SCHEDULE 1PART A:
TIER III NEXT GENERATION AMTRAK/AUTHORITY TRAINSETS PERFORMANCE SPECIFICATION

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TITLE	:	SCHEDULE 1 PART A TIER III NEXT GENERATION AMTRAK/AUTHORITY TRAINSETS PERFORMANCE SPECIFICATION
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Amtrak Signatures

Amtrak Executive Sponsor — Date: 1/23/14

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Authority Signature

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AMENDMENTS

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9	FRA Comments, Amtrak & CHSRA Edits and Answers to the Builders' Questions	Amtrak, Authority, LTK & Interfleet	01/23/14

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1 EXECUTIVE SUMMARY

This document is a high level performance-based Specification identifying Amtrak and California High Speed Rail Authority (Authority) requirements for new Tier III Trainsets.

For the purposes of this document, Amtrak and the Authority shall henceforth be defined as "Owner" unless specifically noted.

The intent of this Section is to provide a high-level summary of Owner expectations. The language contained within this Section shall not supersede any requirements defined in the subsequent sections.

The Contractor shall provide a Trainset platform of a Service-Proven design, or a variant of a Service-Proven Trainset platform, with the following key features:

a) High level of Safety.
b) High Reliability.
c) High Availability.
d) Excellent Maintainability.
e) Energy efficiency.
f) Low life cycle costs.
g) Flexible high quality passenger and Train Crew environments.
h) High level of security.

The Contractor shall be required to support the successful commissioning of the Trainsets, including obtaining relevant Approvals from the Federal Railroad Administration (FRA).

Based on the Owner's experiences and future aspirations, below are several key issues that the Contractor shall address to ensure that the Owner's requirements are met:

a) Environments in which the Trainsets will have to operate.
b) High Reliability and Fault tolerance.
c) Passenger comfort.
d) Passenger and employee Safety and security.
e) Energy efficiency and conservation.
f) Environmental quality and impact.
g) Standardization of a product platform for high speed rail in the U.S.
h) Optimization of whole life cost (Reliability, Availability, Maintainability and Safety).
i) Compliance with Amtrak's and Authority's individual infrastructure and System requirements.

The new Trainsets must enhance Amtrak's present day brand image for high speed passenger transport between city centers on the Northeast Corridor (NEC) and set a high standard for the Authority's introduction of high speed rail in California.

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3 GLOSSARY OF TERMS

3.1 ACRONYMS AND ABBREVIATIONS

General usage acronyms and abbreviations are as follows:

AAR	Association of American Railroads
AC	Alternating Current
ACSES	Advanced Civil Speed Enforcement System
ADA	Americans with Disabilities Act of 1990 (regulations promulgated there-under, including 49CFR Parts 27, 37, and 38 and DOT clarification letter of December 4th 2012)
ADAAG	ADA Accessibility Guidelines
APTA	American Public Transportation Association
APS	Auxiliary Power Supply
ASC	Automatic Speed Control System
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASTM	American Society for Testing and Materials
ATC	Automatic Train Control
ATO	Automatic Train Operation
Authority	California High Speed Rail Authority
BSS	Boeing Specification Support Standard
CDC	Centers for Disease Control and Prevention
CDRL	Contract Deliverable Requirements List
CEM	Crash Energy Management
CEN	Comité Européen de Normalisation (European Committee for Standardization)
cfm	Cubic Feet per Minute
CFR	Code of Federal Regulations
CHSTS	California High Speed Train System
CIL	Certifiable Items List
CMA	Corrective Maintenance Analysis
CPTED	Crime Prevention through Environmental Design
CRAM	Contractor RAM Program Plan
CRMP	Contractor and Supplier RAM Plan
CS/SC	Cab Signal and Speed Control System
CT	Current Transformer
dB	Decibel
dBA	Decibel, "A"- Weighted Scale
DC	Direct Current (specifically traction current supplied by OHL)
DCM	Design Criteria Manual (Authority)
DMI	Driver-Machine Interface
DOT	United States Department of Transportation

EIR/S	Environmental Impact Report/Statement
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EN	European Norm
ETF	Engineering Task Force
EV-DO	Evolution Data Optimized
FAI	First Article Inspection
FCC	Federal Communications Commission
FDA	Food and Drug Administration
FDB	Fahrenheit Dry Bulb
FEA	Finite Element Analysis
FMEA	Failure Modes and Effects Analysis
FMECA	Failure Modes and Effects Criticality Analysis
FRA	Federal Railroad Administration
FRACAS	Failure Reporting and Corrective Action System
FRP	Fiber-Reinforced Plastic
FTA	Federal Transit Administration
GFI	Ground Fault Interrupter
GPS	Global Positioning System
GUI	Graphical User Interface
HABD	Hot Axle Box Detection
HMI	Human-Machine Interface
HPMR	Historical Product Maintainability Report
HSPA	High Speed Packet Access
HVAC	Heating, Ventilation, and Air Conditioning
Hz	Hertz
IBS	Interface Breakdown Structure
ICD	Interface Control Document
ICE	Independent Checking Engineer
ICP	Integrated Control Panel
ICT	Interface Control Team
ICW	Interface Coordination Workshop
IEC	International Electro-technical Commission
IEEE	Institute of Electrical and Electronic Engineers
IM	Interface Management
IOS	Initial Operating Segment
ISO	International Organization for Standardization
ITE	Independent Testing Engineer
ITO	Instructions for The Offeror
IV&V	Independent Verification and Verification
JIS	Japanese Industrial Standards
km/h	Kilometers Per Hour
kV	Kilovolts
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LRU	Line Replaceable Unit

MCAT	Minimally Compliant Analytical Track
MCE	Maximum Considered Earthquake
MDT	Maintainability Demonstration Test
MDTP	Maintainability Demonstration Test Plan
MHz	Megahertz
MPH	Miles Per Hour
MTBCF	Mean Time between Component Failure
MTBSI	Mean Time between Service Interruption
MTTRS	Mean Time to Restore Service
N/A	Not Applicable
NEC	Northeast Corridor
NFPA	National Fire Protection Association
NPRM	Notice of Proposed Rulemaking
O&M	Operations and Maintenance
OBE	Operating Basis Earthquake
OCC	Operations Control Center
OCS	Overhead Contact System
PA/IC	Public Address and Intercom
PHA	Preliminary Hazard Analysis
PMA	Preventative Maintenance Analysis
POS	Point of Sale
PPM	Pulses Per Minute
PRA	Preliminary Reliability Analysis
PTC	Positive Train Control
PTU	Portable Test Unit
QA	Quality Assurance
QC	Quality Control
RAMS	Reliability, Availability, Maintainability, and Safety
RAR	RAM Allocation Report
RCM	Reliability Centered Maintenance
RDT	Reliability Demonstration Test
RDTP	Reliability Demonstration Test Plan
RF	Radio Frequency
RFP	Request For Proposal
RM	Requirements Management
RPR	Reliability Prediction Report
RSAC	Railroad Safety Advisory Committee
RST	Rolling Stock
RVTM	Requirements Verification Traceability Matrix
SEMP	Systems Engineering Management Plan
TMDS	On-Train Monitor and Diagnostic System
TOR	Top Of Rail
TPS	Traction Power Supply
TVA	Threat and Vulnerability Assessment
TSI	Technical Specifications for Interoperability
UIC	Union Internationale des Chemins de fer (International Union of Railways)

UL	Underwriters Laboratories, Inc.
UMTA	Urban Mass Transportation Administration
USC	United States Code
V&V	Verification and Validation
VAC	Volts Alternating Current
VOC	Volatile Organic Compound
VPN	Virtual Private Network
Wi-Fi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access
WSP	Wheel Slide Protection

3.2 DEFINITIONS

Terms used within this Specification shall have the following meanings:

AAR-equipped	Vehicles equipped with AAR coupler and air brake hose configuration.
Analysis	A logical thought process which includes: clearly stated assumptions which can be justified, calculations with references for methods and equations stated, using data from simulation or, preferably, Full-Scale Test, and clearly-stated conclusions which logically follow from the supporting calculations and data.
Approval	This shall be considered as formal disposition in writing by the Owner (e.g., statement of no objections, no objection with comments, with objections). The Contractor shall not be relieved from meeting the Contract requirements except as identified in the Approval document.
Assembly	A group of components or subassemblies.
Availability	The ability of a product to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval assuming that the required external resources are provided.
Bogie	An Assembly that consists of a frame with axle(s)/wheelset(s) and braking Equipment that pivots under a carbody or between two carbodies. It may or may not include traction motors and gearboxes. Also called a truck.
Brake, Dynamic	A general term covering Regenerative Braking and the management of surplus braking energy via an onboard power management System.
Brake, Electric	A general term covering both Dynamic Braking and eddy current braking, if applicable.
Brake, Regenerative	Braking in which kinetic energy is converted to electrical energy in the traction motors, transferred by the control System through the DC link, and returned to the contact line or addressed by the onboard power management System.
Cab	The portion of the superstructure of a Vehicle designed to be occupied by the crew operating the train.
Cab, Controlling	The Cab from which the Operator exercises control over the train.
Cant Deficiency	Involves traveling through a curve faster than the balance speed and produces a net lateral force to the outside of the curve. Cant Deficiency is measured in mm (inches) and is the amount of superelevation that would need to be added to achieve balance speed.
Collapse	Large deformations or buckling of structural members when their yield or buckling strength is exceeded.

Contract	Refer to the General Provisions and relevant Contract Documents for definition.
Contract Documents	The advertisement, the request for proposal with addenda, the executed Contract, the Specifications, the Notice-to-Proceed, the change orders, and the proposal upon which the Contract is awarded.
Contractor	Refer to the General Provisions and relevant Contract Documents for definition.
Core Systems	Core Systems shall include the following aggregate of Systems, at a minimum, that form the Owner's railway System: • Trainsets; • Infrastructure (including trackwork, tunnels, viaducts); • Supervisory control and data acquisition; • Signaling (including Automatic Train Control and Positive Train Control); • Overhead contact System; • Traction power System; • Communications (including public address/intercom, Wi-Fi, radio, closed-circuit television, etc.) System; • Access control (including intrusion detection); • Hazard detection and mitigation (including fire and seismic).
Corrective Maintenance	Maintenance that shall be performed to restore an Equipment component or System to satisfactory condition after a malfunction or Failure has degraded that particular item below the Specified acceptable performance levels. The Maintenance shall be carried out after Fault recognition in accordance with prescribed criteria. The goal of Corrective Maintenance is the placement of the item back into a state where it could resume Normal Operations.
Coupler Adapter	The rescue/recovery Interface unit installed on the Trainsets that permits Trainset coupling with AAR equipped rolling stock.
Data	Presentations, plans, reports, schedules, drawings, forms, plans, Programs, calculations, analyses, samples, photographs, video, etc. prepared by the Contractor and/or the Subcontractor in response to Owner requests and/or in accordance with the requirements identified in the Contract documents.

Design Review Process	The process by which the Trainset is designed to meet the requirements of this Specification and fulfills the requirements of the Contract. The Design Review Process will consist of staged gate review levels (e.g., preliminary, intermediate, and final) and necessitates close coordination between the Contractor and the Owner via design review meetings.
Device	It may be a component, Equipment, Subsystem, or System and may be electrical, mechanical, pneumatic, and/or hydraulic.
Disc Brake Rotor	A rotating disc attached to a wheel or axle which absorbs friction braking energy. This can also refer to an eddy current axle brake rotor, if applicable.
Double Traction	Two Trainsets operating in a coupled configuration.
Downtime	The time interval whereby any Device, component, or Equipment is not under Normal operation due to Maintenance requirements or Failures/Faults (inclusive of repair/reinstallation times and time needed to resume Normal functions).
Equipment	Any physical Device that is part of the Trainset and is the object of Maintenance actions. Equipment may also refer to the Trainset itself.
Failure	A deviation from the Specified performance of a System. A Failure is the consequence of a Fault or error in the System.
Failure Modes and Effects Criticality Analysis (FMECA)	Procedure that follows failure mode and effects analysis, and where each potential failure effect is classified according to its probability of occurrence and degree of severity. Requirements for FMECA are identified in EN 50126.
Fault	An abnormal condition that could lead to an error in a System. A Fault can be random or systematic.
Flammability	The ease, with which a material ignites and, once ignited, continues to burn.
Front End	The end of a Vehicle or Trainset unit facing the direction of travel.
Full-Scale Test	A test of a fully-assembled article.
Glazing Frame	The arrangement used to install the glazing into the structure of the Trainset.
Glazing, Interior	A glazing panel with no surface exposed to the outside environment and which is protected from projectiles by the structure of the Trainset.
Half Coupler	A glad hand style, brake line coupler to be connected to the air pipes between the Trainset and the Rescue Vehicle.
Hazard	A physical situation with a potential for human injury, environmental impact, or service impact.
Interface	The physical or functional connection point between two Systems, Subsystems, components, etc.

Mainline	Lines other than those within the Maintenance facilities/depots. They shall include both dedicated and shared portions of right-of-way or track.
Maintainability	The probability that a given Maintenance action, for an item under given conditions of use, can be carried out within a stated time interval when the Maintenance is performed under stated conditions and using stated procedures and resources.
Maintenance	The combination of technical and administrative actions intended to retain or restore a product to a state in which it could perform its intended functions.
Manufacturer	The builder/producer of Trainset materials or Equipment.
Mock-ups, Hard	Mock-ups used to convey final concepts and Equipment arrangements. All components shall be operable to the extent that their operating mechanisms, controls, and range of operation can be demonstrated. Hard Mock-ups shall be modified, after review and comment, to reflect "as built" conditions and shall be durable to withstand transportation to various locations for interaction with stakeholders.
Mock-ups, Soft	Mock-ups used to convey initial concepts and the general arrangement of Equipment in full size. Such Mock-ups are generally not "durable." Soft Mock-ups shall be neutral in color and shall not represent specific color schemes. Colors shall be used only to represent the range of motion of components. Soft Mock-ups shall include all appropriate simulated signage. The operating envelope of each moveable component shall be defined. All component deployment positions shall be demonstrated. Soft Mock-ups shall be made of inexpensive, easy-to-work materials such as plywood, wood battens, cardboard, foam core panels, and foam plastics. Alterations shall be simple through use of a saw or knife. Components shall be secured with nails, tape, or adhesive. 3D visualization tools for space planning and form, fit, and function would also be acceptable as a Soft Mock-up.
Normal	The condition in which the pertinent part, Equipment, Subsystem, or System is under proper Operations, as intended, and is not in a failed state.
Occupied Volume	The sections of a Vehicle which contain seating and are normally occupied by passengers or crew.
Operating Speed	The speeds that the Trainsets are expected to run during daily Operations on appropriate sections.
Operating Plan	Train Operations and journey time in support of the requirements Specified in Section 5.1. Amtrak Operating Plan is attached to this Specification.

Operations	The supervision, control, and performance of trains, stations, depots, and control center Operations during Normal, degraded, and emergency situations.
Operator	Any qualified person who moves the train or locomotive (if in the event of a rescue operation) regardless of whether or not it is coupled to other rolling stock. Also defined as locomotive engineer.
Owner	The respective agencies; Amtrak and California High Speed Rail Authority.
Pitch	The distance between a point of a seat to a similar point of the seat in front.
Preventative Maintenance	Maintenance that shall be performed to retain the Trainset in satisfactory, operational condition by timely/scheduled inspections, calibrations, cleanings, etc. The Maintenance shall be carried out at predetermined intervals (based on days or distances) in accordance with prescribed criteria. The goal of Preventative Maintenance shall be to reduce the probability of Equipment degradation/Failure that could affect Normal Trainset Operations.
Procurement	The furnishing of items, Equipment, Data, services, labor, management, etc. necessary for the design, manufacture, assembly, testing, and delivery of the Trainsets and Work under this Contract.
Product Safety Plan	A document that the Owner requires of the Contractor that gives the details of the techniques, procedures, and tests to be used as part of the Trainset design process to ensure that the Trainset meets all Federal Safety standards and Owner Safety design requirements.
Program	The process of Procurement, design, construction, testing, acceptance and warranty support of Tier III Trainsets.
Regulatory Agency	Entity responsible for regulatory Approval.
Relevant Standard	An industry-recognized standard used in the design, production, and/or development of high speed rail deliverables identified in this Contract.
Reliability	The probability that an item can perform a required function under given conditions for a given time interval.
Revenue Service	The Normal operation of the Trainset on the railway System whereby passengers are transported and fares are collected.
Safety	The condition in which persons are free from unacceptable risk, harm, threat, or danger.
Service-Proven	Refers to Trainset Standard Platform in use in commercial high speed passenger service at least 257.5 km/h (160 mph) for a minimum of two years.

Shared Right-of-Way	Rail Operations conducted by more than one railroad on the same right-of-way regardless of whether such Operations are the result of: • Contractual arrangement between railroads; • Order of a governmental agency or a court of law; or • Any other legally binding directive
Software Safety Plan	A controlled orderly process to develop, produce, test, and verify safe and reliable computer programs for the Trainset.
Specification	The directions and provisions established in this document, in its entirety, that prescribes the manner of performing the Work, the requirements and criteria to be followed, and the deliverables to be submitted as part of this Contract.
Specified	As stated in this document.
Standard Platform	Defined as a Tier III Trainset with service-proven components/systems. The standard platform shall provide for a high degree of commonality between the Amtrak Trainset and the Authority Trainset.
Static End Load	A compressive force applied to the ends of a carbody structure.
Static End Yield Strength	The Static End Load which just produces the first yielding in the carbody structure.
Static Vertical Axle Load	The sum of the vertical forces exerted by an axle of a Tier III Trainset Vehicle when stationary on tangent, level track.
Subassembly	A grouping of components that are part of a larger System used to perform discrete functions in conjunction with other groupings.
Subcontractor	Refer to the General Provisions and relevant Contract Documents for definition.
Subsystem	A combination of components or Equipment that perform an operational function within a System.
System	A combination of Subsystems that performs a major operational function.
Terminal Unit	Collects various status data relevant to the car and the trainset and outputs operation commands to various types of subsystems and passenger service equipment.
Tier III	Proposed requirements developed by RSAC Engineering Task Force for rail operations up to 354 km/h (220 mph) as described in reference ETF_001-02 – Proposed Rule text for NPRM (Notice of Proposed Rule Making).
Train Crew	Onboard personnel who support the Trainmaster and generally have and perform similar functions/responsibilities. Also called crew.

Trainmaster	A person, who oversees the general welfare, Safety, and security of the passengers, manages the Trainset's assets, assists the Operator, and monitors and controls Trainset Subsystems, as appropriate, with applicable knowledge and qualifications. Also called a conductor.
Trainset	A fixed formation consisting of Vehicles that can only be reconfigured within a workshop environment.
Trainset, Base	The train configuration offered by the Contractor which meets the Trainset capacity requirements of the Specification.
Vehicle	A passenger Equipment of any type and includes a car, trailer car, locomotive, power car, or similar rolling stock.
Vehicle, Café	The Vehicle in the Trainset which serves as the main food preparation and serving area.
Vehicle, Rescue	Fully functional Trainset or AAR-equipped locomotive sent to aid a malfunctioning Trainset.
Vital	A subcomponent, component, or System that is Safety-critical, and therefore, must be designed to be failsafe and/or have a very low incidence of unsafe Failures.
Work	Refer to the General Provisions and relevant Contract Documents for definition.

4 REGULATIONS AND STANDARDS, UNITS, AND DESIGN APPROVAL

4.1 REGULATIONS AND STANDARDS

4.1.1 Regulations

U.S. laws and regulations define the requirements for passenger rail Equipment in the U.S. (refer to Appendix A). The list in Appendix A is non-exhaustive and it shall be the Contractor's responsibility to comply with all regulatory (including statutory) requirements.

While proposed Tier III requirements shall be met, there may be sections of Tier I and Tier II criteria that may be applicable to the Owner's Trainset design. It shall be the Contractor's responsibility to ascertain applicability of all relevant parts of U.S. laws and regulations, and to provide demonstration of compliance with these regulations and justification to the Owner and FRA for Approval.

Notwithstanding any references to Engineering Task Force (ETF) recommendations and Notice of Proposed Rulemaking (NPRM) text, FRA's final regulatory requirements including waivers from existing Relevant Standards will prevail.

4.1.2 Standards

The Contractor shall identify all Relevant Standards (e.g., APTA, EN, JIS, UIC, TSI, etc.) that have been referenced for the design of the Trainset.

Whenever a dated standard is referenced in this Specification, only the cited edition shall apply. For undated references, the latest version of the standard at the time proposals are due shall apply.

It shall be the Contractor's responsibility to ascertain applicability of all relevant parts of the standards and any change required for U.S. Operations and to provide demonstration of compliance with these standards and justification to the Owner for Approval.

4.2 UNITS OF MEASURE

4.2.1 Requirements and Information

As a general requirement, each Subsystem shall be designed and manufactured to a single standard of measurement, and there shall not be a mixture of standards in any enclosure or on any component or Subassembly for a Subsystem within the enclosure.

Subsystem and component designs and associated fasteners shall be metric standard.

Fractional measurements shall not be used on drawings but shall be expressed as decimal values.

The Trainset design drawings shall be metric standard, with the U.S. inch standard noted in brackets or directly below the metric standard.

4.3 DESIGN APPROVAL PROCESS

4.3.1 Requirements and Information

The Contractor shall be subject to a formal Design Review Process.

The Design Review Process shall be applied at the Trainset Subsystem level (e.g., traction, braking, air conditioning, seats, etc.), and shall include a number of staged gate review levels (e.g., preliminary, intermediate, and final).

The Design Review Process shall demonstrate that:

a) The Trainsets will meet the requirements of the Specification, including the provision of a high level of Safety (e.g., crashworthiness, occupant protection, etc.) in their design and construction. Any deviation from the criteria defined in this Specification shall be subject to the Owner's sole discretion. Deviations shall be clearly presented by the Contractor, for the Owner's approval, through an alternative that has been Service-Proven in Tier III Trainset design and Operations.
b) The Maintainability requirements have been implemented in all aspects of Trainsets design relating to planned Maintenance, overhaul, and repair.

Compliance with approved international standards can be verified through the submittal of previously conducted analyses and tests on an identical item provided by the same supplier.

5 PERFORMANCE CAPABILITIES

5.1 JOURNEY TIME

5.1.1 Requirements and Information

The Trainset shall provide performance required to achieve the shortest possible journey times consistent with the overall requirements of this technical Specification.

Amtrak journey time requirements shall be met operating with a full-seated passenger load on the existing infrastructure and are as follows:

a) Washington, DC - New York Penn Station: Not to exceed 2 hours, 21 minutes with one-minute station stops at Baltimore, MD; Wilmington, DE; Philadelphia 30th Street Station, PA and Newark, NJ.

b) New Haven, CT – Boston South Station, MA: Not to exceed 1 hour, 51 minutes) with one-minute station stops at Boston Back Bay Station, MA; Route 128, MA; Providence, RI and New London, CT.

Journey times will be determined by Amtrak through use of its in-house Train Performance Calculator (TPC). Where a total journey time is necessary for duty cycle- and RAMS-related determinations, a Washington, DC to Boston South Station, MA total journey time of 6 hours 8 minutes shall be used.

Amtrak's simulations will be based on operations of up to a maximum cant deficiency of 5 inches (127 mm) for a non-tilt Trainset and up to 9 inches (229 mm) for a tilting Trainset. High cant deficiency operation shall provide compensation for quasi static lateral accelerations exceeding 0.06g and the amount of compensation shall be determined jointly during the performance simulations stated above.

The following documents, physical characteristics, maximum allowable speed information and TPC forms, can be found in the "Journey Times" file attached to this Specification:

a) Next Generation DC to NYP Route Profile.xls;
b) Next Generation NYP to Boston South Station Route Profile.xls;
c) Next Generation TPC Data Form.xls.

For the Authority, the network journey time between San Jose and Union Station in Los Angeles shall be no more than 2 hours 10 minutes. The information provided in the "Authority's San Jose–LA Union Station Alignment" document shall be used to verify compliance with this requirement.

5.2 OPERATIONAL PERFORMANCE

5.2.1 Requirements and Information

The Trainset shall achieve a nominal start up time of two minutes. This time shall be measured from the point when all Systems are off and de-energized, to when the Trainset is able to move with all Systems operational. The Trainset shall be capable of reversing (once stationary) in two minutes, nominal, excluding door open/close times and any walking time between ends.

It shall be possible to reset the Trainset Systems from the operating Cab.

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5.4 PASSENGER FLOWS

5.4.1 Requirements and Information

The Contractor shall provide an Analysis illustrating the passenger flows at terminal stations for able-bodied passengers and passengers with disabilities, in the ratio as determined by the number of seating locations per Trainset. The Analysis shall assume that 50% of the passengers are carrying luggage, with the maximum luggage size equal to 1143 linear mm (45 linear inches) representative of the total of the height, width, and depth of the bag. The Trainset doorways and vestibules shall be sufficiently wide to meet or exceed Americans with Disabilities Act (ADA) requirements. The design of the Trainset including size and location of exterior doorways, vestibules, internal features, and seating areas shall be optimized to achieve ADA compliance for maneuverability, and for allowance of passenger flows that achieve the required boarding, disembarkation, and evacuation times as referenced in section 8.13.1.

6 RELIABILITY, AVAILABILITY, MAINTAINABILITY, AND SAFETY (RAMS)

6.1 RELIABILITY

6.1.1 Requirements and Information

It is a key requirement that the Trainsets are highly reliable from service entry and throughout their service life. RAMS target information has been provided below. Reliability performance shall be achieved by the design, manufacture, testing, commissioning and then maintenance over the life of the Trainset.

The Trainset shall be provided with the necessary functionality and redundancy to recover from or mitigate for reasonably expected technical Failures and malfunction and to reduce any impact to service from a malfunctioning Trainset.

The Contractor shall prepare and submit for the Owner's Approval a Reliability Program Plan that describes how Reliability will be achieved and demonstrated throughout the Program. The Reliability Program Plan shall contain, at a minimum:

a) Program objectives.
b) Reliability Program schedule.
c) Methodology to be used in Reliability Analysis, to include use of FMECA.
d) Apportionment of Reliability target performance to each Subsystem.
e) Organization of personnel responsible for managing Reliability on the Program.
f) Control of Subcontractors and suppliers to ensure compliance with the Reliability Program plan.
g) Details for the Reliability demonstration Program, including procedures, and measurement criteria test parameters.
h) Reliability database, inclusive of Data drawn from current applications of the Standard Platform and technologies, including contact information for the train Operators.

