the Peña Boulevard Base Bridge Project in accordance with Section C of Volume 2 of Attachment 19.

(c) The Concessionaire shall produce and submit to RTD Contract Data relating to the design of the Peña Boulevard Base Bridge Project in accordance with the provisions of this Attachment 7 and Attachment 6 (**Contract Data Requirements**). [CDRL #7F-03] The Concessionaire shall coordinate design development with RTD, DIA and other applicable Project Third Parties.

3.2 **Peña Boulevard DIA Bridge Project**

(a) Subject to inclusion of the Peña Boulevard DIA Bridge Project as part of the Work in accordance with Section 28.6(b)(i) of the Agreement, the Concessionaire shall:

   (i) coordinate design and construction activities with the DIA bridge contractor for the Peña Boulevard Bridge to ensure necessary interfaces are agreed and managed throughout the implementation of the Work; and

   (ii) as part of the base scope of the Work, provide trackwork, traction electrification and all other systems necessary for operation of the Commuter Rail Network across the Peña Boulevard Bridge (the **Peña Boulevard DIA Bridge Project**).

(b) The Concessionaire, RTD, DIA and the DIA bridge contractor shall participate in regular design and construction coordination meetings to review design and construction of the Peña Boulevard Bridge, including:

   (i) horizontal and vertical alignment;

   (ii) bridge design criteria and loadings;

   (iii) interface definition for the trackwork and traction electrification elements;

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38 **NOTE:** See DTP-ATC-028 (**Revised Completion Dates for DIA Bridge Option**) in Section E (**Alternative Technical Concepts**) of Volume 3 of the Technical Proposal contained in the Concessionaire's Proposal.
(iv) mutual review of design documentation; and

(v) scheduling of design and construction activities.
Appendix 1

Regulations, Codes and Standards

[Attached]
Appendix 2

Station Canopy Templates

[Attached]
Appendix 3

Final Design Documents for Work on UPRR Property

[Attached]
EXHIBIT 1

DRAFT VOLUNTARY CLEAN-UP APPLICATION AND MATERIALS MANAGEMENT PLANS

Part A: Draft Voluntary Clean-Up Application and Materials Management Plan for the East Corridor

[Attached]
Part B: Draft Voluntary Clean-Up Application and Materials Management Plan for the Gold Line

[Attached]