The Reliability Program Plan shall address the requirements defined in the Infrastructure Interface Specifications (Appendices B and C), EN 50126, EN 50128, EN 50129, and EN 50155.

At a minimum, the Trainsets shall achieve the following Reliability metrics:

a) Mean Time between Service Interruption (MTBSI) of 4,800 hr. MTBSI is the mean time in train service hours between failures causing a train service interruption. Train service hours are the hours a train is carrying passengers, i.e., running between terminals and boarding and deboarding passengers at station stops. A train service interruption is defined as a Failure that results in a train in service being:
    a. More than 10 minutes late arriving at or departing from any station;
    b. Cancelled either at its originating point or en route; or
    c. Reduced in size or revenue capacity due to requiring a failed Trainset (under double traction configuration) to be removed.

b) Mean Time to Restore Service (MTTRS) of 0.51 hr, where MTTRS is the mean time in hours to restore a train to service after a service interrupting Failure. MTTRS includes the time to replace a train when a service interrupting failure requires train removal from service.

The Contractor shall achieve and demonstrate RAM performance metric values for the Authority Trainset and train Systems for the Authority's Approval, and for the Amtrak Trainset and train Systems for Amtrak's Approval. The required RAM performance metrics are MTBSI, MTTRS, Mean Time Between Component Failure (MTBCF), and Mean Time To Repair (MTTR). The Contractor shall implement a Maintenance Plan to assure the Trainset and Equipment achieve the MTBSI and MTBCF metrics. The Maintenance Plan shall include a completed "Trainset RAM Metric Values" table, or equivalent, which shall account for all equipment on the train, excluding ATC, radio communications, and CCTV for the Authority. The Contractor shall include one table for the Authority Trainset and one table for the Amtrak Trainset.

MTBCF is the mean time in train service hours between all Failures requiring a maintenance action.

MTTR is the mean time in man-hours to repair failed components. MTTR includes all time associated with a repair, such as time required for fault isolation, troubleshooting, component replacement, verification test, etc.

Trainset RAM Metric Values						
Sys. No.	Vehicle System	MTBSI (hr)	MTTRS (man-hr)	MTBCF (hr)	MTTR (man-hr)	List each failure which immobilizes a train and provide its MTBSI (hr)
1	Door Control System & Doors					
2	Communications Systems/Passenger Information Signs					
3	CCTV					
4	Event Recorder					
5	Monitoring and Diagnostic System					
6	HVAC System					
7	Primary Power Distribution and Auxiliary Power System, Low Voltage System, Trainlines and Train and Car Control, and Pantograph Current Collector					
8	Propulsion System and Adhesion Management					
9	Onboard Train Control					

Trainset RAM Metric Values						
Sys. No.	Vehicle System	MTBSI (hr)	MTTRS (man-hr)	MTBCF (hr)	MTTR (man-hr)	List each failure which immobilizes a train and provide its MTBSI (hr)
10	Friction Brake System, Compressed Air System, Parking Brake System, Adhesion Management Dump Valves					
11	Carbody					
12	Interior Furnishing, Finishes, and Lighting					
13	Coupler					
14	Truck Assemblies					
15	Fire Protection Systems and Extinguishing					
16	Café Equipment					
17	Cab Controls					
18	Water and Waste Water System					
Train-Level						

The Contractor's RAM Metric values for the Authority shall use the RAM Analysis Factors, as defined in Section 12.3.42. The Contractor's RAM Metric values for Amtrak shall be based on the parameters defined in Amtrak's Operating Plan and Amtrak Maintenance Requirements Specification (MRS). Operating plan is attached to this Specification.

6.1.2 Reliability Demonstration

The Contractor shall prepare a detailed Reliability Demonstration Program Plan identifying all quantitative requirements, to demonstrate that the design Reliability performance targets of the Trainsets have been achieved.

The plan shall contain Failure accounting ground rules, accept-reject criteria, test locations, environmental conditions, planned starting dates, and test duration. The Reliability Demonstration Program Plan shall be submitted to the Owner for Approval.

6.2 AVAILABILITY

6.2.1 Requirements and Information

Trainset Availability shall be calculated as MTBSI divided by the sum of the MTBSI and MTTRS as defined in Section 6.1.1.

Trainset Availability shall meet further requirements defined in the Infrastructure Interface Specifications (Appendices B and C).

6.3 MAINTAINABILITY

6.3.1 Requirements and Information

The Trainset shall be designed and built so as to minimize Maintenance and repair times, and to reduce Maintenance costs over the entire service life. The Trainset design is expected to incorporate simple-to-change modular Equipment, simple-to-manage diagnostics, condition monitoring, and Data Systems. The Trainset design shall focus on Maintenance and reparability and provide features which enable Maintenance and repairs to be carried out quickly, safely, and effectively.

A Maintainability Program Plan shall be developed by the Contractor and submitted to the Owner for Approval. The plan shall include tasks to be performed at the Subsystem level and shall include the following objectives:

a) Identification of maintainability targets in terms of MTTRS at subsystem levels and identification of the maximum time to repair line replaceable units (LRU).
b) Achievement of a design that complies with Maintainability requirements by identifying areas that are critical in terms of Maintainability, eliminating any potential problems that might affect the Maintainability of the Subsystem, and integrating these tasks with the Contractor's and Regulatory Agency's required Maintenance tasks.
c) Achievement of Maintainability prediction of each Subsystem by conducting an evaluation of the Maintainability level that Subsystems are expected to meet or exceed.
d) Complement and support the Owner's Maintenance Plan.

The Maintainability Program Plan shall address the requirements defined in the Infrastructure Interface Specifications (Appendices B and C) and EN 50126, EN 50128, EN 50129, and EN 50155.

6.3.2 Maintainability Demonstration

Maintainability demonstrations shall involve specific tests to validate that the Maintenance targets outlined in the Maintainability Plan can be completed as defined. The details of the Maintainability demonstrations shall be presented for Approval by the Owner in the Maintainability Program Plan. These tests shall be completed on a selected sample of LRUs, upon agreement with the Owner, by an experienced and qualified Maintenance team.

Maintainability demonstrations shall include a shop exercise including troubleshooting, change out of components, Corrective Maintenance, and the use of Contractor-supplied special tools and Equipment. Compliance with regulatory framework requirements shall be demonstrated. All Systems shall be subject to a Maintainability demonstration, including but not limited to:

a) Bogies.
b) HVAC.
c) Propulsion System.

d) Brakes.
e) Wheels and axles.
f) Auxiliary electric Equipment (including battery charger and battery).
g) Side and end doors.
h) Couplers.
i) Windshields and glazing.
j) Seats (removal and installation).
k) Public address and intercoms.
l) Water and waste System.
m) Emergency Equipment.
n) Lighting.
o) Galley Equipment.

6.4 SAFETY

6.4.1 Requirements and Information

The Trainsets shall be designed with consideration for the health and Safety of passengers, operational crew, emergency responders, and other third parties. The Contractor shall identify and mitigate Safety Hazards from the outset of the design process and report progress on Safety Work activities throughout the design and Approval phases of the project.

6.4.2 Product Safety Plan and the Owner's System Safety Program Plan

The Contractor shall develop, implement, and maintain a comprehensive Product Safety Plan (PSP) for the Trainset that conforms to the guidelines and requirements of 49CFR Part 229 Subpart E, 49CFR Part 236 Subparts H and I, 49CFR Part 238 Subpart G, 49CFR Part 270, applicable proposed Tier III requirements, and the APTA Manual for the Development of System Safety Program Plans for Commuter Railroads. The PSP shall ultimately form a part of the Owner's overall System Safety Program Plan (SSPP). For the Authority, the PSP shall be in conformance with the System Safety requirements of the Authority's Safety and Security Management Plan and its successor SSPP. The Authority's Safety and Security Management Plan will be refined and developed as requirements mature. The Contractor shall review the amended documents and shall ensure that the PSP is updated to remain consistent and in conformance with the latest version of the Authority's Safety and Security Management Plan.

The information provided in the Preliminary PSP submitted at the proposal stage shall be incorporated in the Contractor's PSP and the Owner's SSPP.

An updated draft of the PSP shall be developed and submitted to the Owner for Approval at the Preliminary Design Review stage. The tracking of Safety hazard mitigations shall then be conducted on an ongoing basis throughout the project. The Contractor shall identify Hazards and mitigations, which shall be subject to review and acceptance by the Owner. A final Safety certification report shall be submitted with delivery of the first Trainset, verifying applications of mitigations, validating the effectiveness of the mitigations, and confirming

the residual risk of all identified Hazards. Residual risk shall be assessed and approved by the Owner.

The PSP shall include a software Safety section, which applies to any embedded or external software or firmware which controls or monitors Safety-critical functions.
Software Safety requirements shall be treated as an integral part of a hardware/software System and shall comply with EN 50128 or equivalent. Functions accomplished through the use of software shall be considered Safety critical unless an independent redundant hardware means is also provided to accomplish the same function.

Features of the Software Safety Program shall include the following, at a minimum:

a) Definition.
b) Implementation and oversight of the software design and verification process.
c) Integrity of the documentation.
d) Software Hazard Analysis.
e) Software Safety reviews.
f) Software Hazard monitoring.
g) Reporting and tracking.
h) Software integration with hardware at each stage of the design and testing process for components, Systems, Vehicles, and Trainsets inclusive of software for Safety-critical functions.

7 TRAINSET-WIDE REQUIREMENTS

7.1 OPERATING ROUTES

7.1.1 Requirements and Information

The Trainsets shall be able to operate on the respective Owner's System, as defined in the Infrastructure Interface Specifications (Appendices B and C).

7.2 TRAINSET PRODUCT PLATFORM

7.2.1 Requirements and Information

The respective Owner will be selecting one Trainset platform from the three listed below, which will be identified prior to Contract award:

a) A Trainset UIC profile that complies with the perspective Owner's interface requirements in Section 12.2.7 and 12.3.18, respectively. . For Amtrak, the Vehicle interior width measured at armrests level shall be a minimum of 115 inches (2921 mm).
b) A Trainset that meets a maximum allowable width as defined by the Amtrak Clearance Diagram 05-1355 Rev. E. (Diagram is attached to this Specification).
c) A Trainset that meets a maximum allowable width as defined by the Authority's DC-03 Clearance Diagram.

Amtrak and the Authority's clearance diagrams are included in the Infrastructure Interface Specifications (Appendix B and Appendix C, respectively).

For these three alternatives, maximized use of common train Systems and components is required.

7.3 TRAINSET CONFIGURATION

7.3.1 Requirements and Information

This Section sets out the minimum requirements and constraints which any solution shall fulfill.

The Trainset shall be an electrically-powered train capable of operation on the respective Owner's System.

For Amtrak, the distance between the first and last axles of the Trainset shall be a maximum of 205 m (672.6 feet).

For the Authority, the maximum Trainset length shall be such that all of the side entry doors of the Trainset in double traction can berth at a platform having a length of 407 m (1,335 feet).

The Trainset design shall feature single-deck passenger accommodations.
Seating provisions shall be in accordance with Section 8.4.6.

The Trainset design shall accommodate the flexibility requirements defined in Section 7.8 and the ADA requirements defined in Section 8.7.

7.4 ENERGY USAGE AND EFFICIENCY

7.4.1 Requirements and Information

The Trainset shall be designed to minimize the net energy drawn from the power supply Systems on the respective Owner's System, consistent with the operational performance requirements for traction and auxiliary supplies defined in Sections 8.10 and 8.11, respectively.

The Trainset shall recover a very high proportion of kinetic energy during braking and facilitate its re-use both onboard the Trainset and by return to receptive infrastructure.

When the regeneration limit is exceeded, the energy that cannot be returned to the catenary shall be stored and/or dissipated by an acceptable power management System (e.g., capacitors).

The Trainset shall have an intelligent stabling System, which limits energy consumption during out-of-use periods, but ensures that the Trainset can re-enter service when required.

The Trainset shall have a System to assist the Operator in driving in an economical manner. The System shall use pre-loaded information of line gradient, speed profile, and timetable information to manage timekeeping and energy consumption.

The Trainset shall include Equipment to measure energy consumption that shall identify the net energy used over a settable time span and, separately, the energy regenerated into the Owner's network. It shall be possible to upload this information to a central Data collection point while the Trainset is in motion. The information shall be provided in a form that will support billing requirements between the Owner and the System providers. Refer to Section 8.16 and the Infrastructure Interface Specifications (Appendices B and C) for communications Interface requirements.

7.5 NOISE

7.5.1 Requirements and Information

The Trainset will operate at high speeds, in tunnels and occasionally in close proximity to dwellings. Therefore, the control of interior and exterior noise at speeds up to 354 km/h (220 mph) for the Authority and 257.5 km/h (160 mph) for Amtrak shall be critical.

Current U.S. law and regulations for noise levels for locomotives and rail cars set forth in more detail in 40CFR Parts 201.12 and 201.13 are applicable to this Procurement. The Contractor shall explain whether these regulations can be met, with consideration given to Contractor-developed new technologies and manufacturing techniques. If these regulations cannot be met, the Contractor shall:

a) Explain in detail why technologically and otherwise meeting these regulations is not feasible.
b) Advise of achievable noise levels.

7.6 THIS SECTION INTENTIONALLY LEFT BLANK

7.7 SECURITY, ANTI-SOCIAL BEHAVIOR, AND VANDALISM RESISTANCE

7.7.1 Requirements and Information

The Trainsets shall be designed with consideration for the security of passengers, and crew. The Contractor shall identify and mitigate security vulnerabilities from the outset of the design process, and report progress on security activities throughout the design and Approval phases of the project. The Contractor shall demonstrate conformance with all aspects of the System Security Plan defined below.

The Trainset interior and exterior shall be sufficiently robust to resist damage from vandalism, misuse, and terrorism.

Train communication and control Equipment shall be both redundant and protected by physical protection and shall utilize diverse routing such that the chance of an effective attack on the train Systems is limited. Network information and Data security shall be provided to protect the network and control units from intrusions and unauthorized changes.

7.7.2 Security System Plan

The Contractor shall develop, implement, and maintain a comprehensive Security System Plan that details how the Trainset will be designed and constructed to limit damage or harm from vandalism, misuse, sabotage, or other intentional criminal behavior. This includes security design elements such as fasteners and locks for internal and external areas (i.e., under-body panels, Cab access, access to Equipment compartments and security of internal compartments) to mitigate the risk of unauthorized admission or unintended opening.

Other elements that shall be addressed include the application of Crime Prevention through Environmental Design (CPTED), providing clear sightlines, reducing spaces that packages can be hidden from inspection, optimal placement of CCTV cameras for areas where natural surveillance is compromised, and other security design elements that could mitigate vulnerabilities. Areas, spaces, or structures that provide concealment shall be avoided, particularly in Vehicle interior configurations, storage compartments, rooms (e.g., bathrooms, vestibules), and windows/glazing. These design elements shall be assessed for their vulnerabilities and improved through organization of space, architecture, and lighting. Design shall focus on natural surveillance, natural access control, territorial reinforcement, Maintenance, and activity support. A critical portion of the plan is process for the assessment of the potential vulnerabilities of the Trainset and how the planned mitigations impact and reduce/mitigate potential vulnerabilities.

An initial draft of the Security System Plan shall be developed and submitted to the Owner for Approval at the Preliminary Design Review stage. The tracking of security vulnerability mitigations shall then be conducted on an ongoing basis throughout the project. A final security report shall be submitted with delivery of the first Trainset, verifying applications of mitigations, validating the effectiveness of the mitigations, and confirming the residual risk of all identified Hazards. Residual risk shall be assessed and approved by the Owner.

The Security System Plan shall include a cyber-security section which applies to safeguarding any embedded or external software or firmware which controls or monitors Safety-critical functions.

7.8 FLEXIBILITY

7.8.1 Requirement and Information

Flexibility of the Trainset design, particularly with regard to the interior layout, is a desirable feature.

Trainset Systems and associated technologies shall be upwards-compatible and flexible to changes and updates in technology over the life of the Trainset, where practicable. When considering Trainset communication (e.g., passenger information and associated interfaces), the Contractor shall ensure easy access to components (e.g., computer servers, network hubs, access points, and roof antennas) and provide provisions for future evolutions/changes to onboard Systems that can be achieved with a minimum degree of invasive engineering and/or construction effort.

Trainset interior Systems shall be easily disassembled into recyclable or reusable components at the end of their useful lives.

7.9 ELECTROMAGNETIC COMPATIBILITY

7.9.1 Requirements and Information

The Trainsets shall fully conform to the respective Owner's operating network. These requirements cover emission and immunity limits, cabling, grounding, Equipment-level Electromagnetic Compatibility (EMC), switching converter power and harmonics, motors and controllers, Equipment locations, track circuit compatibility, FCC Type-Accepted radio Equipment, human exposure, and adjacent railroads and airports.

To protect wayside track circuits against conducted interference, the Contractor shall:

a) Use unity power factor traction power converters and Electromagnetic Interference (EMI) filtering as required.
b) Provide converter interleaving to limit audio frequency harmonic emissions.
c) Provide converter Fault detection and reconfiguration to ensure effective interleaving for all train configurations and Failure conditions.

The Contractor shall submit for Approval a report which demonstrates adequate Safety and dependability margins to protect all track circuits against worst-case train emissions. The Contractor shall design, document, and test to ensure adequate protection against inductive interference with track circuits or other wayside Devices, and against Cab signal interference.
The design of the Trainset shall ensure that all Systems function as intended. Consideration shall be given to the effects of overhead catenary and electric third rail.

The Trainset Systems shall not have a negative impact on, nor be negatively impacted by:

a) Operational electronics used by crewmembers, including radios, and wireless ticketing Devices.
b) Consumer electronics used by passengers, including cell phones, computers, and radios.
c) Wayside Equipment.
d) Vital control Systems and electronics.
e) Third party Systems and Equipment.

7.9.2 Electromagnetic Compatibility Control Program

The Contractor shall develop and implement a comprehensive Trainset Electromagnetic Compatibility (EMC) Control Program. The Contractor shall:

a) Develop and deliver a complete Contractor EMC Control Plan that accounts for the EMC requirements identified in this Section and in the Infrastructure Interface Specifications (Appendices B and C).
b) Coordinate Trainset EMC activities with the respective Owner's infrastructure Program.
c) Design for and document compliance with all applicable EMC design guidelines and criteria (as Specified in this Section and in the Infrastructure Interface Specifications (Appendices B and C) in Trainset Equipment and construction.
d) Design Equipment per EMC requirements in technical Contract documents.
e) Perform required EMC Analysis, lab and field testing, and reporting.
f) Integrate EMC design and Analysis results into lab and field test planning.
g) Provide all necessary reports and documentation and track them in a compliant Verification and Validation (V&V) process.
h) Coordinate EMC Work with related activities of other Contractors.

The Contractor shall submit all EMC Program Work products to the Owner for review and Approval.

8 VEHICLE AND SUBSYSTEM PERFORMANCE REQUIREMENTS

8.1 GENERAL VEHICLE PERFORMANCE REQUIREMENTS

8.1.1 Requirements and Information

The Trainset shall have a service life of not less than 30 years. The Trainset shall accommodate an estimated annual mileage of 650,000 km (404,000 miles) per Trainset while operating on the respective Owner's network.

The Vehicle floor height above TOR shall be 1295.4 ± 6.35 mm (51±0.25 inches).

Trainset static axle loads shall be in accordance with 2008 HS RST TSI.

The Trainset structures and Equipment shall be designed for fatigue loadings and service duty cycles under the operating conditions encountered on the defined routes. The Contractor shall refer to the respective Infrastructure Interface Specifications (Appendices B and C) for specific information relating to environmental conditions.

8.2 STRUCTURE AND CRASHWORTHINESS

8.2.1 General Description

The Contractor shall comply with the technical criteria and procedures produced by the FRA RSAC Engineering Task Force (ETF) for Tier III service (reference ETF_001-02 – Proposed Ruletext for NPRM). The Contractor shall also adhere to the requirements of EN 12663 and EN 15227, or comparable Relevant Standards, unless otherwise noted in this Specification.

8.2.2 Vehicle Masses

The maximum payload depends on the number of seats for passengers and on the number of passengers in the standing areas. These values take into account any statutory regulations and give the mass for the payload and the number of passengers that are allowed to be transported in these Trainsets.

Per EN 15663, the typical weight of a passenger, with luggage is identified as 80 kg (176 lbs.). The typical weight of a crew member, with luggage and Equipment, is identified as 80 kg (176 lbs.). A review of U.S. Center for Disease Control weight statistics for adult females and males has been conducted. Based on these statistics, by 2043, the average weight for a U.S. male is predicted to be 97.5 kg (215 lbs.), and the average weight for a female is predicted to be 84.2 kg (186 lbs.).

The weight, with luggage, of seated passengers (seating density Specified in Section 8.4.6), 6 crew members, and 10% standees shall be the absolute minimum payload weight used for Trainset design. The Contractor shall confirm that the structural design of the proposed service proven platform can accommodate this payload, developed in accordance with EN 15663, utilizing the projected U.S. adult average weights identified above. This information shall be submitted to the Owner for review and Approval.
Full load conditions, as identified in this Specification, shall be inclusive of the maximum payload, 6 crew members, 10% standees, all materials needed for operation (e.g.,

lubricants, coolants, catering Equipment, toilet flushing medium, onboard fire suppression System medium, etc.), and two-thirds of consumables (e.g., sand, water, food, etc.).

8.2.3 Carbody Strength

The Contractor shall demonstrate, by means of appropriate calculations and tests, that the carbody strength and fatigue performance of the carbody and Bogies are suitable for the service life of the Trainset within the expected loading conditions, mass distributions, and design configuration for the Owner's Operations. The Contractor shall demonstrate compliance with the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.703.

8.2.4 Crash Energy Management

Each Trainset shall be provided with a crash energy management (CEM) System to dissipate kinetic energy during a collision. The System shall provide for controlled deformation and Collapse of designated sections within the unoccupied volumes to absorb collision energy and to reduce the decelerations on passengers and crewmembers resulting from dynamic forces transmitted to the Occupied Volumes.

The design of the CEM System and the end structure of the Trainset shall satisfy the requirements identified in Sections 8.2.5 and 8.2.6.

8.2.5 Occupant Volume Strength – Dynamic Collision Scenario

The Trainset shall be designed to withstand the dynamic impact conditions defined within the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.705.

8.2.6 End Structure Integrity of Cab End and Fluid Entry Inhibition

The forward ends of Cab Vehicles shall be capable of absorbing energy in a simulated collision with a rigid object per the requirements in the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.711.

The skin covering the forward-facing end of the Trainset shall comply with the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.709.

8.2.7 End Structure Integrity of Non-Cab End

Non-Cab ends of Vehicles shall follow the requirements detailed in the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.713.

8.2.8 Overriding

Anti-climbing resistance shall be demonstrated at both the impacted Interface and at the coupled Interfaces in accordance with the criteria set out in the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.707.

8.2.9 Roof and Side Structure Integrity

The roof and side integrity strength for all Vehicles shall conform to the requirements as described in the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.715.

8.2.10 Obstacle Deflector

Vehicles with a driving Cab shall be fitted with an obstacle deflector at the Cab end to reduce the risk of derailment resulting from impacts with objects or animals lying at, or near, rail level. The Contractor shall demonstrate that the deflector is comparable with that defined in EN15227.

8.2.11 Load Cases for Bogie-to-Carbody Attachments

The Bogie-to-carbody attachment shall conform to the requirements detailed in the proposed regulatory text for Tier III Equipment defined in 49CFR Part 238.717.

8.2.12 Load Cases for Equipment Attachments

Safety brackets, hangers, and other similar Devices shall be designed to carry the Equipment within the clearance envelope under Normal operating load conditions in case of Failure of the primary attachment System. With the Failure of any one of the attachments, the Equipment shall remain within the clearance envelope of the Vehicle. Further, Equipment attachment strength shall be demonstrated to the same levels as Specified for interior fitting attachments in the proposed regulatory text for Tier III Equipment defined in 49CFR Parts 238.733, 238.735, 238.737, and 238.743.

8.2.13 Modes of Vibration

The natural modes of vibration of the carbody, when fully equipped, shall be separated sufficiently, or otherwise decoupled, from the suspension frequencies to achieve acceptable ride quality per Section 8.19.10. The fundamental modes of vibration of items of Equipment, on their mountings and in all operating conditions, shall be separated sufficiently, or otherwise decoupled, from the modes of vibration of the carbody structure and suspension, to avoid undesirable responses.

The Contractor shall create FEA models of each System attached to the carbody and its respective mounting Equipment. Vibration and shock testing of each System shall be performed to validate FEA model results.

8.2.14 Safety Appliance Mechanical Strength and Fasteners

Drawings of all Safety appliances to be installed on the Trainsets shall be submitted to the Owner for review and Approval. Contractor preference for welding over mechanical fastening shall be justified to the Owner for evaluation with FRA. Safety appliances shall be affixed as required to the carbody with sufficient strength to ensure proper function as required in existing 49CFR requirements. The size, location, and function for each Safety appliance shall be clearly described for presentation. Design and mounting of Safety

appliances shall account for aerodynamic effects on and acoustic emissions from the Vehicle.

The Contractor shall ensure that all Safety appliances and fasteners comply with FRA regulations. The Contractor shall be responsible for generating information needed to support any public hearing required for non-compliance of Safety appliance statutes. The Contractor shall develop Safety appliance drawings for the Trainset for submission to the FRA and participate in a Safety appliance sample Trainset inspection by the FRA.

8.2.15 Emergency Signage and Markings

Emergency exits shall be clearly identified to passengers and emergency responders by means of suitable signs. Emergency signage shall be implemented as described within APTA PR-PS-S-002-98.

Emergency exits shall be clearly identified to passengers by means of low-location exit path markings as described within APTA PR-PS-S-004-99.

The Contractor shall develop emergency signage drawings for submission to the FRA and participate in a sample Vehicle inspection by the FRA for determination of compliance.

8.2.16 Evacuation via the Doors

Trains shall be equipped with emergency Devices allowing the evacuation of passengers via access doors, when not present at a platform, to a variety of surfaces and heights (e.g., ballast shoulder, raised walkway, TOR road crossing, tunnels and trenches where space may be limited, etc.). The emergency evacuation Device shall be provided with a means to mechanically fasten to the Vehicle, adjacent to the door threshold. Evacuation from the Equipment, with the associated times detailed in Section 8.13.1, shall be described in an emergency egress plan to be submitted for review and Approval by the Owner.

8.2.17 Emergency Window Egress and Rescue Access

Each passenger Vehicle shall comply with the emergency window egress and rescue access requirements in the proposed regulatory text for Tier III Equipment defined in 49CFR 238.741.

8.2.18 Emergency Roof Access

Each passenger Vehicle shall have a minimum of two emergency roof access locations. Emergency roof access shall be provided by means of a conspicuously marked structural weak point in the roof for access by properly equipped emergency response personnel. Specific requirements for size and placement of emergency roof access points are described within 49CFR 238.123.

8.2.19 End-Facing, Side-Facing and Interior Glazing

The Trainsets shall be equipped with certified end-facing and side-facing glazing compliant with the requirements set forth in the Technical Criteria and Procedures produced by the ETF for Tier III service (reference and draft NPRM language for non-Cab glazing (ETF_001-02 – Proposed Ruletext for NPRM)). Further all glazing, inclusive of Trainset interior glazing, shall conform to EN 15152 and Relevant Standards.

Each exterior window shall remain in place when subjected to air pressure differences caused by two passing high speed trains travelling at maximum velocity in opposite directions, at the minimum separation for two adjacent tracks, and by a Trainset entering a tunnel.

Side-facing glazing shall also meet the passenger and crew containment requirements of GM/RT 2100, Issue 4, December 2010 Appendix C, or equivalent.

8.2.20 Carbody Aerodynamic Provisions

The Contractor shall demonstrate that the body profile, nose shape, and structural response of the Trainsets have been designed to accommodate the requirements of 2008 HS RST TSI Sections 4.2.6.2, 4.2.6.3, and 4.2.6.4.

8.2.21 Corrosion Protection

Materials shall be compatible with the System's ambient conditions and environments Specified in the respective Infrastructure Interface Specifications (Appendices B and C).

Anti-corrosion measures, including the prevention of water build-up, shall be incorporated. The Contractor shall provide the following information:

a) The type and location of anti-corrosion measures and design features.
b) Protective measures employed where dissimilar metals are in contact.
c) Suggested Maintenance requirements, if special attention is required.
d) Protective measures to be taken during shipping and prior to the commencement of trial operation.

8.3 EXTERIOR REQUIREMENTS

8.3.1 Exterior Equipment

Underfloor Equipment shall be protected from water splash, Vehicle water drains, airborne debris, ice, or other objects.

Equipment installations shall allow for the maximum ventilation of parts and minimum restriction to cooling air.

Equipment cover latches shall not violate the Trainset dynamic clearance outline when not engaged, and shall hold the cover firmly to the box without rattling in the engaged condition. Safety catches shall be provided for each Equipment box cover. The catches shall be designed to retain the cover within the Trainset dynamic clearance envelope at all Operating Speeds without the cover latches engaged.

8.3.2 Exterior Finishing

The Trainset exterior, including Front End and skirting, shall be painted in accordance with the color schemes to be proposed by the Contractor and agreed upon with the respective Owner.

Exterior Vehicle finishes shall be compatible with the Owner's livery schemes. Finishes shall also be compatible with the Owner's cleaning methods, trainwash Equipment, and associated cleaning chemicals (refer to the respective Infrastructure Interface Specifications (Appendices B and C).

8.3.3 Exterior Graphics

Suitable graphics shall be provided throughout the Trainset to provide passengers with information. The graphics shall not cover retro-reflective material for the purposes of emergency instructions and access identifications. Final configuration shall be established during design review and approved by the respective Owner.

8.3.4 Side Skirts

Hinged side skirts shall be provided outboard of the Bogies and elsewhere as required to complement the overall aerodynamic and aesthetic design. Bogie skirts shall be designed so as to provide minimum aerodynamic drag, and maximum wheel/Bogie noise abatement capabilities, while ensuring adequate cooling air for all Bogie mounted Equipment.

8.4 INTERIOR DESIGN

8.4.1 Requirements and Information

This Section defines the interior design and configuration requirements for the Tier III Trainset Equipment. It encompasses the Trainset seating, vestibule and toilet areas. Criteria for food service areas are addressed separately in Section 8.5.

The interior of the Vehicle shall be designed and constructed with consideration for Safety, security, comfort, durability, convenience, and service to the passenger, while also ensuring the efficient use of space and maximum seating capacity.

There shall be First Class and Business Class Vehicle designs, both of which shall meet requirements Specified by ADA and shall contain as many common elements as practicable. Interior colors, designs, patterns, and finishes of materials shall be developed by the Contractor as part of the conceptual design and Mock-up process to be approved by the Owner.

For Amtrak, the current premium Acela Express train service provides the baseline upon which this Equipment acquisition is based. As such, it is expected that the Contractor will offer a solution that meets or exceeds every aspect of this existing service from the passenger's point of view. Refer to the "NGHSR Design Vision" file for an overall service concept. (File attached to this Specification). The requirements and information in this Section are supplemented by additional options detailed in Amtrak's Design Ambition for Vehicle Interiors (Appendix D).

8.4.2 THIS SECTION INTENTIONALLY LEFT BLANK

8.4.3 Basic Features of All Vehicle Types

The Trainset shall be designed to account for the following:

a) Compliance with CPTED principles, as defined in Section 7.7.2, with emphasis on natural surveillance, which supports the placement of physical features, activities, and people in such a way so as to maximize visibility and foster positive social interaction among legitimate users.
b) Space for passengers to be able to move through the Trainset to access facilities during their journeys.
c) Evacuation under emergency conditions (e.g., no lighting, smoke, etc.).
d) The ability for Train Crew to efficiently service the needs of passengers, including catering of hot/cold meals and drinks from a trolley and the ability to maintain the temperature of such food via onboard food storage Equipment.
e) An attractive and comfortable passenger environment which meets or exceeds that of other in-service Tier III Trainsets.
f) Flexible/modular internal layout, allowing refurbishment and/or relocation of interior furniture in the future.

g) Seats shall be fixed and non-rotating with a mix of forward-facing, rear-facing, table and accessible seating provided in accordance with the desired proportion of seats per class, as identified in Section 8.4.7.
h) The design for table seating shall allow maximum legroom and minimal obstructions.
i) Interior materials, parts, and design elements shall contribute to decrease the overall noise level within the rail Vehicle.
j) The Vehicle interior shall be finished with high durability, low-Maintenance materials. With the exception of panel coating, all materials and visible surfaces shall be selected to retain their initial appearance for a period not less than 15 years.
k) The interior furnishing shall present a clean, pleasing appearance, and facilitate easy cleaning using Normal railway and industrial cleaning methods and Equipment.
l) For the Authority, the interior finishing shall not contain VOCs that, at a minimum, exceed South Coast Air Quality Management District Specifications for painting, coatings, sealants, and adhesives, or the requirements in a stricter standard identified by the Contractor for Trainset interior finishes.
m) The interior design shall take into consideration compartmentalization for control of smoke/fire spread.
n) Cabin lighting shall utilize LED (where practicable), or other equivalent long-lasting and environmentally-friendly sources of light.
o) Windows shall be provided with tinted glazing. All windows in the passenger seating areas shall be equipped with passenger operated blinds or side curtains to provide protection against the glare of the sun. Curtains or shades shall be replaceable without the need to remove wall panels.
p) The passenger seating and food service areas shall be separated from the vestibule/passageway by doors.
q) ADA-compliant accessible seating shall be provided in all passenger Vehicles, located in close proximity to exit doors and accessible restrooms. ADA seating areas shall not be located directly in front of the accessible restroom door.
r) Handholds shall be located in shared areas of the train (i.e., vestibules and Café Vehicle) for passengers and crew to grab to enable safe circulation throughout the train.

8.4.4 THIS SECTION INTENTIONALLY LEFT BLANK

8.4.5 General Requirements

The Trainset shall be designed to easily accommodate a change in interior finish and layout. Interior components including, but not limited to, the seats, tables, draft screens, partitions, and luggage modules shall be reconfigurable in an operational depot to allow for changes in capacity ratios.

Within the passenger areas, the floor area shall be kept clear of under seat Equipment that could limit interior flexibility. Interior draft screens and other intermediate partitions shall not be structural.

A crew office shall be provided on the Trainset with a table, charging ports, Equipment storage, the ability to accommodate two crewmembers, and access to train diagnostics and information.

As far as reasonably practicable, the Trainset wiring shall be accessible without significant disassembly of the interior. The Trainset shall include provision for additional control and communications cabling to be added at a later date with minimal disruption to the interior or underframe Equipment.

The Vehicle interior color scheme finishes and materials shall be proposed by the Contractor for review and Approval by the Owner. The Contractor shall submit, to the Owner for review and Approval, supporting technical and material datasheets for liners, masks and associated trim pieces, bulkheads, end walls, and other Trainset surfaces.

Flooring in the passenger seating areas shall be covered with industrial grade carpeting that is hard-wearing, non-staining, and non-discoloring. Walls and ceilings' surfaces shall not be carpeted. Flooring in toilets and food service areas shall be covered with rubber sheets that are non-slip, even when wet, and colored so as to not accentuate the presence of stains. The floor shall be sealed to prevent moisture infiltration and shall either be integral with the walls or connected to them by a sealed joint, so as to prevent the leakage of water-based liquids into the Vehicle structure.

The Contractor shall submit, to the Owner for review and Approval, samples of each proposed floor covering along with the supporting technical/material datasheets. The Contractor shall also submit details for the interior arrangement of the floor coverings and for their installation and removal.

Paint shall not be used on any wall surfaces.

8.4.6 Seating Provision

For Amtrak, the baseline interior layout shall provide a nominal 425 passenger seats.

For the Authority, the baseline interior layout shall provide a minimum 450 passenger seats.

If provided, seats in bar, food service, and other passenger circulation areas shall not be included in the seat count for passenger capacity.

A transverse seating configuration in a mixture of both passenger table and unidirectional seating layouts is required. The ratio of table seating to unidirectional seating shall be broadly comparable with that of the Acela Express. These ratios may be adjusted by the Contractor in some Vehicles, to make best use of the available space relative to constraints that the product platform may dictate.

Table seating areas shall be positioned to align with bodyside windows where possible. Tables with tops that can be minimized independently at each seat shall be provided at all table seat positions.

All unidirectional seating shall be provided with folding tables that can accommodate the ergonomic usage of a laptop with a 381 mm (15 inch) screen.

At least one 120 VAC, 60 Hz GFI protected power socket and one USB port shall be provided at each passenger seat. 120 VAC, 60 Hz GFI protected power sockets and one USB port shall be provided in the Cab area. Additional power sockets shall be provided, as needed, to support efficient Maintenance and cleaning of Trainset interiors. All power sockets on the Trainset shall be GFI protected. USB ports shall be provided in accordance with the latest standard.

Armrests shall be padded and comfortable and shall accommodate the U.S. 5th-percentile female and the 95-percentile male population in terms of length.

Each seat shall contain storage space for personal electronic Devices and other miscellaneous items.

An adjustable cup holder shall be provided at each seat such that it does not require the tray table to be in the lowered position in order to be used.

The seats shall include head rests, adjustable footrests, and arm rests. Leather seating (required for Amtrak), or comparable alternative (for the Authority), shall be utilized in all classes of service. The quality of the seat and cushion design shall vary based on the class of service, with First Class offering the highest quality. Samples of all Vehicle seat types and materials to be used shall be provided for evaluation and Approval by the Owner.

Vehicle interior configuration shall vary based on class of service.

Attendant call buttons which annunciate to crew members shall be available at all ADA accessible seating positions.

8.4.7 Seating Classification

First Class accommodations shall represent a minimum of 15% of the total Trainset seating capacity.

Business Class accommodations shall constitute the balance of the Trainset seating capacity.

First Class seating shall be situated together in the Trainset in adjacent locations.

8.4.8 First Class Seating

First Class seating shall be provided in both table and unidirectional seating layouts and shall include accommodations for ADA seating.

The following configurations shall be provided:

a) For Amtrak: 2+1 transverse seating.
b) For the Authority: 2+2 transverse seating.

The First Class areas of each Trainset shall be easily distinguishable to all passengers from the interior and exterior of the Trainset via the use of material, design considerations, and signage.

Seating shall be provided with spacing equivalent to 1067 mm (42 inches) of Pitch. The Contractor shall identify the equivalent spacing, measured in accordance with UIC 660:2002 Appendix D, for review and Approval by the respective Owner.

The minimum seat width shall be 508 mm (20 inches) measured from the inside edges of the arm rest.

Seating configuration shall ensure that another passenger's comfort is not impeded by a fully reclined forward seat.

8.4.9 Business Class Seating

Business Class seating shall be provided in 2+2 configuration, in both table and unidirectional seating layouts, and shall include accommodations for ADA seating.

Seating shall be provided with spacing equivalent to 991 mm (39 inches) of Pitch.
The Contractor shall identify the equivalent spacing, measured in accordance with UIC 660:2002 Appendix D, for review and Approval by the respective Owner.

The minimum seat width shall be 508 mm (20 inches) measured from the inside edges of the arm rest.

8.4.10 Tip-Up Seating

Tip-up seats shall be provided in the space reserved for wheelchairs and bicycle storage. The tip-up seats cushions shall be designed to be similar in width, shape, and contour to the standard seat cushion, complete with upholstery, and shall be suitable for use by the U.S. 5th-percentile female and 95th-percentile male.

The seat shall normally remain in the down position until the wheelchair space is needed. The seat shall then be easily raised with minimal effort by a wheelchair occupant. Once raised, the seat shall remain in the folded position.

8.4.11 Toilets

The toilet facilities provided shall be of high quality and shall be chosen to reflect the needs of a prestige service. The design of the toilet facilities shall be identified by the Contractor for review and Approval by the Owner.

Toilet facilities shall be provided on the Trainset per a maximum of 55 passengers per toilet ratio.

The Trainsets shall be fitted with controlled emission toilets, capable of fully retaining all waste and odor between servicing on all routes and service patterns. Facilities shall have the capacity of storing, operating, and supplying full passenger loads for three consecutive days without servicing.

Toilets shall be of the vacuum type. The retention tanks shall be designed to be emptied by a vacuum System.

All toilets shall incorporate a high level of resistance to becoming blocked due to misuse and overfilling.

All toilets shall be designed to allow for efficient and effective cleaning.

All toilet modules shall be completely sealed and shall incorporate appropriate features to prevent fluid leakage into the passenger area and/or Vehicle underframe.

Toilet waste retention tanks shall be capable of being 100% drained during Normal servicing. The Trainset toilet Systems shall provide sufficient clean water for flushing and hand washing and waste storage capacity per passenger per trip, for three days service, based on System drain and replenishment at service locations only.

Electrical and plumbing connections shall be designed so that components can readily be installed, removed, and exchanged. The tanks and all piping shall be designed to prevent damage from freezing and corrosion. The waste System shall be designed to operate over all operating and environmental conditions outlined in this Specification.

All toilets shall incorporate best practice comfort facilities which shall be positioned at appropriate heights and locations specific to standard and ADA-compliant designs and which shall account for the range of users, including persons with reduced mobility.

A door-locking System with a door lock light shall be included that indicates occupancy status on the inside and outside of the door to prevent accidental intrusion by another passenger.

All toilet access doors shall incorporate a Device to allow the door to be overridden and opened by crew when "locked." The design shall be sufficient to avoid the Device being used or tampered with by passengers. The Device shall be designed to ensure that in the event of Failure, passengers are not locked in the toilet module.

All toilet doors shall incorporate a means for crew to lock the door out of service and clearly identify to passengers that the toilet is "locked out of service."

All ADA-accessible toilets shall have powered doors.

All toilet seats shall incorporate damping mechanisms.

Faucets/water taps, electric hand dryers, paper towel dispensers, soap dispensers, and toilet flushers shall be provided (with non-touch controls), and easy to reach and use in all toilets. All water faucets/taps shall include the ability to provide both hot and cold water. Hot water

temperature range shall be 43.33°C to 48.89 °C (110 °F to 120 °F). The maximum temperature shall not cause injury to the user. Hot water shall be available at all sinks.

Wall-mounted soap and/or paper towel dispensers shall be provided in all toilets.

Hanging hooks, which must be flush to the wall when not in use, and/or shelving for toiletries, purses, and coats shall be provided in all toilets.

A fold-down baby changing table shall be present in at least 1 restroom per Vehicle and in all ADA restrooms.

A trash receptacle with a hands-free lid that is wall or cabinet-mounted shall be provided by the sink in all toilets. This receptacle shall not intrude into the clear space of the accessible restroom such that it hampers wheelchair access.

All toilets shall incorporate a large mirror with bright lighting.

A perfuming or fragrance-dispensing System shall be provided in all toilets.

All toilets shall be well-lit with general and task lighting, and preferably include a source of natural daylight provided by a frosted window.

All toilets shall incorporate fresh air ventilation per section 8.14.7.

Emergency/Safety attendant call buttons, which annunciate to the crew members, shall be located in the toilet room.

8.4.12 Luggage Storage

Luggage storage at the ends of the Vehicles shall be provided at a minimum volume of 0.045 m^3 (1.6 ft^3) per passenger. The Current Amtrak individual maximum baggage weight requirement is 50 lbs.

Overhead luggage storage shall be provided to accommodate a fully loaded Trainset.

Luggage stowed in overhead racks shall be visible from seated positions directly below and by crew walking through the Trainset. Design of overhead racks shall comply with the requirements identified in 49CFR Part 238.737.

8.4.13 Bicycle Storage

For the Authority, a bicycle storage area shall be provided, and designed to accommodate a minimum of 8 bicycles per Trainset. A dedicated bicycle storage area shall be provided, thereby reducing inconvenience to passengers. Bicycle storage areas shall be separate from wheelchair spaces and shall not block or otherwise impede emergency egress and access.
Special attention shall be given to the ease with which bicycles can be placed in the bicycle racks. It is expected that the final design shall include guide rails to help steer the bicycle into the correct position with minimal effort. Bicycles shall be secured as low as possible and designs requiring the lifting of bicycles over fixed objects shall be avoided.

Suitable graphics shall be provided on the exterior of the Vehicle, identifying the doors to be used for bicycle access. Interior graphics shall also provide instructions for using the bicycle racks.

8.4.14 Trash and Recycling

Litter and recycling bins shall be provided throughout all passenger areas, and defined in the Contractor's proposed interior layout.

8.4.15 Vehicle Passageways

Vehicle passageways shall provide access between all Vehicles allowing the free flow of passengers along the Trainset in Normal and emergency conditions. The passageway width, floor, and all level transitions shall be compliant with ADA requirements.

The passageways shall be effectively sealed against the ingress of water, drafts, dust, and external noise. They shall also be insulated against thermal losses and gains.

The interior throughway shall allow the passage of passengers in wheelchairs, passengers carrying luggage, and food service trolleys. It shall be of an aesthetically pleasing design with an appearance consistent with that of the vestibule. It shall also be free of any protrusions and shall not have any gaps that may be exposed during train movements.

8.4.16 Vestibule and Side Door Areas

Side door thresholds shall have an anti-slip abrasive surface with contrasting Safety markings.

Vestibule areas shall be in compliance with ADA requirements.

8.4.17 Interior Graphics

Graphics shall be provided throughout the Trainset to provide passengers with information. Final configuration shall be established during the design review and approved by the Owner.

8.4.18 Emergency Facilities

The Contractor shall provide onboard (fixed or movable) Devices in each passenger Vehicle that facilitate the escape of passengers to the trackside, when advised to do so by authorized crew, through the access doors (see Section 8.2.16), in the case where no platform is available. The Contractor shall submit, to the Owner for review and Approval, drawings illustrating the emergency escape Devices' Interface functionality to the various civil configurations.
An emergency Equipment locker and associated Equipment shall be provided in each Vehicle of the Trainset. The location of each locker shall be in compliance with all applicable requirements. Each locker shall be marked with emergency Equipment signage that is compliant with Federal emergency signage standards.

8.5 FOOD SERVICE

8.5.1 Amtrak Food Service Requirements

The interior layout for Amtrak shall provide a Café Vehicle Galley and First Class Galley space at least equivalent to the Acela Express, as described in the table below:

	Current Space	Current Number of Passengers Served by Space
Café Vehicle Crew Working Floor Space	4.2 m^2 (45.2 ft^2)	256
Café Vehicle Food Storage Space	94 m^3 (3,320 ft^3)	256
Café Vehicle Equipment	2.65 m^2 (28.5 ft^2)	256
Café Vehicle Customer Space – Queuing & Social	20 m^2 (215.3 ft^2)	256
First Class Galley Crew Working Floor Space	2.2 m^2 (23.7 ft^2)	43
First Class Galley Food Storage Space	52 m^3 (1,836 ft^3)	43
First Class Galley Equipment	2.0 m^2 (21.5 ft^2)	43

The Contractor shall assume that the current Acela Express Trainset food service arrangements will prevail (i.e., that all First Class passengers will receive a meal at seat, prepared offsite and presented from a trolley on a tray). The current storage space noted above should provide sufficient space for this service.

The NGHSR Design Vision document (Attachment 13.C) sets out three alternatives:

Option 1 (Preferred) – Café Split Option: this option shall be included as the base option;
Option 2 – Café Full Option: this option shall be priced under the Amtrak options;
Option 3 – Café Split Compartment Option: this option shall be priced under the Amtrak options.

With each option above, the builder shall set out impact on Trainset seating. Option 1 (Café Split) will be used for evaluation purposes in Stage 1 and Stage 2 of the evaluation table.

There is no requirement to have a combined Café Vehicle/First Class Galley at present if the Contractor can propose a more optimal solution. However, no Business Class passengers shall be routinely walking through First Class Vehicles to reach the Café Vehicle facilities. Sufficient aisle space and at-seat table/tray space needs to be provided in First Class to comfortably allow service attendants to serve a meal tray at seat.

The First Class service galley shall be in accordance with United States Food and Drug Administration (FDA) requirements and at a minimum shall include and incorporate the following:

One (1) Convection Oven
One (1) Toaster
Two (2) Fresh brew Coffee Makers
One (1) 2100W Microwave Oven
One (1) Hand Sinks
One (1) Utility Sink
One (1) Ice Bin
One (1) Back-Up Ice Storage Below
Five (5) Chill Carts Storage
Two (2) Refrigeration Head Units
Two (2) Non-Refrigerated Carts Storage
Six (6) Carriers Storage in Pantry
Two (2) Carriers Storage outside Pantry

The Café service galley shall be in accordance with United States Food and Drug Administration (FDA) requirements and at a minimum shall include and incorporate the following:

One (1) Convection Oven
One (1) Toaster
Two (2) Fresh brew Coffee Makers
Two (2) 2100W Microwave Oven
One (1) Hand Sink
Three (3) Utility Sinks
One (1) Ice Bin
One (1) Freezer Below
Nine (9) Chill Carts Storage
Three (3) Refrigeration Head Units
Fourteen (14) Carriers Storage in Galley
Built-in Closet/Storage Space

It is preferable to have an additional external loading door into the Café Vehicle Storage Area from the platform. Should this door not be used for passenger access, the size of the door may be smaller than the ADA requirement. If this door is designated as an emergency exit, it shall be marked accordingly. This door shall also be connected to the door Safety System (i.e., door summary circuit).

8.5.2 Authority Food Service Requirements

For the Authority, food and beverage services are required in all accommodations. These services shall comprise of hot/cold meals and drinks, served from a trolley at the passenger's seat. The food will be brought onto the Trainset pre-heated/pre-cooled. A means of maintaining the temperature of the food shall be provided and shall be in accordance with United States Food and Drug Administration (FDA) requirements.

It is preferable to have an additional external loading door into the food storage area from the platform. Should this door not be used for passenger access, the size of the door may be smaller than the ADA requirement. If this door is designated as an emergency exit, it shall be marked accordingly. This door shall also be connected to the door Safety System (i.e., door summary circuit).

8.6 CLEANABILITY

8.6.1 Requirements and Information

All interior components shall be sufficiently durable to retain their appearance and physical properties throughout all environmental conditions taking full account of passenger loadings, and the cleaning and Maintenance cycles.

Lighting assemblies shall be sealed against the ingress of dust and dirt.

All heating and air conditioning ducts shall be designed to protect against the build-up of dust, dirt, moisture, and combustible detritus, and shall be fitted with suitable covers to both allow easy access for cleaning yet prevent against access by passengers.

8.7 AMERICANS WITH DISABILITIES ACT REQUIREMENTS

8.7.1 Requirements and Information

It is essential that the Trainset design achieves the capacity and passenger flow requirements of this Specification while also achieving full compliance with all applicable U.S. laws and regulations as they pertain to Americans with Disabilities Act of 1990, 42 U.S.C. 12101, et seq., as amended ("ADA") and the Rehabilitation Act of 1973, 29 U.S.C. Section 701, et seq. ("Rehab Act"), and all applicable regulations under both laws.

Applicable regulations under the ADA and Rehab Act are detailed in 49CFR Parts 27, 37, and 38, 2010 ADA Standards for Accessible Design and ADA Accessibility Guidelines (ADAAG), for which additional information is provided in Appendix E.

The Trainset design shall achieve a balance between the needs of Persons with Disabilities (PWD) and the needs of all passengers in general after meeting or exceeding ADA regulations and law.

The Contractor shall Work with the respective Owner to ensure that the internal layout will meet or exceed the regulatory requirements and will meet the needs of people with disabilities. Mock-ups of the passenger Vehicle interiors and toilets shall be used for achieving early design consensus of the Owner.

8.8 CAB

8.8.1 Requirements and Information

The Trainset shall have a fully-functional and identical driving Cab at each end. The layout of the driving Cab shall be arranged for operation by an unaccompanied Operator and shall provide seating for two additional occupants.

The Operator's seat shall have unobstructed forward visibility out the windshield and clear view of a speedometer and Cab signal display.

8.8.2 Cab, Cab Desk, and Driving Simulator

A standardized Cab and Cab desk in accordance with UIC 612-0, or equivalent, shall be provided.

The Trainset design shall be such as to ensure that the driving Cab at each end provides a safe, comfortable, and ergonomically designed environment. Particular attention shall be given to the following:

a) Architecture/ergonomics for Operators ranging from the U.S. 5th-percentile female to 95th-percentile male.
b) Safety/security of the occupants. Circumstances such as terrorism and hijacking shall be considered.
c) Comfort of the Operator.
d) Cab access and egress from ground level.
e) Cab environment provided to the Operator, as necessary, to allow operation during all times of day and night.
f) High efficiency Cab HVAC System (low noise, high Reliability).
g) Cab lighting requirements.
h) Rear viewing capability of trailing Trainset and station platform.

Under the Amtrak Contract, the Contractor shall be required to provide two full-scale Cab Mock-ups, one for Amtrak and one for the Authority (refer to Section 11.3).

The Contractor shall also provide a proposal for a full-motion 3D driving simulator that is in compliance with 49CFR Part 240 Type I.

8.8.3 Gauges, Instruments, and Display Screens

ATC and PTC information shall be integrated on one screen. Gauges shall be integrated electronically with the display screens.

Speed set control and alerter Systems shall be provided in accordance with 49CFR 238.751. The Cab signal and ACSES/PTC System acknowledgement shall reset the alerter timing cycle.

8.8.4 Forward External Visibility

The Authority's Cab shall be compliant with the signal sighting requirements as identified in 2008 HS RST TSI Section 4.2.2.6 and Annex B.3., and shall be compliant with all applicable U.S. laws and regulations.

For the Amtrak Cab, the Operator's minimum clear viewing distance from the seated position shall provide sufficient forward visibility at all speeds for signals, track, and catenary.

8.8.5 Facilities for Use by Cab Crew

Cab crew facilities shall be provided and shall be adequate to store crew's clothing and Equipment in or near the Operator's Cab. Additional Operator facilities/provisions shall include:

a) A cup stand accessible in the Normal seated position.
b) Three coat hooks.
c) Removable waste bin made of corrosion resistant material.
d) Desktop train order holder to hold a 279.4 mm (11 inch) by 279.4 mm (11 inch) document (e.g., Working instructions/timetable, Fault finding guides, etc.).
e) A suitably sized holder for FRA inspection cards and forms.
f) Crew refrigerator.
g) Fusees containers.

8.8.6 Emergency Equipment Locker

An easily accessible emergency Equipment locker shall be provided in each Cab. The locker shall contain the Equipment Specified in 49CFR Part 239.101. The Contractor shall develop a list of emergency tools to be submitted to the Owner for review and Approval.

8.8.7 Warning Bell and Horn

Warning Devices consisting of an electric bell and horn shall be provided on the exterior of the Cab. It shall be possible to activate these Devices from the Operator's console. Actuation of the horn shall also actuate the bell.
The bell shall produce a repeating sound with a one second repetition rate in response to switch activation. The sound level emitted by the bell shall be a minimum of 75 dBA at 15.2 m (50 feet). The horn shall meet the requirements of 49CFR Part 229.119.

8.8.8 Windshield and Wipers

The windshield shall be replaceable from the exterior of the Vehicle and shall limit external glare and reflections from inside the Cab when the train is operated at night with all interior illumination on.

A windshield wiper and washer Assembly shall be provided for each Cab that covers the Operator's sight line area, when seated. The windshield wipers shall be effective in the environmental conditions Specified in the respective Infrastructure Interface Specification (Appendices B and C).

When stopped, the windscreen wiper blades shall park in the rest position automatically and out of the Operator's sight line area. They shall maintain this position regardless of the speed of the Trainset.

A System for defogging/defrosting of the windshield and an adjustable front windshield visor shall be provided. They shall be effective at the environmental conditions Specified in the respective Infrastructure Interface Specification (Appendices B and C).

The capacity of the Trainset windshield wash System shall support three days of Trainset service operation between top-up.

8.9 CURRENT COLLECTION EQUIPMENT

8.9.1 Pantograph

The Contractor shall be responsible for interfacing/integrating the pantograph with the respective Owner's as-built OCS and high voltage Equipment, as Specified in the Infrastructure Interface Specifications (Appendices B and C).

Two pantographs shall be supplied per Trainset; however, current collection during Normal operation shall be performed by only 1 pantograph. The design of the pantographs shall account for the reduction of aerodynamic noise emissions and shall provide excellent current collecting performance at all speeds on all routes.

The pantograph shall be of a proven design capable of current collection at all speeds up to 390 km/h (242 mph).

The pantograph shall have an operating range for wire heights from 4.5 m (14.83 feet) to 7.5 m (24.5 feet).

8.9.2 Arrangement of Pantographs

The maximum spacing between the first and last pantograph for two coupled Trainsets shall be less than 400 m (1,312 feet) in order to negotiate the Specified types of separation sections. Where two pantographs are simultaneously in contact with the OCS during Normal operation at maximum speed, the minimum spacing between the pantographs shall be 200 m (656 feet). Multiple pantographs shall not have electrical links (e.g., via isolation switches) between the pantographs in use.

8.9.3 Automatic Lowering Device

Trainsets shall be equipped with a Device to automatically lower the pantograph head if a contact strip becomes sufficiently damaged in any position along its length so as to not cause consequential damage to the OCS Equipment.

The pantograph shall have weak points integrated throughout its structure that break to allow the pantograph to lower and prevent excessive wire damage in the event of entanglement with the OCS. The pantograph mounting design shall limit the chances of pantograph debris breaching the Trainset roof.

8.9.4 Running through Phase Separation Sections

Trainsets shall be fitted with Systems able to receive information from control-command and signaling Devices that communicate the requirements of separation sections on a line to trains. Subsequent actions shall be triggered automatically.

8.9.5 Pantograph Camera

Monitoring of pantograph operation shall include means to visually observe operation in either direction, in real time. Capacity to store a minimum of 1 complete round trip of Data shall be provided.

8.10 TRACTION SYSTEM

8.10.1 General Description

The propulsion System shall be designed to achieve the propulsion and braking performances required to fulfill Reliability, Availability, Maintainability, and Safety (RAMS) requirements and to efficiently deliver all of the functionalities needed for the fulfillment of the Owner's Operating Plan. The System shall take into account full loading conditions and permit rescue of disabled Trainsets.

Propulsion Equipment and Devices shall be of Service-Proven design.

Propulsion performance shall be provided assuming a unity power factor at the pantograph.

8.10.2 Operating Speed

For Amtrak, the Trainset shall be capable of an initial minimum continuous Operating Speed of 257.5 km/h (160 mph) under full load conditions, and a testing speed of the Operating Speed plus 5 mph.

Further enhancements to this are shown in the "Options Schedule." Refer to Schedule 14- The Pricing Schedule.

For the Authority, the Trainset shall be capable of a continuous Operating Speed of 354 km/h (220 mph) under full load conditions, and a testing speed of 390 km/h (242 mph).

8.10.3 Mean Acceleration

The Contractor shall provide the acceleration rates to the Owner for Approval, and shall demonstrate that the Trainset shall be able to meet the level of performance required by the Owner's Operating Plan (e.g., journey times). At the maximum Operating Speed and on straight level track, with new or worn wheels, the Trainset shall be capable of a minimum residual acceleration of 0.05 m/s^2 (0.11 mphps).

8.10.4 Service Braking

Service braking shall be configured to maximize use of Electric Braking, in accordance with Section 8.12.2, prior to supplementing with friction brake effort to achieve the necessary brake rate for Operations. Blended braking can be achieved using Electric Braking modes alone and Electric Brake and friction brake. Service braking shall be compatible with the respective Owner's infrastructure.

The maximum speed shall be automatically limited when any Electric Brake unit has failed. The speed limit shall be contained within the control logic, and shall be user

programmable. The maximum speed shall be identified by the Contractor, taking into account the level of degradation of the Electric Brake, required braking effort and the thermal limitations of the mechanical braking System.

The propulsion System shall regenerate into the Trainset's auxiliary power supply (APS) during Dynamic Braking. The remaining energy shall regenerate into the OCS so long as the OCS is receptive. (For Owner limits, see respective Infrastructure Interface Specifications in Appendices B and C).

8.10.5 Abnormal Operating Conditions

The Trainset shall be capable of restarting on a 3.5% gradient under full load conditions with only 75% traction available.

A single Failure of power Equipment feeding the traction modules shall not deprive a Trainset of more than 50% of its traction power.

When operating the Trainset with one failed traction module, loss of 50% of its traction power, or train pushing or towing a disabled Trainset under maximum load from any point of the route to the end of the line, making all station stops and observing all speed restrictions, there shall be:

a) No Equipment damage.
b) No activation of any protective Devices.
c) No heating above design limits.
d) No reduction of the life of the traction motors below the design life of the Trainset.

OCS voltages on the respective Owner's network are included in the Infrastructure Interface Specifications (Appendices B and C).

The Contractor shall submit a System description that details how the traction System design will accommodate the abnormal operating conditions identified in this Section, for Owner review and Approval.

8.10.6 Harmonic Characteristics and Related Over-Voltages on the OCS

The Trainset shall not cause unacceptable harmonic currents, voltages, or overvoltages. The Contractor shall perform a compatibility assessment on the Trainset as a whole, including all power units which can generate harmonics into the traction power system, per EN 50388:2005 Section 10, and shall demonstrate that the Trainset does not generate harmonics beyond the defined limits.

The Trainsets harmonic characteristics shall conform to Infrastructure Interface Specifications (Appendices B and C).

8.10.7 Electrical Protection Coordination with the Primary Power Supply

Electrical protection coordination design shall comply with the requirements detailed in EN 50388:2005 Section 11. Conformity assessment shall be carried out according to the requirements of EN 50388:2005 Section 14.6.

Propulsion System components shall be protected from damage due to cooling Failure and from water ingestion into the cooling air supply. If forced air cooling is provided, high voltage elements shall be isolated from the cooling air stream. There shall be no electrically live external surface of enclosures. Liquid cooling Systems shall be sealed and all components shall be rated for continuous exposure to the liquid. Environmentally friendly, non-toxic, biodegradable, non-flammable or fire-resistant, and non-conductive liquid compounds shall be used.

Appropriately rated and coordinated electrical protection shall be provided to protect all Systems from permanent damage from overheating, loss of cooling, overvoltage, overcurrent, voltage flashovers, electrical Faults, ground Faults, and other potential problems.

8.10.8 Traction Motors

The design of traction motors shall be of robust capacity for 354 km/h (220 mph) operation for the Authority and 257.5 km/h (160 mph) for Amtrak, limit unsprung mass, and eliminate use of consumables. They shall have sufficient capacity such that the Trainset under fully loaded conditions shall be able to continue operation with 25% of the rated power unavailable. Traction motor cooling air intakes and exhausts shall be protected against the admission of debris.

The motor shall be designed with suitable Bogie clearances to permit each motor and gear unit combination to be removed from the Bogie without interference with members of the Bogie frame. It shall be possible to remove the traction motor from above the Bogie without removal of the gear unit. Lifting lugs or other means shall be provided for attaching lifting Devices.

The motor shall be provided with Safety straps, tabs, or hangers to prevent the motor from falling in the event of Failure of the primary motor mounts.
A monitoring System shall be supplied to detect rotor bearing, gearbox bearing, and/or traction motor to gearbox coupling Failures.

8.10.9 Gearboxes

Gear units shall be of a Service-Proven design under similar service conditions on the Standard Platform. Gear unit duty cycle, torque ratings, maximum speed, and other applicable factors shall equal or exceed expected dynamic requirements.

The gear unit lubrication System shall be readily accessible without necessitating the removal of Bogies and shall be designed to prevent overfilling.

Gearboxes shall be mounted and attached to the traction motors to limit transmission of vibration into the trackwork by reducing unsprung mass.

8.10.10 Master Controller

A manual mode of controlling propulsion and braking shall be accomplished through a master controller provided in each Cab, located on the Operator's console. The design of the master controller shall match the overall aesthetic concept of the Cab and console and meet Safety and ergonomic requirements while utilizing robust components of traction power System quality in its construction.

Should a Trainset be required to be pushed by a rescue Trainset, the master controller in the leading Cab shall remain functional even if propulsion is cutout on that same Trainset.

8.10.11 System Interfaces

The propulsion System design shall be fully coordinated with the OCS, main transformer, auxiliary power Systems, Cab control, signaling System, friction braking, door interlocks, no motion detection, and Trainset Fault monitoring & diagnostic System and all other Systems that interface with the propulsion System. The Contractor shall be responsible for coordination of Interfaces of the propulsion System.

8.10.12 System Faults

The operational status of the electric portion of the brake System, and all critical, Safety-related propulsion System Faults shall be displayed for the train operator in the control Cab. The display shall also depict the total tractive effort, wheel slip conditions, and acceleration and deceleration rates.

8.10.13 Data Logger and Status Indication

The System shall be equipped with a Data logger that shall diagnose and record performance information regarding the propulsion and braking Systems in the Trainset, by date and time. The Data logger shall be part of the TMDS, as Specified in Section 8.17.

The Contractor shall identify the System status and Fault indications that will be provided, for review and Approval by the Owner.

8.11 AUXILIARY POWER SUPPLY

8.11.1 General Description

Electrical Equipment shall be of a Service-Proven design in a similar operational environment. Proposals offering new technologies or implementation of design changes to existing Systems may be considered given that the Contractor can provide sufficient Data to indicate that the System is capable of meeting all of the requirements Specified.

All electrical and electronic Systems shall be capable of operating in the presence of external electromagnetic noise sources and shall not produce electrical noise that interferes with trainline control and communications or with wayside signaling Systems.

8.11.2 Low Voltage Power

The Contractor shall determine the load shedding scheme and provide a proposal for a staged degraded operation based on battery capacity including sustaining emergency operations.

8.11.3 Shop Power Supply Receptacle

Auxiliary power receptacles and jumper cables shall be installed on each end on both sides of the Trainset.

The components shall allow 480 VAC to be supplied to a Trainset from a Maintenance facility standby power station, and auxiliary power distribution System when coupling two Trainsets without using adapters.

The auxiliary power System must be interlocked with the shop power supply to prevent double feed.

8.11.4 Test, Download and Adjustment Points for Troubleshooting and Testing

Local Fault logs, along with System status indicators shall be provided to aid troubleshooting activities.

Ports shall be provided to make it possible to observe and record parameters required to troubleshoot or to verify proper operation of the Equipment, or to initiate diagnostic tests. It shall be possible to perform these tasks with a Portable Test Unit (PTU).

8.12 BRAKING SYSTEM

8.12.1 General Description

The brake Equipment shall be of a Service-Proven design. The Contractor shall provide a detailed description of the proposed braking System, identifying clearly those areas where developments are necessary to fulfill the requirements of the operating conditions of the Owner's System.

The braking performance of the Authority's Trainset shall be compliant with 2008 HS RST TSI Section 4.2.4, relative to the maximum speed of 354 km/h (220 mph).

The brake System shall be capable of stopping a fully loaded Trainset from its maximum Operating Speed within the signal spacing existing on the track over which the train is operating, and/or within the given movement authority, under worst-case adhesion conditions.

The design of the brake Equipment shall:

a) Comply with the performance requirements detailed in this Specification and shall be in accordance with the Owner's Operating Plan.
b) Comply with all proposed Tier III brake System criteria defined in 49CFR Part 238.731 and ETF_001-02 – Proposed Ruletext for NPRM.
c) Provide wheel slip/slide protection (WSP) for all traction and braking cases to limit wheel damage.
d) Provide and display System monitoring and Fault indications.

In the case of partial or complete loss of Electric Brake, the friction brake shall be capable of achieving the desired speed reduction rates and maximum mandated stop distances under worst case dynamic loads.

Loss of power or Failure of the Electric Brake shall not result in exceeding the allowable stopping distance as defined in this Specification.

The friction brake alone shall be adequate to safely stop the train under all operating conditions defined in this Specification. The friction brakes shall be sized to permit the completion of the Trainset's trip, with friction brakes alone, after one emergency brake application at any location on the respective Owner's network.

An Interface between friction brakes, Cab signal, alerter, ATC/PTC System, and train diagnostic and monitoring Systems shall be provided.

A redundant multi-master brake control configuration shall be provided. The control of the braking System is Safety critical. The brake control unit shall be configured for graduated release only.

The Trainset shall provide a continuous application of partial brake (e.g., on one Vehicle) during the brake test segment of the pre-departure test, sufficient to hold position at terminal stations. Particular attention shall be paid to the impact of degraded mode operation on this function.

Provisions shall be made to allow release of the Trainset parking brakes (e.g., spring applied, air released) using an independent or dedicated power source (battery pack), in emergency situations (i.e., Trainset stop in a tunnel), when the power from the Trainset batteries is not available.

The following requirements are intended to be specific to Amtrak's operation and shall be met in addition to the remainder of Section 8.

Amtrak's Trainset will operate on the existing NEC and consequently will be required to comply with existing stop distances up to an Operating Speed of 257.5 km/h (160 mph); refer to table below. The Contractor shall use the pertinent parts of 2008 HS RST TSI to determine service braking stop distances for speeds greater than 257.5 km/h (160 mph).

Entry Speed	Maximum Stop Distance
265.5 km/h (165 mph)	TSI 4.2.4.4
257.5 km/h (160 mph)	3400 m (11,154 feet)
241 km/h (150 mph)	2988 m (9,803 feet)
201 km/h (125 mph)	2075 m (6,808 feet)

Stop distances provided up to 257.5 km/h (160 mph) shall be met with full friction, Dynamic Braking capability, no allowances for degraded modes or degradation due to wheel adhesion and with a fully seated and crewed Trainset, ready to run. The Contractor's brake System and control scheme shall be in compliance with relevant parts of 49CFR Part 238 for Tier III operation.

Stop distances above 257.5 km/h (160 mph) shall be determined using the procedure in 2008 HS RST TSI Section 4.2.4.4.

The Contractor shall determine the emergency braking performance for the Trainset per 2008 HS RST TSI Section 4.2.4.1, Case A, for speeds up to 265.5 km/h (165 mph). Eddy current track braking is permissible for emergency braking purposes only.

8.12.2 Types of Brake Subsystems

The Trainset braking System shall utilize Electric Braking and friction braking to achieve the Specified Trainset braking rates and stopping distances.

Electric Braking may consist of Dynamic Braking, and, if proposed, eddy current braking. Eddy current track braking is prohibited on Amtrak's infrastructure for service braking purposes for all speeds. Eddy current track braking will be permitted on the dedicated portion of the Authority's network.

If tread brakes are not part of the Trainset friction brake design, alternative provisions shall be made to account for tread cleaning.

The friction brake shall have sufficient capacity to brake the Trainset to a standstill from the maximum operating in emergency with all of the Electric Braking Systems inoperable. Other than increased wear of consumable components, there shall be no damage to the braking System as a result of such duty.

The Contractor shall demonstrate, through Analysis and testing, that the braking System does not exceed the thermal duty cycle of the brake components under any braking scenario, while respecting the maximum stop distance identified for safe operation.

Electric Braking shall be maximized as a percentage of the total Trainset braking effort required. For at least 90% of the time period over which braking is demanded, the brake force necessary to meet the Owner's Operating Plan shall be achieved without the use of friction brakes.

It shall be possible to test the application and release of the mechanical brakes from the driving Cab. The Contractor shall declare the application times for all braking modes.

The Contractor shall provide the control logic necessary to ensure smooth integration of the friction brake and wheel slip/slide Equipment and to coordinate electric and friction brake blending.

An "insufficient brake" detection circuit shall be provided on each Vehicle. The "insufficient brake" detection System shall be configured to detect actual levels of brake cylinder pressure and Electric Brake effort.

8.12.3 Protection of an Immobilized Train

It shall be possible to keep a train with a full load stationary for an unlimited period of time on the maximum gradient to be encountered with the maximum operational brake cylinder pressure applied and without assistance from the parking brakes.

It shall be possible to hold a train with a full load stationary for an unlimited period on the maximum gradient to be encountered with parking brakes.

The parking brake shall be able to be applied and released by hand from the Operator's Normal seated position in each Cab of the Trainset. Each Vehicle shall be equipped with a means to release the parking brake manually, preferably from the interior of the Trainset.

8.12.4 Power Management System

A power management System shall be provided to store and/or to dissipate Dynamic Braking energy when the OCS is non-receptive and the maximum amount of energy has been supplied to auxiliary loads.

Braking resistors, if used, shall be double insulated and sized for duty cycles without any dependency upon Regenerative Braking to dissipate all Dynamic Braking energy. Power dissipating resistors shall be adequately ventilated to prevent overheating under worst-case operating conditions. Power dissipation grids shall be designed and installed with sufficient isolation to prevent combustion between resistor elements and combustible material.

8.12.5 Wheel Slip/Slide Protection (WSP)

A WSP shall be fitted to each Vehicle, having the role of reducing excessive wheel slide (resulting from brake applications) and wheel slip (resulting from traction applications) in situations where wheel/rail adhesion is temporarily impaired (e.g., inclement weather conditions, fouling of the rail), and of preventing wheels from locking. The Contractor shall outline the control philosophy for the WSP, which shall be redundant and act independently on all axles or Bogies under its control. The Contractor shall submit details describing how the WSP System has been designed for use at high speeds in the respective Owner's environment.

The function shall operate with all wheel sizes, new through condemning, and shall periodically self-calibrate wheel speed to compensate for wheel wear to maintain performance of at least 90% efficiency. The WSP shall be interfaced with the sanding trainlines, if provided.

The Trainsets shall also be provided with rotation monitoring Equipment to detect locked axles and to indicate this condition in the operating Cab through an audible and/or visual alarm.

8.12.6 Emergency Brake Devices

The Trainsets shall be provided with emergency brake Devices, in each Cab and crew compartment, that can be used to initiate an emergency brake application. The Operator shall not be capable of releasing the brakes until the Trainset has come to a complete stop.

8.12.7 Passenger Brake Alarms

A passenger brake alarm shall be provided in the passenger compartment that initiates a retrievable penalty brake application, which uses a brake rate consistent with prevailing adhesion, passenger Safety, and brake System thermal capacity. The Operator shall be capable of releasing the brakes to allow the Trainset to be stopped at a safe location.

8.12.8 Pre-Departure Test

Pre-departure brake tests shall be initiated by the Operator from the driving Cab. Such tests shall also include WSP System tests.

8.12.9 Rescue Operations

The brake System design shall allow a disabled train's friction brakes to be controlled by a Rescue Vehicle, during a rescue operation. The Contractor shall be responsible for any Interface units that may be required between the Rescue Vehicle and the disabled Trainset. The Rescue Vehicle shall only be capable of supplying main reservoir pressure, and brake pipe pressure control (refer to Section 8.22).

8.13 DOOR SYSTEMS

8.13.1 General Requirements

Each passenger Vehicle shall have a minimum of 1 electrically controlled, power operated entrance door per side. Each doorway shall have minimum clear opening dimensions of 815 mm (32 inches) horizontal by 1880 mm (74 inches) vertical.

The side entry door System shall be designed and constructed such that no single point malfunction of door System components shall create an unsafe condition.

The Contractor shall submit a Train Egress Report outlining the number and size of side entry doors that shall facilitate the complete evacuation of a fully loaded Trainset to an adjacent platform within three minutes of the Trainset stopping. It shall also be possible to evacuate a fully loaded Trainset to a location other than an adjacent platform within ten minutes of the Trainset stopping. Also to be included in the report are specific features incorporated on the Trainset to permit crew, passengers, and passengers with disabilities to emergency evacuate the Trainset safely in a tunnel, trench, or aerial structure and in the absence of platforms.

The Contractor shall provide an assessment of boarding/egress times to/from the proposed Trainset that demonstrates the design of the Trainset adequately permits the required dwell times to be consistently achieved during Normal operation, including the periods of peak passenger boarding and alighting with luggage.

Doors, doorways, and vestibules shall not have surfaces or edges capable of causing injury to passengers or of damaging or dirtying their clothes or baggage. Thresholds including the overhangs shall have an anti-slip surface that allows for the safe entry and exit of passengers in all weather conditions.

Passenger doors closest to the Cab shall have a key switch to allow access by authorized crew from the exterior. The doors shall be operated from battery power. The key switch shall be accessible both from the track and at platform levels.

8.13.2 Door Operation

Powered door operation shall be initiated by the train Operator or via passenger enabled pushbuttons at each door location.

The train Operator shall be able to close/lock the passenger doors. All doors on the platform side of the Trainset that are not adjacent to a platform, or are on the opposite side of the Trainset, shall remain closed and locked.

A visual and audible indication shall be given to passengers in the vestibule whenever a door is released.

Door operation signal shall be interlocked with a zero speed command and tied to the door summary circuit.

Each passenger Vehicle shall have pushbuttons provided on the exterior and the interior at each side door location so passengers can control the powered operation of local doors. Operating instructions shall be posted adjacent to the pushbutton.

8.13.3 Door Closing

When the locking control is under crew control and activated from a door, it shall be permissible for this door to remain open when the other doors close. It shall be possible for crew to close and lock this door subsequently, and it shall be closed prior to the train departing.

When closed, the doors shall be weathertight and pressure-sealed under all Vehicle operating conditions.

Audible and visual warnings shall be initiated at each doorway to warn the passengers that the door has been commanded to close.

At the end of the close cycle, each door shall be fully closed and mechanically locked to prevent un-commanded door opening. Each door shall provide detection to the door summary circuit indicating the door is closed and locked.

8.13.4 Door Obstruction

Each side entry door shall be equipped with an obstruction detection System. The Contractor shall provide a detailed assessment of the obstruction detection System, including theory of System operation, proven service history, Reliability and Maintainability, compliance with applicable standards, and Safety Analysis.

8.13.5 Door Control Panel

A door control panel shall be provided at each doorway in a Vehicle with powered doors to control the operation of the side entry doors, or other doors on that Vehicle, or other Vehicles in the train via trainline control signals. The panel shall be accessible to the Train Crew via a locking cover opened by a crew key.

8.13.6 Information Available to the Train Crew

The train control and monitoring System/onboard computer shall indicate to the train Operator and the Train Crew that all the doors (except for the door under local control of the Train Crew) are closed and locked. A subsequent indication shall inform the train Operator that the door under local control of the Train Crew is closed and locked. An appropriate indication shall be provided to the train Operator or the Train Crew of any Fault in the door closing operation.

8.13.7 Locking a Door Out of Service

Each door shall be equipped with a cutout/lockout mechanism providing door closed indication to the summary circuit. The cutout/lockout feature shall not be readily accessible to unauthorized personnel and shall be subject to override by the door emergency release. The cutout/lockout shall be provided adjacent to the door inside the train to enable the Train Crew to lock a defective door out-of-service in the closed and locked position.

8.13.8 Emergency Release

Each side entry door shall have an internal emergency release Device, accessible to passengers, and designed so as to not facilitate accidental or malicious operation. The Contractor shall advise the Owner of the details of a speed interlock with this Device, for review and Approval. This Device must be proven to be fail-safe. This Device, when activated, shall cause an alarm to sound at the door, remove traction power, unlatch the door, remove the door isolation lock, release seal (if so equipped), remove power from the door Operator or controls, move the door to the open position, and send an indication to the train Operator. This Device shall unlock a door that has been locked out-of-service.

Each door shall also be equipped with an external emergency release Device, accessible to rescue crew, to allow the door to be opened for emergency reasons. This Device shall also unlock a door locked out-of-service. The design shall prohibit malicious entry into the Vehicle.

8.13.9 Door Summary Circuit

A trainline door summary circuit shall be provided to give indication to the Cab that all exterior side doors are closed and latched, and/or locked out with the door cutout lock.

The door summary circuit shall include functionality to inhibit tractive effort until the train reads zero speed condition and all passenger entry doors are closed and locked. Also, if the door summary circuit senses a passenger side door open when the train is in motion, the tractive power shall be removed.

8.13.10 Door Summary Circuit Bypass

Operating Cabs shall be equipped with two summary circuit bypass switches provided to override the door closed summary circuit for each side of the train.

The switches shall have provisions for sealing in the "Normal" position and shall provide an indication to the Operator and central control when the train is operating in bypass.

8.13.11 Audible and Visual Indicators

The Contractor shall provide audible and visual indicators at each passenger door prior to the opening and closing cycles. The audible and visual indications (type, location, frequency, duration, as appropriate) shall be submitted for review and Approval by the Owner.

8.13.12 Driving Cab Internal and External Access Doors

The driving Cab shall be accessible from ground and platform level, from either side of the Trainset.

The door between the driving Cab and the end of the nearest passenger area shall be fitted with slam-locks. The doors shall be capable of being locked from the outside by means of a key operated security lock. The same key shall open and lock the driving Cabs of all Trainsets. Operation of the door internal handle shall release the security lock to allow the Operator to escape in an emergency.

Exits from the driving Cab shall be equipped with hand rails and footsteps so that the Train Crew can get on and off the Vehicle safely. The hand rails and footsteps shall allow crew to enter or leave the driving Cab from or to ground level.

Crew side doors, if provided, shall not be accessible to passengers. Crew side doors shall include the same requirements as Cab side doors.

The Contractor shall justify the size and location of any non-passenger access doors.

8.13.13 Door Data Logger

The Trainset shall be equipped with a Data logger to diagnose and record the door System performance and Fault information. The Data logger shall be part of the TMDS, as Specified in Section 8.17.

8.13.14 Maintenance/Accessibility

All door mechanisms requiring Maintenance or adjustment shall be easily accessible via access panels or other alternative means from inside the Vehicle. Access shall be provided from inside the Vehicle to all points necessary for inspection, service, installation, or removal.

8.14 HEATING, VENTILATION, AND COOLING

8.14.1 General Description

The Contractor shall, using information provided in this Section, evaluate and select the worst-case conditions required for the NEC and the Authority network, and provide an HVAC System that meets the performance criteria at the respective operating environments. This shall be verified through calculations submitted to the Owners.

The Heating, Ventilation, and Air Conditioning (HVAC) System shall include all the necessary components to provide the required level of passenger and crew thermal comfort. The integrated, microprocessor-controlled HVAC Equipment shall include separate temperature controls for the Operator's Cab and the passenger areas with continuous monitoring of outside and inside temperatures to maintain the proper interior thermal comfort.

Such Equipment shall be of robust, heavy duty construction and shall be proven in high speed rail transit applications. The purpose of the HVAC Equipment is not only to provide thermal comfort and proper ventilation during both Normal and emergency conditions, but also to control the pressure inside the Vehicle against outside pressure fluctuation.

8.14.2 Passenger Comfort

The HVAC System shall provide comfort air inside the Trainset per Figure 5 and Chapter 9 of the ASHRAE Fundamentals Handbook. ASHRAE Standard 55-2010 shall be used to determine the interior thermal environmental factors that will provide environmental conditions acceptable to passengers.

8.14.3 Ambient Conditions

The climatological design Data provided in the Climatic Design Information chapter of the ASHRAE Fundamentals Handbook for the NEC and the Authority's network shall be used for design ambient conditions.

For cooling, ASHRAE 0.4% cooling dry-bulb temperature/mean coincident wet-bulb temperature Data shall be used.

For heating, ASHRAE 99.6% heating dry-bulb temperature Data shall be used.

8.14.4 Interior Conditions

The thermal comfort conditions defined in ASHRAE Standard 55-2010 shall be maintained within the Vehicle, including toilet rooms and Cab, throughout the entire exterior ambient design conditions defined in the table below:

Outside Ambient	Interior Vehicle Temperature
Below -25 ºC (-13 ºF)	Equipment shall be operable within the limits Specified in EN 13129-1:2002 Section 5.2.
-25 ºC to +15 ºC (-13 ºF to +60 ºF)	21 °C ± 1 °C (±2 °C for toilet room) 70 °F ± 2 °F (±4 °F for toilet room)
15 ºC to 43 ºC (60 ºF to 110 ºF)	23 °C ± 1 °C (±2 °C for toilet room) 74 °F ± 2 °F (±4 °F for toilet room)
Above 43 ºC (110 ºF)	Equipment shall be operable within the limits Specified in EN 13129-1:2002 Section 5.2.
Layover Cool Mode	29 °C ± 1 °C (±2 °C for toilet room) 85 °F ± 2 °F (±4 °F for toilet room)
Layover Heat Mode	10 °C ± 1 °C (±2 °C for toilet room) 50 ºF ± 2 °F (±4 °F for toilet room)

8.14.5 Heating

The Cab shall be provided with proper ventilation in accordance with ASHRAE 62.1-2010 at a minimum, and with a heating arrangement that maintains a temperature equivalent to that found in the passenger compartment.
The Contractor shall determine Equipment requiring freeze protection and incorporate appropriate controls in the HVAC temperature control System. Freeze protection requiring power shall be automatically energized at an ambient set point temperature determined by the Contractor.

8.14.6 Safety and Protective Devices

All heating Equipment shall incorporate overheat protection in accordance with the U.S. National Electrical Code.

If applicable, where airflow is required to maintain temperature of heating Devices, power shall be interrupted upon loss of airflow.

Surfaces accessible to passengers shall not exceed 51.7 °C (125 °F) for metallic surfaces and 62.2 °C (144 °F) for non-metallic surfaces.

8.14.7 Ventilation

Passenger areas, including toilets and food service areas, shall be ventilated at least at the minimum rates required in ASHRAE 62.1-2010. Ventilation shall include a mixed airflow, comprising of fresh air and re-circulated air, by the evaporator unit blower fans and exhaust fans. The two types of fans shall be independently controlled. Operator Cabs shall be ventilated by a minimum fresh airflow of 30 m^3/hr. (17.7 ft^3/min) per person.

The Contractor shall provide a means of exhausting stale air and odor from the food service galleys and restrooms, respectively.

The ventilation System shall maintain a Vehicle internal positive static pressure at all Trainset speeds, and alignment conditions, including higher altitudes and within tunnels. Intake of filtered fresh air shall be provided to maintain positive pressurization.

Emergency ventilation of at least 6 m^3/hr. (3.5 ft^3/min) per person of fresh air shall be provided in the event the HVAC System fails or auxiliary power supply is lost. Such ventilation shall be available for at least 30 minutes thereafter.

8.14.8 Sealing of Trainsets

The Trainsets shall be appropriately configured to seal and/or automatically ventilate to ensure aural comfort for passengers when Trainsets enter/leave tunnels. If the Trainset incorporates intake and exhaust flaps to maintain adequate carbody sealing, the intake and exhaust flaps shall be automatically closed prior to the Trainset entering a tunnel. The pressure experienced by the Train Crew and passengers onboard the train shall not exceed the limits Specified in UIC 660:2002 Section 4.6, and UIC 779-11 Appendix F.4 (for sealed trains). The Contractor shall verify that the Trainset can achieve the medical health criteria for basic tunnel cross-section using the UIC software SEALTUN, or equivalent, during the design phase.

8.14.9 Air Conditioning

Refrigeration Equipment shall be designed to protect against lock-out due to temporary extremes such as tunnel operation and pulldown.

Chlorofluorocarbon (CFC)-based refrigerants are not allowed.

8.14.10 Pre-Conditioning

A means shall be provided from the Cab to remotely start the HVAC System to pre-heat or pre-cool the Trainset to the interior temperatures Specified.

8.14.11 Particular Specification for Tunnels

Measures to protect against the distribution and inhalation of smoke and fumes in the event of a fire shall be provided. The switching off or closing of all means of external ventilation and the switching off of air conditioning shall be triggered by remote control by the Operator, for the entire train, or by a crewmember, for the individual Vehicle.

Should the source of the fumes originate within the Trainset, the HVAC System shall provide a means to extract the fumes from the affected Vehicle(s). Such actions shall be automatically triggered by the fire detection System. Means to initiate such actions shall also be made available at the Operator's console.

It shall be possible for the Operator to return the HVAC System to Normal operation in the Vehicle(s) not affected by fire or smoke.

Such overriding action shall be recorded by the event recorder.

8.14.12 HVAC Controls

Heating and cooling control shall be controlled by a microprocessor using solid state Devices. The output of the microprocessor shall control electrical power to the heater elements, motors, and various control Devices. The changeover between heating and cooling shall be automatic and, except for the reheat stage of overhead heat, shall preclude the simultaneous operation of heating and air conditioning.

A PTU shall be provided allowing service personnel full control of the HVAC microprocessor. The PTU shall also have the capability of changing any variable set points within the System.

Each HVAC unit shall have local diagnostic indicators to aid troubleshooting Faults on the unit. HVAC System Faults shall be reported to the Trainset monitoring and diagnostic System.

Each HVAC unit shall be equipped with a Data logger that shall diagnose and record the performance and Fault information regarding the HVAC units. A list of these Data shall be provided for review and Approval by the Owner. The Data logger shall be part of the TMDS, as Specified in Section 8.17.

8.15 LIGHTING

8.15.1 Requirements and Information

The lighting fixtures shall complement the aesthetic design of the Trainset while meeting the regulatory requirements.

Lighting fixtures shall be dust-proof and moisture-proof. Those installed on the Trainset exterior, and in the interior within 610 mm (24 inches) of a doorway (with the exception of the interior ceiling lights), shall be watertight.

All lighting fixtures shall provide for easy installation, removal/replacement, change-out, adjustment, and cleaning (including diffusers, lamps, and ballasts). Lighting levels shall be adjustable by crew members. Parts of lighting Equipment shall not deteriorate or discolor as a result of continuous exposures. Interior, exterior, and indicator lights shall be of the long-life light emitting diode (LED) type wherever practical.

8.15.2 Interior Lighting and Passenger Reading Light

Design and tests of the Normal interior lighting shall follow the guidance contained in APTA PR-E-RP-012-99.

An individually switched high-intensity low-heat controllable reading light shall be fitted at all seats, and shall have a beam that is directionally adjustable. The Contractor shall demonstrate that the position of the reading light and its control are suitable for a U.S. 5th-percentile female to a 95th-percentile male.

8.15.3 Cab Lighting

The Operator's Cab shall have Cab lights that provide sufficient illumination for the control instruments, meters, and gauges to enable the crew to make accurate readings from their Normal positions in the Cab. These lights shall be located, constructed, and maintained so that light shines only on those parts requiring illumination and does not interfere with the Operator's vision of the track and signals.

Each Cab shall also have a conveniently located light that can be readily turned on and off to provide sufficient illumination to read train orders and timetables.

To avoid glare on the windshield, dimmer control and directional adjustment of the Cab lighting shall be provided.

8.15.4 Exterior Side Door Threshold Light

All exterior side doors shall be equipped with LED door boarding lights designed to illuminate the side door threshold.

8.15.5 Standby/Emergency Lighting

The Trainsets shall be equipped with LED emergency lighting utilizing self-contained battery packs and/or capacitors.
At a minimum, as a standby mode, 30% of all Normal lighting in the main passenger areas (as evenly distributed throughout the Vehicle) and 100% of all emergency lighting shall be operational during power interruptions with durations over 10 minutes. Reduced Normal lighting shall not de-energize until after 90 minutes. Emergency lighting shall remain functional for a minimum operating time of three hours.

Low-location exit path markings shall continue to be operable for a minimum of 90 minutes after the loss of power from standby lighting.

8.15.6 Headlights

Two white headlights, (also known as headlamps), each producing a peak intensity of no less than 200,000 candelas, shall be provided at the front end of each Cab Vehicle.

8.15.7 Auxiliary Lights

Two white auxiliary lights, each producing a peak intensity of no less than 200,000 candelas, shall be provided at the front end of each Cab Vehicle to form the points of a triangle with the headlights.

The auxiliary lights may be arranged to burn steadily or flash. The flashing feature may be activated automatically, but shall also be capable of manual activation and deactivation by the train Operator.

8.15.8 Rear End Marking Devices/Marker Lights

Two red marker lights, with intensity greater than 100 candelas and less than 1000 candelas, shall be provided at the front end of each Cab Vehicle. Marker lights shall be of an approved LED design.

8.15.9 Combined Lamps

Combined lamps (e.g., lamps capable of different functions) shall be permitted only where the requirements for the individual lamp functions are achieved.

8.15.10 Lamp Controls

The Operator shall be able to control the headlights and auxiliary lights from the Normal driving position.

The following functions shall be provided:

a) All lamps off.
b) Full auxiliary lights on (daytime and night time use by Operator's choice).
c) Dimmed headlights on (daytime and night time use by Operator's choice).
d) Full-beam headlights on (daytime and night time use by Operator's choice).

The marker lights shall be arranged to burn steadily when on the trailing end of the train. The marker lights at the rear end of the train shall also be automatically switched on whenever the headlights are operational at the front end. In the event that the Trainset cannot recognize the train direction, the marker lights shall be on at both ends.

8.15.11 Number Lights

A weatherproof, illuminated number board shall be provided on the front end of the Trainset. Similar boards shall be provided one per side of each Cab Vehicle.

8.15.12 Door Indicator Lights

LED door indicator lights shall be provided for each door on the Trainset. The door open indicator light of each door shall be illuminated when the door is not closed and locked.

8.16 TRAINSET COMMUNICATIONS, PASSENGER INFORMATION, AND INTERFACES

8.16.1 General Description

The Systems shall be designed to allow both simple and logical uses to be made of the Systems under Normal operating conditions while ensuring that all necessary communications and Data transmissions can be made reliably when emergency situations arise.

Appendix F describes desired capabilities for Trainset communications, passenger information, and Interfaces in further detail.

Additional requirements/Interfaces for the Authority's communication System are defined in the Authority's Infrastructure Interface Specification (Appendix C).

8.16.2 Centralized Time Display

The Contractor shall link all communications Systems, Data recorders and event recorders that are controlled by time and provide a time stamp to the Eastern or Pacific Time zone. This System shall be a part of the Global Positioning System (GPS) Global network timing system.

In addition, a digital clock linked to this System shall be located on the Operator's Cab console, in the crew compartment, and on the internal electronic displays. The clock shall show the standard reference time in hours, minutes, and seconds.

8.16.3 Radio System

For Amtrak, the components for a voice/Data radio System shall be provided and installed by the Contractor at each Trainset Cab end and in the crew compartment compliant with the U.S. laws and regulations. The radio shall be located for ease of operation by the Operator.
For the Authority, the Contractor shall provide the Interface points, as Specified further in the Authority's Infrastructure Interface Specification (Appendix C).
The radio System shall be compatible with handheld radio Devices used onboard and any associated antennas shall be provided if required to ensure radio communications. In addition, handheld radio Devices shall be interfaced with the public address (PA) System for announcements and the Intercom (IC), passenger alarm, and "Call-for-Aid" Systems for emergency response.

8.16.4 Controls – Cab

The Contractor shall provide all communications Equipment and visual and audible indications necessary to meet the functional requirements of the communications section in the driving Cab. This shall include an Integrated Control Panel (ICP) which shall integrate the PA and IC Systems.

8.16.5 Controls – Crew Compartment

A communications console shall be provided in the crew compartment. The layout of this console shall be presented to the Owner for review and Approval.

8.16.6 Controls – Vestibule

The Contractor shall provide the PA and Operator-to-Trainmaster IC communications Equipment for Train Crew in the vestibule.

8.16.7 Public Address/Intercom System (PA/IC)

All passenger Vehicles shall be equipped with a PA System that provides a means for a Train Crew member to communicate by voice to the passengers and/or the OCC. The PA System shall also permit communication between the OCC and the passengers.

The PA System shall also provide means for intercommunication between Train Crewmembers and for a Train Crewmember to communicate by voice in an emergency situation to persons in the immediate vicinity of the train (e.g., persons on the station platform).

Means shall also be provided for the triggering of pre-recorded PA messages.

This PA System shall interface with the interior electronic displays to provide dual-mode communications (audio and visual) to accommodate deaf, hard-of-hearing, and visually impaired individuals. Assistive listening Devices (e.g., hearing loops such as an ALS System that is T-coil compatible) shall be provided and shall interface with the PA System.

All passenger Vehicles shall be equipped with an IC System that provides a means for passengers to communicate by voice with crewmembers and OCC in an emergency situation. Provisions shall be made to permit recording of the conversation, once the IC is activated, and downloading of the recording.

At least one IC that is accessible to passengers without using a tool or other implement shall be located in each end (half) of each Vehicle. The location of each IC intended for passenger use shall be conspicuously marked with photo-luminescent material.
Legible and understandable operating instructions printed on photo-luminescent material shall be posted at or near each such IC.

8.16.8 Exterior Emergency Intercom

A microphone and push-to-talk button shall be provided at all passenger doors on both sides of the Trainset to enable rescue personnel outside of the Trainset to communicate through the PA System.

8.16.9 Back-Up Power

The backup power System shall be capable of powering each System, independent from the main energy source, to allow intermittent emergency communication for a minimum period of three hours and continuous communication for the last 15 minutes at the end of the three hour period.

The communication System shall be designed in such a manner that it continues to operate no less than 50% of (distributed throughout the train)its loudspeakers in the event of a Failure in one of its transmission elements, or another means shall be available to inform the passengers.

8.16.10 Passenger Information Signs

All Vehicles shall be conspicuously and legibly posted with passenger information signs in their interiors.

All signage shall comply with ADA requirements. For Amtrak, all non-mandatory signs shall be to Amtrak design requirements. (Amtrak Onboard Signage Manual is attached to this Specification). For the Authority, the Contractor shall submit proposed designs for Authority Approval.

All Vehicles shall be conspicuously and legibly posted with emergency signs and instructions in their interiors (e.g., on Vehicle bulkhead signs, seatback decals) that shall be visible at all lighting levels.

Each seat shall have a designated seat number that is displayed at the seat via integrated signage.

Electronic signs that interface with the passenger information System shall be designed for information comprehension.

Information for the display shall be consistent with the station, PA, customer information System, and the train control System.

Train Crew shall have the ability to control the operational display signs via a central Interface.

The passenger information System, which includes both hardware and software, shall provide passengers with both audible (e.g. pre-recorded automated announcements) and visual information, through electronic signs (e.g. travel status updates) and displays (e.g., moving maps, news, sports, menus for food service Vehicles, and others).

The Contractor shall provide for dynamic at-seat signage and end-of-Vehicle signage, together with dynamic signage in vestibules, bar/food service areas, and other passenger circulation spaces.

The location, function, and appearance of all signage, graphics, and displays shall be submitted for Owner review and Approval.

The Contractor shall also provide a seat-back Safety information card illustrating the type, location, and use of Safety features available to the passenger, emergency Equipment, emergency signage, and emergency exit pathways for each Vehicle type. This Safety card shall include a clear Braille overlay. Artwork shall be provided to the Owner for review and Approval.

8.16.11 Passenger Alarm System

A passenger alarm System accessible by all passengers (including persons with disabilities) shall be provided. The Contractor shall provide details of the proposed System for review and Approval by the Owner.

Operating instructions, printed on photo-luminescent material and in Braille, of the emergency signal shall be posted adjacent to the Device.

Back-up power for the passenger alarm System shall be available for a minimum period of three hours in case of an emergency.

8.16.12 ADA Compliant Call-for-Aid Signal

The "Call-for-Aid" signal shall be easily activated at each ADA position and toilet. Indication of the call shall be identified to the crew by location.

The signal shall be accessible within the reach of a U.S. 5th-percentile female on the ground or seated on the toilet.

8.16.13 General Alarm

The Trainset shall have a general alarm in the communications control unit (CCU) to allow an Operator to alert all trains within a radio ground station transmission area of major emergencies such as derailment, landslide, fire, or flood.

8.16.14 Internal and External Camera Video Recorders

A digital video recorder shall be provided in each Vehicle to continuously record each of the camera inputs in that Vehicle whenever the Trainset is in operating service. The video recorder shall be located in the Vehicle to protect against damage that might occur in the event of a collision. The recorder shall have a removable memory module with a storage capacity of at least 48 hours of incident free operation plus one incident of 15 minutes duration.

8.16.15 External Video Cameras – Platform Monitoring

Externally mounted color video cameras shall be mounted on both sides of the Trainset at each Cab end to allow the Operator to monitor platforms at stations. The cameras shall be capable of operating at low illumination levels. Suitable signals shall be provided from the door control pushbuttons to enable and display the correct cameras on the Operator's video monitors. Should doors on both sides of the Trainset be selected, the left side cameras shall be displayed on the left (split screen) and the right side cameras on the right.

8.16.16 External Video Cameras – Forward Facing Cameras

One or two forward facing color video cameras shall be mounted on the front of the Trainset to provide a full frontal view. The cameras shall be capable of operating at low illumination levels. These cameras shall continuously record all activities in front of the Trainset.

The Cab communications System shall incorporate audio recording on the exterior of the Cab to confirm proper operation of horn and bell. Audio recording shall be synchronized with the forward facing cameras.

8.16.17 External Cameras and Housings

External camera housings shall be provided to accommodate the external video cameras.

The external camera housings shall be of a harmonious, attractive design integrated into the Trainset bodyside and shall be placed so as to not contribute extensively to aerodynamic noise.

External cameras shall have an anti-fog feature and be easily accessible, modular, vandal-resistant, and shall have easy manual aiming adjustment facilities for use by Maintenance personnel. The camera lens covers shall not deteriorate due to the abrasive effects of airborne particulates.

8.16.18 Internal Video Cameras – Video Recording

Internally mounted color video cameras shall be provided in each Vehicle to allow full monitoring of all passengers inside the Vehicle. This System shall be specifically designed to record anti-social behavior of passengers, as well as allow real time visual communication with all Vehicles in the consist by the Operator.

Internal cameras shall be integrated into the ceiling so as to present a clean, neat, but vandal resistant installation. The adequacy of coverage shall be confirmed by the Owner in the Mock-up evaluation.

In the event of the activation of a passenger-to-Train Crew IC, passenger alarm, or the passenger emergency manual door release handle, the System shall automatically select the two internal cameras that best cover this area and display it on the Operator's video display. Should the use of the passenger-to-Train Crew IC initiate this coverage, an audio track shall also be added which records both sides of the conversation.

8.16.19 Cab Video Monitoring

Internally mounted color video cameras shall be provided to allow full monitoring inside the Cab. Internal cameras shall be integrated into the Cab paneling so as to present a clean, neat, but vandal resistant installation. The System shall be designed to record any intrusion into the Cab area by unauthorized persons.

The adequacy of coverage shall be represented and confirmed by the Owner in the Mock-up evaluation.

8.16.20 Cab Audio Monitoring

A microphone shall be provided in the Cab to be able to continuously monitor/record all audio conversations in the Cab area. This microphone shall be concealed and installed so as to prevent any deliberate or accidental damage or disablement. The placement of this microphone shall be such that all conversations in the Cab area can be clearly understood.

8.16.21 Operator's Video Monitors

A pair of liquid crystal display (LCD) color monitors, or equivalent, or alternatively a single larger split screen LCD color video monitor shall be fitted in the Cab desk for the viewing of all internal and external camera images. The monitor shall be large enough to display all interior and/or exterior images.

8.16.22 Cellular Phones

The Contractor shall ensure that mobile cellular phones can operate reliably, inside all Vehicles within the Trainset, under all operating conditions and at all locations along the respective Owner's System, provided that the necessary external facilities have been installed by others.

8.16.23 Internal and External Electronic Displays

Internal and external electronic displays shall be provided.

Interior and exterior displays shall be integrated with the Vehicle lighting System to control brightness under all lighting modes.

Displays and signs shall include, at a minimum:

a) Passenger Entry Area Display.
b) General Information Display.
c) Network Location Display/Sign.
d) Toilet Room Sign.
e) Exterior Display.
f) Food Service Display/Sign.

The external electronic passenger information display shall be fitted at a position within or adjacent to each passenger door and at a height that is convenient for reading by a passenger standing on a station platform.

8.16.24 System Maps and Display Panels

Display panels shall be provided consistent with the Trainset industrial design scheme.

8.16.25 Antennas

All antennas for the different communication Systems shall be mounted to avoid damage from Vehicle wash brushes, and to achieve optimal signal strength. The locations of the antennas shall be selected to eliminate any electrical interference and shall be inside the Trainset clearance diagram.

8.16.26 Onboard Wireless Internet Access

It shall be possible for all passengers to access a broadband wireless network while onboard the Trainsets at all times. Capacity shall be provided to accommodate the maximum passenger load, be compatible with the respective Owner's infrastructure and commercial decisions, and be upwardly compatible with emerging technology.

The solution shall operate over the entire length of the Trainset and uses a combination of cost-effective multiple wireless Interfaces to establish bi-directional broadband connections to the wayside (e.g., Wi-Fi, Worldwide Interoperability for Microwave Access (WiMAX), High Speed Packet Access (HSPA), and Evolution Data Optimized (EV-DO)), spectrum bands (cellular, 2.4 GHz, and 5.x GHz, and 4G) to provide maximum throughput, bandwidth, performance, coverage and redundancy.

8.16.27 Food Service Point-of-Sale

Point-of-sale (POS) Equipment shall be provided in the Café Vehicle/food storage and preparation area of each Trainset. The POS shall utilize the onboard network to transmit Data to designated wayside locations. Including the following types of Data, at a minimum:

a) Credit card Approval.
b) Transmission of onboard sales information to remote sites.
c) Automatic ordering of inventory.

Any Data that is transmitted between the Trainset and wayside/remote locations must reside in the U.S.

All information, communications, and Data Systems shall provide a graphical user Interface (GUI), preferably web-based, for reporting, alerting, and management reporting. The System design shall enable the Owner to process credit transactions securely in accordance with PCI standards.

8.16.28 Train Communication Network

The train communications network shall supply the following information, at a minimum:

a) Travel status updates.
b) Train destination.
c) Current location or station.
d) Next station and time to next station.
e) Time and date.
f) Service alert messages.
g) Pre-recorded messages.
h) Visual graphics for inside displays (i.e., maps, advertisements, video, etc.).

For Amtrak, the System shall utilize Amtrak-provided Data for real-time and predictive train status. The Contractor shall have no responsibility for the collection or calculation of real-time or predictive train status Data other than retrieving the pre-calculated values using Amtrak's web services. When the Train-to-Ground communication is unavailable, the passenger information System shall utilize Data provided by the Trainset. Network connections to Amtrak's Data center shall be provided by the onboard Train Communications Network.

For the Authority, in addition to traditional, baseband analog, twisted-pair trainlines, a digital trainline network shall be provided to network on-board Devices and Systems using non-proprietary, open networking standards, and Interfaces. The digital trainline network shall be designed to transmit inter- and intra-Vehicle communication of digitized passenger information, intercom, internal and external sign Data, radio Data, video Data, fire alarm Data and infotainment Data. The Data capacity and latency of the digital trainline network shall be designed to support the performance of interconnected Systems with 20% reserve capacity for expansion. The digital trainline network shall be provided via mechanically

hardened, dedicated mechanical copper or fiber coupler cable, over a shared medium-voltage coupler cable, integrated into the mechanical coupler or implemented via a wireless link in acquirable spectrum. Alternatives may be proposed by the Contractor and shall be subject to Authority Approval. In any implementation, the digital trainline network shall be secure, electromagnetically compatible, shall not interfere with reconfiguration of Vehicles (if needed) and shall not have a single point of Failure.

8.16.29 Onboard Media Content Delivery

The passenger information System shall integrate with the existing onboard Wi-Fi network for its Internet communication to send and receive real-time and stored messages and content to and from the Owner's designated control center. Content may include, but is not limited to, the following:

a) Downloaded movies.
b) Streamed TV channels stored on local DVR for delayed local transmission onboard.
c) Train schedule information (train numbers and associated schedule including station stops and arrival times).
d) Menus.
e) Advertising.

There shall be the ability to deliver Owner-controlled content that is stored locally on the train to display units in all cars over the passenger information System or to passengers' personal Devices over the passenger Wi-Fi network.

There shall be the ability to update the stored media content with over-the-air updates from centralized command and control points without requiring physical touching of onboard computer servers.
It shall be possible to manage content and push updates remotely to:

a) Entire fleet.
b) Sub-groups of fleet.
c) An individual train.

Food service signage shall have the ability to display rich media (e.g., images and animations) from an onboard media server for the purpose of displaying and making real time changes to the menu.

8.17 On-Train Monitor and Diagnostics System

8.17.1 Requirements and Information

The Contractor shall provide an On-Train Monitor and Diagnostic System (TMDS), integrated into the Trainset and the Trainset's Subsystems. The TMDS shall collect, advise, and display status information relevant to the operational conditions of the Trainset's Systems and Subsystems, and their respective Equipment, by monitoring their status and health. The Contractor shall provide a listing of Subsystems that will be monitored.

This monitoring of the Subsystems, functions, and Equipment shall be continuous, or at a frequency to ensure reliable detection of Failure. Indication and source of a Failure shall be provided to the Operator upon detection.

The System shall make it possible for Maintenance personnel to troubleshoot any problems to the LRUs without the need to use external test Equipment.

The System shall also be linked to the onboard diagnosis Data recorder to allow for traceability.

When any such System or component is operating outside of its predetermined Safety parameters, the train Operator shall be alerted, and the relevant alarms shall be transmitted to the train Operator console. TMDS shall be capable of transmitting collected Data over the Owner-provided communication infrastructure to an appropriate wayside facility.

The monitoring System shall be designed with an automatic self-test feature that notifies the train Operator that the monitoring capability is functioning correctly and alerts the train Operator when a System Failure occurs.

Trains operating as a single Trainset and/or two Trainsets coupled together shall have all Faults, statuses, and indications displayed in the Controlling Cab.
The Data stored on TMDS shall be secured and shall not be deleted without proper password protected authority.

The Contractor shall provide information about how the design handles the collection, transmission, and display of the following for the Trainset:

a) Real-time telemetry.
b) Real-time health status and diagnostics.
c) Real-time Fault logs and monitoring parameters.
d) Real-time System alerts via email/text message.
e) Data transfer from the train's onboard Systems to the Owner-approved database and/or monitoring System.
f) Internal, external, and Cab camera recording.
g) Location.
h) Direction.
i) Speed.

8.17.2 Event Recorders

One of the subset Subsystems of TMDS shall be an event recorder, which primarily collects train operational Data. The event recorder shall also record additional Safety events as required by the Owner and FRA.

Event recorders shall be in full compliance with 49CFR Part 229 Appendix D, 49CFR Part 229.135, and the ETF requirements.

All Trainsets shall have an in-service event recorder. The event recorder shall record the most recent 168 hours of train operation Data.

The information stored shall not be corrupted as a result of any technical malfunction. One event recorder shall be associated with each driving Cab of a Trainset and both shall be functional whenever the Trainset is in service.

The Contractor shall provide examples of how the captured Data will be displayed during playback along with the format, content, and Data retention duration requirements Specified in the PSP that is required to be submitted to the Owner during the Design Review Process.

8.17.3 Trainset Preparation/Pre-Departure Test

Basic departure tests shall be carried out automatically upon each power up and their successful completion recorded as a timed event on the TMDS. Pass/fail indications shall be incorporated to indicate the status of the System.

The Contractor shall submit the list of Trainset preparation/Trainset pre-departure checks proposed, together with details of the test functionality, for Owner review and Approval.

8.17.4 Vehicle/Track Interaction Monitoring System

A Vehicle/track interaction monitoring System shall be provided to detect excessive accelerations on the carbody, Bogie, and axles. The System shall be autonomous and function without train Operator intervention.

It shall be possible to transmit the Data on each detected exception to the Owner's Maintenance management information System. When the communication network is not available, the System shall be capable of queuing Data transmission until coverage is available.

The information shall also be available for review and Analysis on a secure Web Site. The information on each exception shall include, at a minimum:

a) Vehicle ID.
b) Date/Time of detection.
c) Trainset speed during detection.
d) Location of exception (GPS coordinates, etc.).
e) Value of the acceleration.
f) Estimated force of wheel impacts.
g) Waveforms associated with the event.

8.17.5 Operational Alarms

The Trainsets shall be provided with operational alarms. These alarms include those that may potentially affect passenger service.

There are two types of operational alarms:

a) Alarms generated by the Operator, crew member, and/or passenger.
b) Alarms generated by the Trainset.

The TMDS shall be configured to control, monitor, display, diagnose, and, if applicable, conduct performance tests on both types of operational alarms. There shall be two ways to indicate alarm condition, audible and visual. The Contractor shall provide the list and types of alarm conditions for Owner review and Approval.

8.17.6 Technical/Maintenance Alarms

The Trainsets shall be provided with technical/Maintenance alarms. These alarms are generated upon detection by Subsystems and/or sub-Subsystems Equipment and indicate the Failure status of such Equipment being monitored (Equipment status can either be "Normal" or "failed").

8.17.7 TMDS Fault Log

Detected Faults shall be stored in the TMDS Fault log. The Fault log shall record any Fault/alarm generated in the most recent 168 hours. After the 168 hour period, the oldest Data shall be deleted and the newest Data shall be entered on a first-in/first-out basis. The information stored shall not be corrupted as a result of any technical malfunction. The Data in the Fault log shall include the date, time, location/source of the Fault, Fault status, and the location of occurrence on the network. The Contractor shall provide the detailed description of Fault log management for railroad the Owner's Approval.

8.17.8 Portable Test Unit (PTU)

It shall be possible to extract Data from the TMDS memory. The Contractor shall provide the PTU to view and analyze the retrieved Data. The information shall be downloaded to the PTU or removable USB memory storage Device. The Contractor shall provide all the necessary hardware and software to perform all necessary diagnostic functions.

8.17.9 TMDS Terminal Unit

Each Vehicle shall be provided with a TMDS Terminal Unit, including units that shall be installed in both Cabs of the Trainset. A Terminal Unit shall also be provided for the crew compartment. In addition to the requirements above, this unit shall also transmit Data to the crew member's display unit.

8.18 FIRE SAFETY SYSTEMS

8.18.1 Requirements and Information

The fire precautions on the Trainsets shall be in accordance with the standards applicable to a high speed rail operation, taking into account the operating conditions on the respective Owner's network, including tunnels, underground stations, extended-length viaducts, and trench sections.

The safest and quickest means of evacuating a train is at a station, where passengers can self-evacuate from a Vehicle directly onto a platform via all passenger doors adjacent to the platform. The Trainset System design and operating procedures shall therefore incorporate all practicable measures to ensure that a train does not stop between stations, and is able to reach and stop at a station.

The Contractor shall select and use interior materials available to the transportation industry, taking full account of the toxicity and combustibility requirements. All materials used in the Trainset construction shall be tested for toxicity in accordance with BSS 7239.

The Trainsets shall be designed to accommodate TSI category B fire Safety.

8.18.2 Fire Detection

A System shall be provided for the automatic detection of fire in all Vehicles. The fire detection System shall interface with the event recorder and the TMDS so as to provide a record and display the location of the detection and any automatic action taken.

The detection System shall be able to accommodate simultaneous or sequential detection of fire at more than one location.

Upon activation of the detection System, the following automatic actions shall be required:

a) Activation of alarms.
b) Shut down of forced ventilation and high voltage energy supply to the affected Equipment that could cause the fire to develop.

8.18.3 Fire Suppression Systems

The Trainsets shall be equipped with automatic fire suppression Systems to extinguish a fire upon detection in the affected location, in all cases and at all Trainset speeds.

Methods of extinguishing fire shall be provided for the passenger and crew areas and for the electrical compartments and cabinets.

The automatic fire suppression Subsystem shall be equipped with a self-test feature that will monitor the integrity of the piping and valves, and shall provide an indication of the Availability of the System. This self-test feature shall be automatic, and shall not require involvement from any additional Maintenance crew. The status of the fire detection and suppression Systems shall be available to the Operator on the operating screen upon request.

8.18.4 System Requirements in the Event of Fire

The HVAC System shall be isolated in the area affected by the fire to prevent the spread of fire. The System of control shall be completely automatic and shall be triggered by the fire detection System. It shall also be possible for the Operator to initiate operation from the Operator's desk. It shall be possible for the Operator to return the HVAC System in that part of the Trainset unaffected by fire or smoke to Normal operation. Such overriding action shall be recorded by the event recorder.

All power-operated doors, both access doors and internal doors shall be capable of manual operation in the event of Failure of pneumatic or electric power.

8.18.5 Fire Resistance

The Trainsets shall be equipped with adequate fire barriers and partitions at appropriate locations. Upon detection of fire, held open fire doors shall either close automatically or be closed by manually-initiated remote control.

The partition tests shall be carried out in accordance with the requirements of ASTM E119. The floors of all Vehicles in the Trainset shall provide a fire barrier, with a test period not less than 30 minutes. The walls and any doors on both sides of any Equipment areas within a carbody and the rear wall of the driving Cab shall provide a fire barrier for at least the same period as that provided by the floors.

8.18.6 Materials

Materials used in constructing the Trainsets shall meet the test performance criteria for Flammability and smoke emission characteristics identified in 49CFR Part 238.103. A materials matrix shall be developed as part of the fire Safety Analysis. The matrix shall contain the total weight of all materials, where used, Flammability and smoke emission test identity, test facility, test requirements, test results, and nature and quantity of the products of combustion shall be submitted by the Contractor during the design review.

8.18.7 Fire Safety Analysis

The Contractor shall complete a written fire safety Analysis, in accordance with 49CFR Part 238.103, for the passenger Equipment being delivered.

8.19 BOGIE REQUIREMENTS

8.19.1 Requirements and Information

Bogies shall be of a Service-Proven design.

The Contractor shall be responsible for providing smooth and safe performance of the Trainset, and of two Trainsets coupled together, at all speeds and track profiles experienced on the respective Owner's network. Contractor requirements for wheel/rail Interface criteria are defined in the Infrastructure Interface Specifications (Appendices B and C).

The proposed designs shall be demonstrated as being compliant with all Specification requirements through finite element Analysis (FEA), Vehicle dynamic simulation, and instrumented testing at approved testing facilities and on the respective Owner's network.

8.19.2 Wheel Truing

Wheel reprofiling shall be possible with Bogies mounted on the Vehicle.

For Amtrak, the Bogie arrangement shall be compatible with current wheel truing Operations.

Wheel true drawings have been included as an attachment (see attached). A journal box adapter maybe needed, this will have to be determined after the review of the Contractor's design.

8.19.3 Suspension

The secondary suspension shall incorporate automatic carbody-to-Bogie height adjustment, which shall be functional for all loading conditions, and shall include auxiliary spring units, or equivalent, to ensure safe wheel-rail performance at all speeds in the event of secondary suspension Failure. If the secondary suspension utilizes air springs, the air pressure of the springs shall be monitored by the Trainset monitoring System.

Protective construction (e.g., Equipment Safety hangers) shall be provided as required. Vertical and lateral stops shall be incorporated to limit Vehicle displacement to remain inside the clearance diagram in the event of primary or secondary suspension Failure.

Provisions shall be made for vertical adjustment to compensate for wheel wear to maintain the TOR-to-floor height within the vertical tolerance. The design, which shall be subject to Owner review and Approval, shall permit adjustment with standard Maintenance Equipment and shall not impair the operation of the Bogie. Suspension design shall permit adjustments to be made without disconnecting the Bogie from the carbody. Wheel wear shall not be compensated at the primary suspension.

8.19.4 Component Commonality

The Contractor shall ensure as many components as possible are identical and interchangeable between the Bogie types:

a) Each powered axle shall be identical and use identical Equipment.
b) Each unpowered axle shall be identical.

8.19.5 Lifting and Jacking Locations

Each Bogie shall be provided with slip resistant pads to allow lifting by floor jacks.

8.19.6 Bogie Mounted ATC/PTC and ATO Equipment

The Bogie design shall include the allocation of space and provision of mounting points and means for Automatic Train Control (ATC)/Positive Train Control (PTC) and, for the Authority, Automatic Train Operation (ATO) Equipment integration.

8.19.7 Alignment Protection Devices

The Contractor's Bogie design shall incorporate passive Safety measures for maintaining the alignment of the Trainset with respect to the running rail in the event of a derailment. The Bogie design shall provide a mechanical means to keep the Trainset in-line with the track in case of a derailment by guiding the rail between the back of the wheelset and a major Bogie-mounted component (e.g., a traction motor or gearbox).

8.19.8 Trainset Dynamic Behavior

The Contractor shall demonstrate safe operation of the Vehicle by conducting MCAT simulations on track Classes 2-9, as defined in the amended Track Safety Standards 49CFR Part 213 Appendix D for track Classes 6-9 and in the respective Infrastructure Interface Specifications (Appendices B and C) for track Classes 2-5.

The Contractor shall conduct analyses and testing of Vehicle-track performance to demonstrate compliance with the VTI Safety limits in 49CFR Part 213.333.

The Contractor shall describe its approach during the conceptual stage of the Design Review Process to mitigating low-speed wheel-climb derailments and conduct analyses in accordance with the FRA Low Speed Derailment Safety Advisory SA-2013-02.

Trainsets shall be designed to be stable and free from hunting oscillations at all Operating Speeds up to 10% in excess of the maximum intended Operating Speed under worst-case conditions inclusive of component wear.

8.19.9 Bogie Instability and Defective Gearbox Monitoring

Bogie instability and gearbox performance defects shall be monitored as part of the Trainset monitoring System.

The criteria for the activation of an onboard instability alarm shall be identified by the Contractor for review and Approval by the Owner. The Trainset monitoring System shall advise the Operator to reduce speed in the event of instability exceeding the criteria for activation of this alarm as defined by the Contractor.

8.19.10 Ride Quality

Ride comfort shall be evaluated using the guidelines of the ISO 2631, or equivalent standard, for all speeds and up to maximum Operating Speed plus 10% for the Authority and up to maximum Operating Speed plus 5mph for Amtrak over track maintained in accordance with the railroad's track geometry Maintenance limits. The Contractor shall provide the evaluation of human exposure to whole-body vibration and repeated shock for assessment with respect to possible effects on passengers' health. Any vibration that is caused by Equipment operation (e.g., compressors, blowers, electromagnetic Equipment, circuit breakers, motors, etc.) and emitted by the Trainset shall not be a source of discomfort to the passengers. For the Authority, lateral and vertical acceleration values for ride comfort are detailed in the Authority's Infrastructure Interface Specification (Appendix C).

8.19.11 Clearance Limits

The completely assembled Bogies with motors, brakes and other Equipment shall not exceed the clearance limits required between Bogie and carbody, or between Bogie and track and wayside structures, with maximum wear and load, over minimum-radius curves and on tangent track as described in this Specification. Bogie and Bogie-mounted components shall respect the minimum vertical clearance above TOR stipulated in 49CFR Part 229.71.

The maximum vertical and lateral deflection and maximum roll shall not exceed those values which will keep the complete Vehicle within the respective Owner's static and dynamic clearance outlines.

The Bogie and all connections between the Bogie and the carbody shall be designed for the full range of relative movement between the Bogie and the carbody. The maximum range of motion through horizontal and vertical curves shall accommodate the respective radii defined in the respective Infrastructure Interface Specifications (Appendices B and C).

8.19.12 Electrical Resistance

The wheelset design shall ensure the operation of track circuits. The electrical resistance of each wheelset, measured from wheel rim to wheel rim shall meet the requirements of the respective Owner's ATC Systems (refer to Appendices C and G).

8.19.13 Derailment Detection System

Derailment detection Systems shall be installed on the Trainsets. The System shall be proposed by the Contractor for Owner Approval.

8.19.14 Machine-Based Measurement/Inspection

The Contractor shall submit, for Owner review and Approval, methods incorporated onto the Trainset to enable wayside-based monitoring and inspection Systems to evaluate components en route including, but not limited to, wheels, brake pads and rigging, and bearing housings.

8.19.15 Axle Bearing Health Monitoring

The health of wheelset bearings on the Trainsets shall be monitored by onboard detection Equipment. This Equipment shall be able to detect a deterioration of the wheelset bearing health, either by monitoring its temperature, its dynamic frequencies, its acoustic signatures or some other suitable wheelset bearing health condition characteristic. A Maintenance requirement shall be generated by this Equipment and indicate a need for operational restrictions when necessary depending on the extent of the wheelset bearing deterioration. The detection System shall be located entirely onboard and diagnostic messages, along with the Vehicle position in the Trainset and the journal box location on the identified Vehicle, shall be communicated to the Operator. The Contractor shall provide details of the condition monitoring System for Owner review and Approval.

Provision of an onboard axle bearing health monitoring System must not interfere with the operational effectiveness of existing wayside detection Systems.

8.19.16 Hot Axle Box Detection

To prevent Trainsets triggering an incorrect alarm of trackside hot axle box detection (HABD) Equipment, the Trainsets shall have no component or Vehicle part, or commodity that generates sufficient heat in the target area that triggers an alarm.

8.19.17 Carbody Monitoring

The Trainsets shall either be instrumented or equipped with permanent Devices that monitor onboard instrumentation. The Devices shall monitor vertical and lateral accelerations. The accelerometers shall be placed below the floor of the Vehicle as near the center of a Bogie as practicable.

8.19.18 Flange Lubrication

If flange lubricators are necessary, the Contractor shall indicate which wheelsets will be equipped and identify the type of Equipment to be supplied. After lubrication occurs, the wheel/rail contact area shall not be contaminated. The Contractor shall consider and propose environmentally-friendly methods for reducing flange and rail wear as well as specific methods that result in reduced energy consumption and life cycle operating costs.

8.19.19 Sanding

If applicable, sanding Devices shall be provided for improving the braking and traction performance of the Trainset. Automatic sanding Systems shall be inhibited at specific locations as required on the respective Owner's network.

8.20 SIGNAL AND CONTROL

8.20.1 Requirements and Information

The Owner's Automatic Train Control (ATC)/Positive Train Control (PTC) signaling core System shall be based on service-proven communications and train control technologies. It shall consist of the use of track circuits, transponders, radio frequency (RF) links, bidirectional digital communications, and a network of distributed wayside Equipment designed for very high System Reliability and Availability. The Subsystems shall be of a Service-Proven design.

The ATC and PTC Systems shall accommodate the following objectives and functionalities, at a minimum:

a) Speed enforcement in all modes of revenue and non-revenue Operations.
b) Integration of ATC and PTC Systems for Shared Right-of-Way Operations.
c) Complete redundancy with no single point of Failure.
d) Protection against unauthorized movements onto the main line, Maintenance depots, and yards.
e) Enforcement of Vital supervision for permanent and temporary speed restrictions (e.g., in Work zones).
f) For the Authority, Automatic Train Operation (ATO) with time-tabled operation.
g) Self-tests of ATC/PTC and ATO functions during the Trainset's pre-departure test for compliance with applicable FRA regulations.
h) Communications Interface with the train monitoring System for applicable ATC/PTC Data.
i) Hazardous condition prevention during all modes of train operation.

The onboard PTC Subsystem shall interface with the associated wayside System to reliably and functionally prevent:

a) Train-to-train collisions.
b) Overspeed derailments, including derailments related to speed restrictions, slow orders, and excessive speeds over switches and through turnouts.
c) Incursions into established Work zone limits without first receiving appropriate authority and verification from the Operations control center (OCC) or roadway worker-in-charge.
d) The movement of a train through a Mainline switch in the improper position

The requirements for ATC/PTC apply to both Amtrak and the Authority. The Contractor shall provide signal and train control Equipment compatible with existing Amtrak infrastructure. For the Authority, the Contractor shall provide the Interface points, as Specified further in the Authority's Infrastructure Interface Specification (Appendix C). Refer to the respective Infrastructure Interface Specifications (Appendices B and C) and Amtrak ATC/PTC Functional Requirements (Appendix G) for additional information.

8.20.2 Amtrak Train Control Requirements

The Trainset shall be equipped with the following bi-directional Systems:

a) Cab Signal/Speed Control System (CS/SC).
b) Advanced Civil Speed Enforcement System (ACSES).

The Cab Signal/Speed Control (CS/SC) System shall include:

a) A nine-aspect continuous coded Cab signal with provision to display a tenth (stop signal) aspect when triggered by ACSES.
b) An automatic train stop function (ATS).
c) An automatic speed control function (ASC).

8.20.3 Amtrak ACSES Requirements

Amtrak's current FRA PTC Type Approved PTC System for the NEC is ACSES II. The existing FRA rules and regulations are limited to 241 km/h (150 mph). The existing ACSES transponder and receiver System is not verified for operation over 257.5 km/h (160 mph).

The existing design, operational, and functional descriptions for Amtrak's Cab Signal, ATC, and ACSES II Systems are provided in Appendix G as well as Amtrak's Infrastructure Interface Specification in Appendix B.

The ATC and ACSES Systems supplied for the Amtrak Trainset shall be FRA PTC Safety certified and Revenue Service ready.

The Contractor shall be responsible for providing FRA type approval under all applicable rules and regulations for the new Trainset operation. The Contractor shall be responsible

for providing an FRA-compliant PTC type approved ACSES System including all PTC upgrade Type Approved variances.

8.20.4 Amtrak CS/SC (ATC) Requirements

CS/SC (ATC) shall be fully compatible with existing NEC wayside signal and communication Systems (refer to Appendix G).

8.20.5 Operating Profiles

The Normal speed profile shall be constantly generated based on information provided by the wayside and stored in the onboard map/route database. Such Data shall include, at a minimum, track circuit/RF-link information, number of cleared sections, route classifications, speed restrictions, and civil (e.g., tunnel, grade, curve) information.

8.20.6 Braking Profiles

The ATC/PTC System shall supervise train Operations and automatically apply the brakes when necessary to maintain Safety.

The braking profiles shall be created taking into consideration the train performance (e.g., deceleration/acceleration rates), civil conditions (e.g., tunnels, curves, and gradients), and appropriate speed restrictions.

8.20.7 Onboard Map/Route Database

New or revised maps/routes shall be uploadable to the onboard database. The Contractor shall determine the procedure to control the uploaded Data and to verify their versions.

8.20.8 ATC/PTC Subsystem Monitoring

The System shall continuously monitor the health of the ATC/PTC onboard Subsystem and its operational status. Should an abnormality be detected, the System shall impose the most restrictive states on the outputs of the affected Trainset.

All events and changes relative to the ATC/PTC onboard Subsystem shall be monitored and logged. Monitored events, operational Data, and failures shall be recorded and made available for downloading.

8.20.9 ATC/PTC Onboard Equipment Inspections

ATC/PTC daily Equipment inspections shall occur as part of the Trainset pre-departure test prior to its entry into service. The Contractor shall supply all ATC/PTC functional inspection specifics. It shall be possible to perform the ATC/PTC 92-day functional inspection independently from each end of the Trainset.

8.20.10 Restricted Manual Mode Operations (ATC/PTC Isolated – Authority only)

In the case of a Failure of the ATC/PTC onboard Subsystem, the train shall be able to continue operation under a restricted manual mode with a non-equipped configuration (i.e., ATC/PTC isolated). In this mode, the Trainset shall be under Operator control with a maximum permitted speed of 95 km/h (59 mph) (final speed based upon the FRA PTC final rule) limited by a speed governor. In the event of an overspeed condition, an emergency brake application shall occur.

8.20.11 Direction and Rollback Detection

In all ATC/PTC supervision modes on the Mainline, the Trainset shall not be permitted to roll back by more than 2 m (6.6 feet). In the event that this default value is exceeded, emergency braking shall be immediately applied.

8.20.12 Automatic Train Operation (Authority Only)

ATO shall allow for the automatic control of propulsion and brake commands to operate trains between stations and from other stopping locations.

ATO shall, at a minimum:

a) Command the train speed within the limits of the Normal speed profile and service brake profile imposed by the ATC/PTC onboard Subsystem.
b) Ensure smooth ride quality based on operating rules, train number and timetable, and energy efficiencies.
c) Cause an automatic service brake application, as required, to reduce train speeds when approaching a civil Work speed restriction or a temporary speed restriction.
d) Control the train to a platform stopping location.
e) Control the door release and/or open and close processes.

During coupling procedures, ATO shall limit the Trainset speed to less than the maximum allowable coupling speed. ATO shall also limit the speed of the Trainset to less than the maximum allowable speed through a Trainwash facility. If these values are exceeded, the ATC/PTC onboard Subsystem shall provide a predetermined penalty brake application to stop the Trainset.

During Trainset startup, the System shall automatically perform a self-diagnostics test to verify that the System is operative. The ATO Subsystem shall be designed for redundancy. In the event that one Subsystem fails, the second Subsystem shall continue ATO functions without delay.

8.20.13 ATC/PTC Displays

ATC and PTC information shall be consolidated onto one screen.

8.20.14 EMI/EMC Requirements

All signal and train control Systems shall comply with the EMI/EMC requirements of Section 7.9 and the respective Infrastructure Interface Specifications (Appendices B and C).

8.20.15 Trainset Location and Identification

Each Trainset shall be equipped with an automatic location and identification System and Data Analysis and geo-fencing to determine geographical position and orientation as part of the infrastructure monitoring System.

The Owner shall have the ability to create, update, and delete geo-fences for the purpose of reporting and monitoring Trainset movement.

The Data from the Trainset location and identification System shall be accessible remotely.

8.21 CONTROL/COMMAND AND ONBOARD DATA SYSTEM

8.21.1 Requirements and Information

The control/command and onboard Data System is required to provide a high level of functionality and Reliability.

The System shall be comprised of:

a) A suite of functional Specifications.
b) A local diagnostics unit (carrying out of self-test at power up and during operation, detection and management of anomalies during the different phases of operation, signaling to the central diagnostics of the Trainset).
c) A local human-machine Interface (HMI) composed of a local display unit and of a local control unit (local operation test, isolation request, etc.) that monitors the health of all onboard Systems with status indicators.
d) A suite of standardized Interfaces (Data exchange with the Trainset environment, Data exchange with Maintenance tools, etc.).

It is envisioned that the System shall:

a) Be based on an optimized architecture (operational independence of the train functions, simplicity, standardization of components, etc.).
b) Provide high Reliability levels.
c) Permit management of modifications and their validation (independence of functions, reserve capacity for future updates in terms of memory capacity and intrinsic flexibility).
d) Provide management of Data exchange (local diagnostics, event recording, Data transfer both onboard and import/export from the Trainset).
e) Provide high performance Interfaces for both Operations and Maintenance.

A key objective is the ability to reprogram less critical functions, without the need for revalidation or extensive testing of critical Systems.

Where Safety is not compromised, automatic System resets shall be included where possible. Automatic resets shall be logged for Maintenance purposes. As far as practicable, selective resets shall be proposed to minimize reset time and the risks associated with any general reset.

The Trainset shall be Fault tolerant, with no conceivable Failure mechanism that could result in a "false departure" of the Trainset.

8.22 COUPLERS AND END OF TRAINSET INTERFACES

8.22.1 Requirements and Information

Trainset coupling Devices (including leading and trailing end couplers, intermediate couplers, and Coupler Adapters) shall be based on the Standard Platform and shall be of a Service-Proven design.

The couplers on the Trainsets shall operate safely through curves for all combinations of horizontal and vertical radii and reverse curves and permitted track irregularities on the respective Owner's network.

The couplers shall have sufficient strength to allow recovery by a second Trainset or a rescue locomotive.

8.22.2 Leading and Trailing End Couplers

The Trainsets shall be equipped, at each end of the Trainset, with an automatic center buffer coupler, geometrically and functionally compatible with a "Type 10 latch System automatic center buffer coupler" ("Scharfenberg" System, or equivalent). The coupler shroud shall be remotely opened/closed, and the coupler shall automatically couple mechanically, pneumatically, and electrically on impact and uncouple by activation of an uncoupling mechanism that does not require a person to go between the Equipment units.

The height above TOR of the coupler center shall be proposed and submitted by the Contractor to the respective Owner for review and Approval.

8.22.3 Intermediate Couplers

The intermediate sections of the Trainset shall be semi-permanently coupled.

8.22.4 End Handholds

If, during depot/Maintenance facility and/or rescue Operations, two Trainsets are coupled to form a single train that is not semi-permanently coupled, and the coupling operation requires an individual to manually couple or uncouple the Trainsets, the coupled ends shall be equipped with an end handhold that is located and installed so that an individual can safely couple and uncouple the Trainsets.

8.22.5 Coupler Adapter

Coupler Adapters shall be provided to permit the recovery of the Trainsets by standard AAR equipped locomotives. The adapter shall couple with the Type 10 latch coupler and the recovery unit's Type H tightlock coupler. Its Interface with the rescue unit shall have a pulling face center height of 876.3 mm ± 12.7 mm (34.5 inch ± 0.5 inch) above TOR.

The Contractor shall specify and submit the maximum tensile and compressive force values for the Coupler Adapter, along with the appropriate Safety factors, for Owner review and Approval.

8.22.6 Friction Brake Equipment Requirements for Rescue Operations

The Trainset to be recovered shall be connected to the brake pipe (or equivalent if the rescue unit is a Trainset that utilizes wired control) and the main reservoir of the rescue unit. Should a Trainset be required to be pulled by a rescue unit, the Controlling Cab shall be located within the rescue unit. All Trainsets shall be able to be moved safely and braked through connection of the rescue unit's brake pipe only. Should the design of the Trainset braking System include wired control, the Contractor shall be responsible for any Interface units that may be required between the rescue unit and the disabled Trainset.

8.22.7 Auxiliary Power/Control Requirements for Rescue Operations

Auxiliary power and control connectivity configurations shall be included at each end of the Trainset to accommodate the provision of auxiliary power and control signals to the disabled Trainset by either a Trainset or a rescue locomotive.

9 OPERATIONS AND MAINTENANCE

9.1 MAINTENANCE REQUIREMENTS

9.1.1 Requirements and Information

The Contractor shall develop and implement a comprehensive Maintenance Program for the Trainset and its Subsystems. The Contractor's response shall align with 49CFR Part 238.503.

The Contractor's Preliminary Maintenance Plan shall identify the spare parts, special tools, test and diagnostic Equipment, and jig requirements necessary for the Maintenance of the Trainsets. It shall also identify the predetermined mileages, thresholds, Maintenance tasks, and Equipment needed to perform each of the Contractor-identified Preventative Maintenance items throughout the design life of the Trainset. This plan shall also list the relevant Corrective Maintenance Operations and those Operations depending on specific conditions of use.

The Trainset design shall be such that Maintenance, overhaul, and repair are minimized, and where possible Maintenance can be accommodated in times that are consistent with the Availability requirements.

The Contractor shall verify that all Interfaces with the following facilities/Equipment are addressed as part of the Trainset design:

a) Wheel truing machines.
b) Trainset jacking and Vehicle lifting Devices:
    a. Portable Vehicle lifts for occasional lifting inside the facility.
    b. Fixed in-floor hydraulic hoists as a means of Normal Trainset/Vehicle lifting in the facility.
    c. Portable jacks for emergency lifting not inside the facility.
c) Overhead cranes.
d) High-level access platforms.
e) Service pits.
f) Facility traction power supply.
g) Special tools and Equipment.
h) Trainset washing and cleaning facilities.
i) Trainset painting facilities.

The Contractor shall ensure that the Trainset design takes account of human factors in Maintenance, by ensuring that inherent design features reduce or mitigate the effects of human error during Maintenance processes.

The Trainset design shall provide for the long term Availability and quality of all spare parts and consumables for the life of the Trainset.

The Trainset design process shall incorporate processes such as Reliability Centered Maintenance (RCM) in order to inform good design and generate Maintenance requirements.

9.2 TRAINSET REPAIRS

9.2.1 Requirements and Information

The Trainset shall be designed and constructed to facilitate replacement of modular elements due to structural collision, damage, and vandalism.

10 GENERAL INFORMATION REQUIREMENTS

10.1 STANDARD PRODUCT DESIGN CUSTOMIZATION

10.1.1 Requirements and Information

The Contractor, as part of the Design Review Process, shall provide details of the extent of customization required to their standard product platform in order to meet the requirements contained in this Specification, and how they intend to manage any changes in order to preserve as far as possible the inherent benefits of the standard product platform.

10.2 TESTING

10.2.1 Requirements and Information

The Contractor shall provide a draft Testing Strategy, for Owner review and Approval, that defines the testing to be performed to ensure successful service delivery and achieve Reliability requirements of the Trainsets.

The Testing Strategy shall comply with all applicable standards and CFR testing criteria. Previous type test results for proven Equipment on the standard product, assuming the supplier remains unchanged, may be accepted in lieu of new testing conducted specifically for this Procurement. However, the Owner will review the output test reports from such previous testing to determine their applicability. If, in the determination by the Owner, the application, and System Interfaces or manufacturing source have changed, then further testing shall be required.

All testing may be witnessed by the Owner, third party independent assessors and representatives of regulatory authorities.

Test plans and test results shall be submitted in accord with agreed-upon schedules.

The Testing Strategy shall address and provide information on the requirements detailed below, at a minimum, and demonstrate how compliance with the Safety and security certification program requirements of the Owner's SSPP will be met:

a) The dynamic test track testing proposed.
b) Any pre-service simulated running proposed.
c) Details of climatic testing, that has been or will be carried out to ensure all Specified climatic and temperature conditions are met.
d) Details of electrical Systems integration that has been completed or will be carried out.
e) Improvement management process to be used during testing.
f) Approach to conducting RAMS testing throughout the product development cycle, and subsequent monitoring of RAMS performance through the early months of revenue service.

10.2.2 Component, Subsystem and Vehicle Level Proof-of-Design Type Testing

Proof-of-design type testing shall be conducted at the component, Subsystem, and Vehicle levels. These tests shall be carried out on specific items of Equipment, Vehicle Systems, or Vehicle to prove that their design, construction and performance are suitable for their intended applications and fitness for the service described herein.

10.2.3 Trainset Static and Dynamic Type Testing

One Trainset shall be subject to static and dynamic type testing to demonstrate that all aspects of the design are in accord with Specification requirements and comply with governing regulations. Previous Trainset static and dynamic type tests results from another build will not be accepted.

As part of dynamic type testing, qualification on the relevant corridor will be required to satisfy 49CFR Parts 213.329, 213.345, and 238.111. The Trainset shall be instrumented as necessary to obtain the quantitative Data necessary to demonstrate Trainset compliance. The Contractor shall be responsible for all costs associated with the provision of such instrumentation and associated installation/de-installation.

10.2.4 Trainset Acceptance Testing

Each Trainset shall be subject to acceptance testing to confirm that the Trainset has been properly manufactured and prepared for service, and demonstrate that it is capable of meeting the Specified performance requirements. Successful conduct of acceptance tests shall be a prerequisite for Contractual acceptance and release of the Trainset in to Revenue Service.

Acceptance testing shall constitute a subset of the tests conducted during type and corridor qualification testing and shall:

a) Demonstrate that all Safety-critical Systems are in proper working order.
b) Exercise all Systems normally utilized during Revenue Service Operations.

10.3 QUALITY

10.3.1 Requirements and Information

The Contractor shall provide a draft Quality Plan that demonstrates the methods that will be employed to ensure the full control of all Systems, processes, materials supply and the selection, competence and on-going use of Subcontractors. Refer to the General Provisions and relevant Contract Documents for additional information.

11 TRAINSET EXHIBITS AND MOCK-UPS

11.1 GENERAL

11.1.1 Requirements and Information

Full scale (1:1) Mock-ups for the Trainset environments/areas identified in the Sections 11.3 and 11.4 shall be produced to allow the respective Owner to evaluate the Trainset design against its respective requirements as well as support the design review acceptance process, that will include external stakeholders and user groups review involvement.

The finalized Mock-ups shall be located in the U.S., (location to be agreed between the Contractor and the respective Owner) and shall be transportable.

The standard of construction adopted by the Contractor shall be commensurate with the use of each Mock-up as a design development and stakeholder review tool. For the Authority, the Mock-ups will be used for public display or storage/use outdoors. While Mock-up requirements are identified below, subject to suitability for adequately representing the proposed design arrangement in question, the Owner is willing to entertain the use of the Contractor's actual Trainset hardware for Mock-up purposes.

Hard Mock-ups, as a minimum, shall be provided for all areas/environments called out in the Sections 11.3 and 11.4 below. Where considered beneficial from a design advancement and early Approval making standpoint, the Contractor shall look to make use of Soft Mock-ups.

11.2 TRAINSET EXHIBITS

11.2.1 Exterior Aesthetic Design Concepts

The Contractor shall develop a minimum of three distinctly different exterior concept packages for each Owner. In the case of the Amtrak exterior concepts the livery will be developed in close collaboration with Amtrak's nominated interior designer.

These packages where applicable shall be representative of the Contractor's proposed concepts, from multiple views, and shall detail the lead Vehicle, trailing Vehicles, and the overall Trainset configuration. The proposed concepts shall take into consideration the operating environment and overall Maintainability (e.g., appearance of cleanliness, repair of damaged surfaces, etc.).

11.2.2 Interior Aesthetic Design Concepts

During design review, the Contractor shall advance detailed versions of the minimum three different interior concept packages, for each Owner that were submitted during the proposal stage.

These packages where applicable shall be representative of the Contractor's proposed concepts, from multiple views, and shall detail the leading and trailing Vehicles, First Class, Business Class areas, Café Vehicle, and the overall Trainset configuration. The proposed concepts shall take into consideration the class of service, operating environment, and

overall Maintainability (e.g., cleaning ability, resistance to wear, repair of damaged surfaces, etc.).

11.2.3 Dimensioned Interior Layout Concepts

The Contractor shall advance detailed versions of the minimum three different interior layouts, for each Owner that were submitted during the proposal stage.

These layouts shall illustrate where applicable proposed locations of First and Business Class seating areas and locations of onboard facilities (e.g., ADA seating locations, food service, toilets, luggage areas, bicycle storage locations, etc.). These layouts shall identify seat width, seat Pitch, aisle, vestibule, and gangway width, and shall identify the overall passenger seating capacity of each layout.

11.3 CAB MOCK-UP

11.3.1 Requirements and Information

Under the Amtrak Contract, two Cab Mock-ups shall be provided (i.e., one for Amtrak and one for the Authority). The Cab Mock-up shall present the cab equipment layout, ergonomics and Operator/human-machine Interfaces (DMI/HMI) including all primary controls, for Approval purposes. Primary controls in this context are those controls and indicators that the Operator handles during Normal driving Operations of the Trainset. The Mock-up will be used as part of the Design Review Process for developing the Cab design arrangement and identifying Hazards and risks. The Mock-up shall also:

a) Include the Operator's seat positioned properly to determine lines of sight and wayside signal visibility.
b) Have a non-functional windscreen wiper and arm mounted on the Cab.
c) Include all Specified emergency accessories.
d) Include operational headlights, auxiliary lights, marker lights, and number lights.
e) Include a rapid means of emergency egress.
f) Include all displays.

11.4 PASSENGER/ONBOARD CREW AREA MOCK-UP

11.4.1 Requirements and Information

An evolving series of Mock-ups are required which shall be constructed in a timely manner to help develop the passenger area and onboard crew area design concepts, and allow the Owner to give clear creative direction and make timely decisions throughout the process and at staged gate reviews. Under the Amtrak Contract, the Contractor shall be required to provide two full-scale sets of passenger/onboard crew area Mock-ups, one for Amtrak and one for the Authority. The Owner expects the Mock-ups to be used specifically to inform decisions around 3D-space planning, form, function and aesthetics as well as compliance with FRA mandatory ADA requirements and the identification of potential ADA feature enhancements above and beyond those required for regulatory compliance.

Mock-ups shall be required for the following passenger and onboard crew areas:

a) First Class seating and environment.
b) Business Class seating and environment.
c) Toilet module.
d) Vestibule.
e) Café Vehicle, food preparation/storage area, trolley storage area, and passenger environment.
f) First Class galley (Amtrak only).

By the final design review stage, the Mock-ups shall provide:

a) First and Business Class seating environment – Working seat Mock-ups for both classes of environment with final color and material and finish proposed with final carpet and wall and ceiling paneling proposed. Working lighting effects shall be in order to see the seats fully in context. Each type of seat configuration shall be represented in the Mock-up. Minimum quantities shall include 1 seat mocked-up as above combined with 3 other seats and a table in order to see the spatial environment. Seats shall have moving parts and perform as the Owner would expect, but need not necessarily have the final mechanisms to do this.
b) Toilet Module – A Mock-up with real materials proposed to show space and situation of key functionality (e.g., toilet, sink, hand-dryer, baby change, flush, etc.) plus the colors, materials, and finishes proposed. The Mock-up shall be sufficient to ascertain ADA compliance, cleanability and Maintainability. It shall not be necessary to have a fully functioning toilet with working flush, hand-dryers, etc.
c) Vestibule – A Mock-up clearly demonstrating space and situation of key functionality (e.g., luggage, doors (including emergency egress facilities/functions), ease of access for wheelchair users navigating from the vestibule to the ADA seating space in the passenger areas as well as the toilet module, etc.) plus the colors, materials, and finishes proposed for both First and Business Class vestibules. The Mock-up shall have working lighting effects in order to see the space in context.
d) Café Vehicle/Food Preparation and Storage Area – A Mock-up showing space and situation of key functionalities (e.g., Café passenger area, seating, countertops, carts galley, partitions, etc.) plus the colors, materials, and finishes proposed. The Mock-up shall be sufficient to ascertain the position of all key Equipment (though this need not be functioning) and to assess cleanability and Maintainability. The Mock-up shall have working lighting effects in order to see the space in context and the carts shall be functional to simulate their circulation and loading in the Café car galley area.
e) First Class Galley – A Mock-up showing space and situation of key functionality. The Mock-up shall be sufficient to ascertain the position of all key Equipment (though this need not be functioning) and to assess cleanability and Maintainability. The Mock-up shall have working lighting effects in order to see the space in context

and the carts shall be functional to simulate their circulation and loading in the galley area.

11.4.2 G Scale Models

The Contractor shall supply three G scale (1:22.5) models of the as-built Trainsets to both Amtrak and the Authority. The model construction shall be configured so that the interior decor and layout may be viewed.

12 APPENDICES

12.1 APPENDIX A – U.S. LAWS AND REGULATIONS MATRIX

12.1.1 Requirements and Information

U.S. laws and regulations define the mandatory basis of design of passenger rail Equipment in the U.S.

References	Descriptions	Relevant Subsystems	Notes
29 CFR Part 1926	Safety and Health Regulations for Construction	High/Low Voltage Electrical Equipment	
40 CFR Part 82	Protection of Stratospheric Ozone	Heating, Ventilation, and Cooling	
40 CFR Part 201	Noise Emission Standards for Transportation Equipment, Interstate Rail Carriers	Noise and Vibration	
40 CFR Part 201.11	Standard for Locomotive Operation under Stationary Conditions	Noise and Vibration	
46 CFR Part 111.87	Electric Air Heating Equipment	Heating, Ventilation, and Cooling	
49 CFR Part 27	Non-discrimination on the Basis of Disability in Programs or Activities Receiving Federal Financial Assistance	Interior Design; Persons of Reduced Mobility Requirements	
49 CFR Part 37	Transportation Services for Individuals with Disabilities (ADA)	Interior Design; Persons of Reduced Mobility Requirements	
49 CFR Part 38	Americans with Disabilities Act (ADA) Accessibility Specifications for Transportation Vehicles	Interior Design; Persons of Reduced Mobility Requirements; Door Systems	
49 CFR Part 38 Appendix	Figures to Part 38	Persons of Reduced Mobility Requirements	
49 CFR Part 38.111	General	Persons of Reduced Mobility Requirements	
49 CFR Part 38.113	Doorways	Persons of Reduced Mobility Requirements; Door Systems	
49 CFR Part 38.115	Interior Circulation, Handrails, and Stanchions	Persons of Reduced Mobility Requirements	
49 CFR Part 38.117	Floors, Steps, and Thresholds	Persons of Reduced Mobility Requirements	
49 CFR Part 38.119	Lighting	Persons of Reduced Mobility Requirements; Lighting	
49 CFR Part 38.123	Restrooms	Persons of Reduced Mobility Requirements	
49 CFR Part 38.125	Mobility Aid Accessibility	Persons of Reduced Mobility Requirements	
49 CFR Part 38.175	High Speed Rail Cars, Monorails, and Systems	Persons of Reduced Mobility Requirements	
49 CFR Part 210	Railroad Noise Emission Compliance Regulations	Noise and Vibration	
49 CFR Part 213	Track Safety Standards	Bogie Requirements	
49 CFR Part 213.329	Curves, elevation and speed limitations	Bogie Requirements	

49 CFR Part 213.333	Automated Vehicle Inspection Systems	Bogie Requirements	
49 CFR 213.345	Vehicle Qualification Testing.	Testing	
49 CFR Part 216	Special Notice and Emergency Order Procedures: Railroad Track, Locomotive and Equipment	Operating Environment; Heating, Ventilation, and Cooling	
49 CFR Part 221	Rear End Marking Device Passenger, Commuter, and Freight Trains	Lighting	
49 CFR Part 221.13	Marking Device Display	Lighting	
49 CFR Part 221.14	Marking Devices	Lighting	
49 CFR Part 223	Safety Glazing Standards Locomotives, Passenger Cars and Cabooses	Structure and Crashworthiness	
49 CFR Part 223 Appendix A	Certification of Glazing Materials	Structure and Crashworthiness	
49 CFR Part 223.9	Requirements for New or Rebuilt Equipment	Structure and Crashworthiness	
49 CFR Part 227	Occupational Noise Exposure	Noise and Vibration	
49 CFR Part 229	Railroad Locomotive Safety Standards	Operating Environment; Noise and Vibration; Interior Design; Cab Design; Traction/Propulsion System; Braking System; Heating, Ventilation, and Cooling; Lighting; Bogie Requirements; Signaling and Control; High/Low Voltage Electrical Equipment	
49 CFR Part 229 Appendix D	Criteria for Certification of Crashworthy Event Recorder Memory Module	On Train Monitor and Recorder	
49 CFR Part 229 Subpart C	Ventilation and Heating Requirements. Inspection and Maintenance of HVAC units.	Heating, Ventilation, and Cooling; Cab Design	
49 CFR Part 229 Subpart E	Locomotive Electronics	Operating Environment; On Train Monitor and Recorder; Cab Design	
49 CFR Part 229.13	Control of Locomotives	Cab Design	
49 CFR Part 229.25	Tests: Every Periodic Inspection	Maintainability	49 CFR Part 238.805 will govern
49 CFR Part 229.27	Annual Tests	Maintainability	49 CFR Part 238.805 will govern
49 CFR Part 229.29	Air Brake System Calibration, Maintenance, and Testing	Braking System; Maintainability	49 CFR Part 238.805 will govern
49 CFR Part 229.31	Main Reservoir Tests	Braking System	49 CFR Part 238.731 will govern
49 CFR Part 229.41	Protection against Personal Injury	Structure and Crashworthiness; High/Low Voltage Electrical Equipment	
49 CFR Part 229.45	General Condition	High/Low Voltage Electrical Equipment	
49 CFR Part 229.47	Emergency Brake Valve	Braking System; Cab Design	49 CFR Part 238.731 will govern
49 CFR Part 229.49	Main Reservoir System	Braking System	49 CFR Part 238.731 will govern

49 CFR Part 229.51	Aluminum Main Reservoirs	Braking System	49 CFR Part 238.731 will govern
49 CFR Part 229.53	Brake Gauges	Braking System; Cab Design	49 CFR Part 238.731 will govern
49 CFR Part 229.55	Piston Travel	Braking System	49 CFR Part 238.731 will govern
49 CFR Part 229.57	Foundation Brake Gear	Braking System	49 CFR Part 238.731 will govern
49 CFR Part 229.59	Leakage	Braking System	49 CFR Part 238.731 will govern
49 CFR Part 229.63	Lateral Motion	Bogie Requirements	
49 CFR Part 229.65	Spring Rigging	Bogie Requirements	
49 CFR Part 229.67	Trucks	Bogie Requirements	
49 CFR Part 229.71	Clearance above Top of Rail	Operating Environment; Signaling and Control	
49 CFR Part 229.73	Wheel Sets	Bogie Requirements	
49 CFR Part 229.77	Current Collectors	High/Low Voltage Electrical Equipment	
49 CFR Part 229.83	Insulation or Grounding of Metal Parts	High/Low Voltage Electrical Equipment; Cab Design	
49 CFR Part 229.85	High Voltage Markings: Doors, Cover Plates, or Barriers	High/Low Voltage Electrical Equipment	
49 CFR Part 229.87	Hand-Operated Switches	High/Low Voltage Electrical Equipment	
49 CFR Part 229.89	Jumpers; Cable Connections	High/Low Voltage Electrical Equipment; Passenger Information and Communications	
49 CFR Part 229.91	Motors and Generators	High/Low Voltage Electrical Equipment	
49 CFR Part 229.115	Slip/Slide Alarms	Traction/Propulsion System; Braking System; Cab Design	49 CFR Part 238.731 will govern
49 CFR Part 229.117	Speed Indicators	Signaling and Control; Cab Design	
49 CFR Part 229.119	Cabs, Floors, and Passageways	Heating, Ventilation, and Cooling; Cab Design	
49 CFR Part 229.121	Locomotive Cab Noise	Noise and Vibration	
49 CFR Part 229.123	Pilots, Snowplows, End Plates	Structure and Crashworthiness	
49 CFR Part 229.125	Headlights and Auxiliary Lights	Lighting	
49 CFR Part 229.127	Cab Lights	Lighting; Cab Design	
49 CFR Part 229.129	Locomotive Horn	Cab Design	
49 CFR Part 229.131	Sanders	Bogie Requirements; Braking System	As optioned by 49 CFR Part 238.753
49 CFR Part 229.133	Interim Locomotive Conspicuity Measures – Auxiliary External Lights	Lighting	
49 CFR Part 229.135	Event Recorders	On Train Monitor and Recorder	
49 CFR Part 229.137	Sanitation; General Requirements	Interior Design; Cab Design	
49 CFR Part 229.139	Sanitation; Servicing Requirements	Interior Design	

49 CFR Part 229.140	Alerters	Cab Design	49 CFR Part 238.751 will govern
49 CFR Part 229.141	Body Structure, MU Locomotives	Structure and Crashworthiness	49 CFR Part 238.703, 49 CFR Part 238.705, 49 CFR Part 238.707, 49 CFR Part 238.709, 49 CFR Part 238.711, 49 CFR Part 238.713, 49 CFR Part 238.715, 49 CFR Part 238.717 will govern
49 CFR Part 231	Railroad Safety Appliance Standards	Structure and Crashworthiness; Braking System	
49 CFR Part 231.14	Passenger-Train Cars without End Platforms	Braking System	
49 CFR Part 231.18	Cars of Special Construction	Structure and Crashworthiness	
49 CFR Part 232	Brake System Safety Standards for Freight and Other Non-Passenger Trains and Equipment; End-of-Train Devices	Braking System	
49 CFR Part 232 Subpart B	General Requirements	Braking System	
49 CFR Part 232 Subpart E	End-of-Train Devices	Braking System	
49 CFR Part 232 Subpart F	Introduction of New Brake System Technology	Braking System	
49 CFR Part 232.407	Operations Requiring Use of Two-Way End-of-Train Devices; Prohibition on Purchase of Nonconforming Devices	Braking System	
49 CFR Part 236	Rules, Standards, and Instructions Governing the Installation, Inspection, Maintenance, and Repair of Signal and Train Control Systems, Devices, and Appliances	Signaling and Control	
49 CFR Part 236 Subpart H	Standards for Processor-Based Signal and Train Control Systems	Signaling and Control	
49 CFR Part 236 Subpart I	Positive Train Control Systems	Signaling and Control; On Train Monitor and Recorder	
49 CFR Part 236.1005	Requirements for Positive Train Control Systems	Signaling and Control	

49 CFR Part 238	Passenger Equipment Safety Standards	Operating Environment; Structure and Crashworthiness; Interior Design; Cab Design; Traction/Propulsion System; Braking System; Door Systems; Lighting; Passenger Information and Communications; On Train Monitor and Recorder; Fire Systems; Bogie Requirements; Signaling and Control; Couplers; High/Low Voltage Electrical Equipment	
49 CFR Part 238 Appendix B	Test Methods and Performance Criteria for the Flammability and Smoke Emission Characteristics of Materials Used in Passenger Cars and Locomotive Cabs	Fire Systems; Unit Safety Principles	As revised for Tier III
49 CFR Part 238 Appendix C	Suspension System Safety Performance Standards	Bogie Requirements	
49 CFR Part 238 Appendix F	Alternative Dynamic Performance Requirements for Front End Structures of Cab Cars and MU Locomotives	Structure and Crashworthiness	As revised for Tier III
49 CFR Part 238 Appendix G	Alternative Requirements for Evaluating the Crashworthiness and Occupant Protection Performance of a Tier I Passenger Trainset	Structure and Crashworthiness	49 CFR Part 238 Appendix G to replace 49 CFR Part 238.203, 49 CFR Part 238.205, 49 CFR Part 238.207, 49 CFR Part 238.211, 49 CFR Part 238.213 and 49 CFR Part 238.219.
49 CFR Part 238 Subpart H	Specific Requirements for Tier III Passenger Equipment	Structure and Crashworthiness; Braking System; Interior Design; Lighting; Cab Design; Bogie Requirements	
49 CFR Part 238 Subpart I	Inspection, Testing, and Maintenance Requirements for Tier III Passenger Equipment	Maintainability	
49 CFR Part 238.15	Movement of Passenger Equipment with Power Brake Defects	Braking System; Maintainability	As referenced by 49 CFR Part 238.803
49 CFR Part 238.103	Fire Safety	Fire Systems; Cab Design; Lighting; On Train Monitor and Recorder; Signaling and Control	
49 CFR Part 238.105	Train Electronic Hardware and Software Safety	Signaling and Control; Cab Design; On Train Monitor and Recorder	
49 CFR 238.111	Pre-Revenue Service acceptance testing plan.	Testing	
49 CFR Part 238.113	Emergency Window Exits	Structure and Crashworthiness; Interior Design	As optioned by 49 CFR Part 238.741
49 CFR Part 238.114	Rescue Access Windows	Structure and Crashworthiness; Interior Design	As optioned by 49 CFR Part 238.741

49 CFR Part 238.115	Emergency Lighting	Lighting	As referenced by 49 CFR Part 238.743
49 CFR Part 238.117	Protection against Personal Injury	Structure and Crashworthiness; High/Low Voltage Electrical Equipment; Cab Design; Lighting; On Train Monitor and Recorder	
49 CFR Part 238.121	Emergency Communication	Interior Design; Passenger Information and Communications	
49 CFR Part 238.123	Emergency Roof Access	Structure and Crashworthiness; Interior Design	
49 CFR Part 238.203	Static End Strength	Structure and Crashworthiness	49 CFR Part 238.703 and 49 CFR Part 238.705 to replace 49 CFR Part 238.203
49 CFR Part 238.205	Anti-Climbing Mechanism	Structure and Crashworthiness	49 CFR Part 238.707 to replace 49 CFR Part 238.205
49 CFR Part 238.207	Link between Coupling Mechanism and Car Body	Structure and Crashworthiness	49 CFR Part 238.707 to replace 49 CFR Part 238.207
49 CFR Part 238.209	Forward End Structure of Locomotives, Including Cab Cars and MU Locomotives	Structure and Crashworthiness	49 CFR Part 238.709 and 49 CFR Part 238.711 to replace 49 CFR Part 238.209
49 CFR Part 238.211	Collision posts strength for Cab and non-Cab end structure integrity	Structure and Crashworthiness	49 CFR Part 238.711 and 49 CFR Part 238.713 to replace 49 CFR Part 238.211 and 49 CFR Part 238.213 238.211 continue to apply to semi-permanently coupled articulated equipment.
49 CFR Part 238.213	Corner Posts	Structure and Crashworthiness	49 CFR Part 238.711 and 49 CFR Part 238.713 to replace 49 CFR Part 238.211 and 49 CFR Part 238.213
49 CFR Part 238.215	Rollover Strength	Structure and Crashworthiness	As referenced by 49 CFR Part 238.715
49 CFR Part 238.217	Side Structure	Structure and Crashworthiness	As referenced by 49 CFR Part 238.715
49 CFR Part 238.219	Truck-to-Car-Body Attachment	Structure and Crashworthiness	As optioned by 49 CFR Part 238.717
49 CFR Part 238.221	Glazing	Structure and Crashworthiness	
49 CFR Part 238.225	Electrical System	Operating Environment; Traction/Propulsion System; High/Low Voltage Electrical Equipment	
49 CFR Part 238.227	Suspension System	Bogie Requirements	
49 CFR Part 238.230	Safety Appliances – New Equipment	Structure and Crashworthiness	
49 CFR Part 238.231	Brake System	Braking System	49 CFR Part 238.731 will govern

49 CFR Part 238.233	Interior Fittings and Surfaces	Structure and Crashworthiness; Cab Design	As optioned by 49 CFR Part 238.733 and inclusive of APTA SS-C&S-006, Rev.1 As optioned by 49 CFR Part 238.735 and inclusive of APTA SS-C&S-016, Rev 2 As referenced by 49 CFR Part 238.735 and inclusive of AAR-RP-5104 As optioned by 49 CFR Part 238.737
49 CFR Part 238.235	Doors	Interior Design; Door Systems	
49 CFR Part 238.313	Class I Brake Test	Braking System	As referenced by 49 CFR Part 238.803
49 CFR Part 238.403	Crash Energy Management	Structure and Crashworthiness	49 CFR Part 238.703 and 49 CFR Part 238.705 will govern
49 CFR Part 238.405	Longitudinal Static Compressive Strength	Structure and Crashworthiness	49 CFR Part 238.703 and 49 CFR Part 238.705 will govern
49 CFR Part 238.407	Anti-Climbing Mechanism	Structure and Crashworthiness	49 CFR Part 238.707 will govern
49 CFR Part 238.409	Forward End Structures of Power Car Cabs	Structure and Crashworthiness	49 CFR Part 238.709 and 49 CFR Part 238.711 will govern
49 CFR Part 238.411	Rear End Structures of Power Car Cabs	Structure and Crashworthiness	49 CFR Part 238.713 will govern
49 CFR Part 238.413	End Structures of Trailer Cars	Structure and Crashworthiness	49 CFR Part 238.713 will govern
49 CFR Part 238.415	Rollover Strength	Structure and Crashworthiness	49 CFR Part 238.715 will govern
49 CFR Part 238.417	Side Loads	Structure and Crashworthiness	49 CFR Part 238.715 will govern
49 CFR Part 238.419	Truck-to-Car-Body and Truck Component Attachment	Structure and Crashworthiness	49 CFR Part 238.717 will govern
49 CFR Part 238.425	Electrical System	Operating Environment; Traction/Propulsion System; High/Low Voltage Electrical Equipment; Cab Design; Lighting; On Train Monitor and Recorder; Signaling and Control	
49 CFR Part 238.427	Suspension System	Bogie Requirements	
49 CFR Part 238.428	Overheat Sensors	Bogie Requirements	
49 CFR Part 238.429	Safety Appliances	Structure and Crashworthiness; Braking System; Door Systems; Couplers	
49 CFR Part 238.431	Brake System	Braking System	49 CFR Part 238.731 will govern
49 CFR Part 238.435	Interior Fittings and Surfaces	Structure and Crashworthiness; Cab Design; Lighting	49 CFR Part 238.733, 49 CFR Part 238.735, and 49 CFR Part 238.737 will govern
49 CFR Part 238.439	Doors	Structure and Crashworthiness;	

		Interior Design; Door Systems	
49 CFR Part 238.441	Emergency Roof Access	Structure and Crashworthiness; Interior Design	
49 CFR Part 238.443	Headlights	Lighting	
49 CFR Part 238.445	Automated Monitoring	On Train Monitor and Recorder; Passenger Information and Communications	
49 CFR Part 238.447	Train Operator's Controls and Power Car Cab Layout	Structure and Crashworthiness; Cab Design	
49 CFR Part 238.501	Scope	Maintainability	49 CFR Part 238.801 will govern
49 CFR Part 238.503	Inspection, Testing, and Maintenance Requirements	Maintainability	49 CFR Part 238.803 and 49 CFR Part 238.805 will govern
49 CFR Part 238.703	Occupied Volume Integrity	Structure and Crashworthiness	
49 CFR Part 238.705	Dynamic Collision Scenario	Structure and Crashworthiness	
49 CFR Part 238.707	Override Protection	Structure and Crashworthiness	
49 CFR Part 238.709	Fluid Entry Inhibition	Structure and Crashworthiness	
49 CFR Part 238.711	End Structure Integrity of Cab End	Structure and Crashworthiness	
49 CFR Part 238.713	End Structure Integrity of Non-Cab End	Structure and Crashworthiness	
49 CFR Part 238.715	Roof and Side Structure Integrity	Structure and Crashworthiness	
49 CFR Part 238.717	Truck Attachment	Structure and Crashworthiness	
49 CFR Part 238.721	Glazing	Structure and Crashworthiness; Cab Design	
49 CFR Part 238.731	Brake System	Braking System; Cab Design	
49 CFR Part 238.733	Interior Fixture Attachment	Structure and Crashworthiness; Lighting	
49 CFR Part 238.735	Seat Crashworthiness (Passenger and Cab Crew)	Structure and Crashworthiness	
49 CFR Part 238.737	Luggage Racks	Structure and Crashworthiness	
49 CFR Part 238.741	Emergency Window Egress and Rescue Access	Structure and Crashworthiness	
49 CFR Part 238.743	Emergency Lighting	Lighting	
49 CFR Part 238.751	Alerters	Cab Design	
49 CFR Part 238.753	Sanders	Bogie Requirements; Braking System	
49 CFR Part 238.805	Periodic Tests; Brake Systems	Braking System	
49 CFR Part 239	Passenger Train Emergency Preparedness	Structure and Crashworthiness; Interior Design; Fire Systems; Door Systems; Unit Safety Principles	
49 CFR Part 239.101	Emergency Preparedness Plan	Interior Design; Fire Systems	
49 CFR Part 239.107	Emergency Exits	Structure and Crashworthiness; Interior Design; Door Systems	
49 CFR Part 240	Qualification and Certification of Locomotive Engineers	Driving Simulator; Quality Software Assurance	
49 CFR Part 240.7	Definitions	Driving Simulator; Quality Software Assurance	
49 CFR Part 270	System Safety Program Plan	Unit Safety Principles	
49 CFR Part 393.77	Heaters	Heating, Ventilation, and Cooling	
49 USC 20107	Inspection and Investigation	Cab Design	

49 USC 20302	General Requirements		
49 USC 20306	Exemption for Technological Improvements		
APTA SS-E-013-99	Emergency Lighting		
APTA SS-M-014-06	Standard for Wheel Load Equalization of Passenger Railroad Rolling Stock	Bogie Requirements	As required by FRA Safety Advisory 2013-02; Class R
APTA SS-PS-002-98	Emergency Signage		
APTA SS-PS-004-99	Low Level Exit Path Marking (LLEPM)		
DOT/FRA/ORD-11/22	Technical Criteria and Procedures for Evaluating the Crashworthiness and Occupant Protection Performance of Alternatively-Designed Passenger Rail Equipment for Use on Tier I Service	Structure and Crashworthiness	
ETF_001-02	Proposed Ruletext for NPRM	Structure and Crashworthiness	
ETF_016-03	Tier III Cab Glazing Task Group Recommendations	Structure and Crashworthiness	
FRA-2006-25273	Passenger Train Emergency Systems II; Proposed Rule		
FRA-2007-0010	APTA Petition to FRA to Use APTA SS-M-016-06 for "Cars of Special Construction"	Door Systems	
FRA-2009-0036, Notice No. 2	Vehicle/Track Interaction Safety Standards; High Speed and High Cant Deficiency Operations	Bogie Requirements	
FRA-2011-0060	System Safety Program Plan	Unit Safety Principles	
FTA-IT-90-5001-02.1	Quality Assurance and Quality Control Guidelines	Quality Software Assurance	
FTA-VA-90-1003-06	Transit Noise and Vibration Impact Assessment	Noise and Vibration	
GM/RT 2100 (Issue 4, December 2010)	Requirements For Railway Vehicles Structures	Structure and Crashworthiness	
MP&E 98-14	Safety Appliance Securement	Structure and Crashworthiness	
NFPA 130	Standard for Fixed Guideway Transit and Passenger Rail Systems	Fire Systems	

12.2 APPENDIX B – AMTRAK INFRASTRUCTURE INTERFACE SPECIFICATION

12.2.1 Introduction

Trainsets proposed for Amtrak Next Generation High Speed Rail Procurement project shall be designed and manufactured to operate on the Northeast Corridor as it is presently configured.

Amtrak train service information, network information, clearances and restrictions, and other related information is given in this document and is applicable to Amtrak Next Generation high speed rail services on the Northeast Corridor. Except if otherwise stated, the Trainset shall be compliant and compatible with the requirements of this Interface Specification.

12.2.2 Climatic Conditions

a) Salt, ice, severe dust and iron particle laden wind conditions, with severe lightning storms, snow and driving rain occur in the areas in which trains shall operate.
b) The altitude at which the trains shall operate ranges from 30.5 m (100 feet) below sea level to 182.9 m (600 feet) above sea level.
c) Trains shall operate continuously in a relative humidity as high as 100%.
d) Unless Specified otherwise in the technical Specification, the maximum air temperature is 43 °C (109.4 °FDB) and the minimum air temperature is -25 °C (-13 °FDB) in the areas in which trains shall operate.
e) Snow conditions are seasonal.
f) The maximum rainfall in 24 hours is 26 cm (10.36 inches) and the maximum snowfall in 24 hours is 60 cm (23.6 inches) in the areas in which trains shall operate.
g) The environment in which the trains operate is highly industrialized and therefore air pollution will be high.
h) Extremely severe electric storms are frequent in the summer months.

12.2.3 Track Geometry

The following is a description of the Northeast Corridor rail line geometry on which the Trainsets shall be able to operate:

a) Except when modified below the minimum requirements of 49CFR Part 213 track Safety standards, Trainsets must be able to operate on the minimum requirements of 49CFR Part 213 for each speed range defined for each class of track.
b) Horizontal curves or radius equal to or greater than 100 m (328 feet).
c) No. 8 crossovers per Amtrak Drawing No. AM 73195-A on 3.6 mm (12 feet) track centers. (Attached to this Specification).

d) A Trainset, or Trainsets operating in multiple-traction, shall be capable of negotiating facing No. 8 turnouts per Amtrak Drawing No. AM 73195-A arranged to form an "S" curve with a minimum of 1.5 m (5 feet) of tangent between switch points.
e) Vertical curves with 0.5% change in grade per 30.5 m (100 feet) on main lines.
f) Vertical curves with 2% change in grade per 30.5 m (100 feet) in yards when train sets have no passengers and any single point suspension Failure.

12.2.4 Rail Profiles

The Northeast Corridor utilizes four unique rail profiles based on Operating Speeds. The rail profile details and properties can be located in the "Amtrak Rail Profile" file attached to this Specification.

12.2.5 Wheel Tread Profile

a) The Contractor shall recommend a wheel profile that is compatible with the infrastructure, including special trackwork and provides safe dynamic performance at all speeds and under worn wheel/rail conditions.
b) The wheel flange angle shall meet the limiting flange angle criteria in APTA PR-M-S-015-06PR-M-S-015-06.
c) Note: The Amtrak wheel profile attached to this Specification is for reference only.

12.2.6 Vertical Alignment

The minimum design standards for grades are:

a) The steepest gradient for main lines is 2%.
b) The steepest gradient in storage yards is 2.5%.
c) The steepest gradient for parking brake use is 6%.

12.2.7 Clearances

a) The horizontal and vertical Vehicle clearance outlines are shown on Amtrak Drawing D-05-1355 Rev. E. The Trainset shall remain within the clearance outline under the worst-case combination of dynamic excursion, wear, and Failure of any one suspension element as well as through the full range of motion of the tilt System (if applicable).
b) The Vehicle floor height above TOR shall be 1295.4 ± 6.35 mm (51±0.25 inches).
c) All high-level station platforms are built to 1.7 m (5.58 feet) from centerline of track, and to a height of 1219 mm (48 inches) above TOR. Vehicle clearance shall be maintained to Amtrak Diagram 05-1355 Rev. E under all operating conditions. Fixed door thresholds shall be designed such that they do not produce a gap of more than 178 mm (7 inches) while remaining within the limits of Amtrak Diagram 05-1355 Rev. E. Retractable gap fillers incorporated into the passenger side door

design will be considered and if used must be designed to carry up to 453.6 kg (1,000 lb.) live load.

12.2.8 Wayside Power

NEC wayside power facilities consist of 480 VAC, 3-phase, 60 Hz, 800A power stations. Power receptacles are compatible with Amtrak Drawing D-12-7191. Drawing D-12-7191 is attached to this Specification.

12.2.9 Trainwash Facilities

Description of trainwash facilities and requirements can be found in the "Amtrak Trainwash Facilities" file attached to this Specification.

12.2.10 Wheel/Rail Dynamics, Stability, and Ride Quality

Trainset design and interaction with the NEC infrastructure shall assume and be consistent with the following:

a) Trainset dynamic behavior must be qualified per 49CFR Part 213.345 at 8 km/h (5 mph) above maximum intended Operating Speed.
b) ISO 2631-1.
c) APTA PR-M-S-014-06 –compliance with Class R is required.
d) Maximum Cant Deficiency operation up to 127 mm (5 inches) for a non-tilt train and up to 254 mm (10 inches) for a tilting train provided the tilting System compensates for quasi static lateral accelerations exceeding 0.06g.

12.2.11 Traction Power Supply

a) The Northeast Corridor has three operating voltages:
    a. 12 kV, 25Hz +10/-30 %.
    b. 12.5 kV, 60Hz +10/-30 %.
    c. 25 kV, 60Hz +10/-30 %.
    d. In normal Operations, line current available is no greater than 1200 A.

b) Appropriate switchgear, transformer windings and controls shall be provided for an automatic transition between the 12 kV, 12.5 kV, and 25 kV Systems. Transition shall be possible at any speed. Rheostatic braking and regeneration into the Trainset auxiliary power or controlling Systems shall remain in operation. When the Trainset senses catenary voltage again, the System shall identify the line voltage range, connect the transformer windings appropriately, reclose the breaker, and restore traction or Electric Brake to Normal operation. The transition shall be completed in the minimum possible time. Indications of the transition shall be provided to the Operator through the TMDS. Each Vehicle shall negotiate the transition independently. The transition System shall be wired to receive the signal to initiate transition from the PTS System initially.

c) The propulsion System shall be designed to operate with a limit of 5 MW of regenerative power. Total available capacity shall be sized to 8 MW regenerative power capability pending future NEC infrastructure development.

d) During Regenerative Braking, when the catenary is non-responsive prohibiting regeneration of braking energy, or regenerated power level exceeds 5 MW, the maximum practical amount of non- dissipated residual energy should be captured in an energy storage System (i.e., bank of ultra-capacitors). This energy could be used during peak demand (acceleration phase) or during phase breaks/loss of catenary power. The Contractor shall ensure that maximized braking regeneration shall not increase catenary voltage beyond Amtrak's safe limits.

12.2.12 Pantograph Contact Wire Interface

a) The pantograph shall not exceed a height of 4.4 m (14.5 feet) above TOR when in the locked down position (Amtrak Clearance Diagram D 05-1355).

b) The pantograph shall track the catenary wire at all speeds up to 265.5 km/h (165 mph) on Mainline track, with a gradient equal to 1/5 times the speed (in mph), and in conjunction with three overhead contact system designs, these are: The new constant Tension OCS currently under design for the New Jersey High Speed Rail Improvement Program, the current fixed termination OCS, and the Northend Electrification constant tension OCS. The dynamics between the pantograph and the OCS shall be validated in accordance with the most current version of specification BS EN 50318 and by field test measurements of the three types of OCS according to most current version of specification BS EN 50317.

c) Wire heights throughout the NEC range from 4.5 m (14.83 feet) to 6.7 m (22 feet) on Mainline track and up to 7.3 m (24 feet) in yard speeds.

d) Proper overhead wire contact requires a shoe width over end horns of 1994 mm (78.5 inches) and a working contact surface width of 1321 mm (52 inches).

12.2.13 Electromagnetic Compatibility

The Next Generation Trainset shall be compliant and compatible with the applicable parts of the following:

a) IEC-61000-4-3.
b) Amtrak Drawing A-60-7659. (Drawing is attached to this Specification).
c) FCC standards.
d) APTA PR-E-S-010-98.

12.2.14 Noise

The Next Generation Trainset shall be compliant and compatible with the applicable parts of the following for operation on the NEC:

a) 40CFR Part 201.
b) 49CFR Part 210.
c) 49CFR Part 229.
d) 49CFR Part 213.
e) 49CFR Part 238.

12.2.15 Signaling and Train Control

The NEC infrastructure, Operations and rolling stock are compatible with the following regulations and standards. The Next Generation Trainset shall be compliant and compatible with the applicable parts of the following for operation on the NEC:

a) 49CFR Part 229 Subpart E.
b) 49CFR Part 236 Subpart I.
c) 49CFR Part 238.105.
d) 49CFR Part 238.117.
e) 49CFR Part 238.425.
f) 49CFR Part 238.445.
g) Appendix G of this Specification.

12.3 APPENDIX C – AUTHORITY INFRASTRUCTURE INTERFACE SPECIFICATION

12.3.1 Introduction

Trainsets for the Authority Trainset Procurement shall be able to operate on the planned high speed rail System on both dedicated and shared (blended Operations) right-of-ways.

Authority Trainset-to-core System Interfaces, Authority infrastructure designs, clearances and restrictions, and other related Interface requirements and information are Specified in this appendix and shall apply to Authority Trainsets and rail services on the planned California High Speed Train System (CHSTS).

12.3.2 Verification and Validation

The Contractor shall develop and implement a Verification and Validation (V&V) process to confirm to the Authority that by examination and provision of objective evidence, the technical Contract requirements (verification) and the requirements for specific intended use (validation) have been fulfilled.

Systems Engineering Management Approach: The Contractor shall develop a Systems Engineering Management Plan (SEMP). The SEMP shall address the Technical, Project, Agreement, and Organizational Project Enabling Processes as applicable for a Trainset Procurement project in accordance with INCOSE Systems Engineering Handbook and the ISO/IEC 15288. Change/Configuration Management shall follow the general provisions of the ISO/IEC 10007. The SEMP shall address the Contract life cycle phases, stakeholder coordination, inputs, outputs (deliverables), tools and methods used for each phase, activities for each deliverable, roles and responsibilities, and metrics used to measure and report progress.

Requirements Management Tool: The Contractor shall parse, capture, document, analyze, derive, apportion, trace, manage, verify, and validate the technical Contract requirements using a Requirements Management (RM) tool. Technical Contract requirements are defined as Contract requirements specifying the characteristics of the final Trainset deliverable including related design, production, testing, commissioning, and acceptance requirements. The RM tool shall be IBM Rational DOORS, version 9.5 or later. The Contractor shall manage the design, production, testing, commissioning, and acceptance documents in the RM tool to allow the export of Requirements Verification Traceability Matrices (RVTM) and Certifiable Items Lists (CIL). The Contractor shall submit the RM tool database monthly and provide the Authority's representative with full real-time readability web access.

Requirements Verification Traceability Matrix (RVTM): The Contractor shall demonstrate compliance to the technical Contract requirements using the RVTM. The RVTM shall identify the appropriate section references to the design, production, testing, commissioning, and acceptance documents for each technical Contract requirement. The RVTM shall be managed within the RM tool. Appropriate section references to these documents shall explain how each technical Contract requirement is met, tested, and accepted by the Contractor's design and production. The Contractor shall submit an RVTM including the applicable technical Contract requirements with each technical Contract submittal. Technical Contract submittals are defined as the Contract submittals that address the technical Contract requirements.

Certifiable Items List (CIL): The Contractor shall demonstrate compliance to the critical items using CILs and manage the CIL in the RM tool. Critical items are a subset of the technical Contract requirements, and include the following: CHSTS performance requirements (such as RAMS), applicable environmental requirements and mitigations as found in the environmental documents including EIR/S, ROD, permits, and Approvals; Safety requirements including Hazard mitigations; security requirements including threat mitigations; and interoperability items with other CHSTS Contracts. CILs shall be tailored as needed for the specific certification processes, such as for Safety and security certifications, including management of preliminary Hazard analyses (PHA) and threat and vulnerability assessments (TVA). CIL shall be developed based on the RVTM, with extra columns or fields to include the date and initials of the verifier, certifying that the critical item has been incorporated into the design and production, tested, commissioned, and accepted as appropriate at each stage of development. The Contractor shall submit a CIL including the applicable critical items with each technical Contract submittal.

V&V Report: The Contractor shall provide a V&V report that accompanies every technical Contract submittal. The report shall be used to provide an executive summary and certification of compliance with the technical Contract requirements. Additional explanation shall be provided, as necessary, on how the technical Contract submittal meets the technical Contract requirements that are not readily available from the RVTM or CILs. Variances between the technical Contract requirements and the technical Contract submittal shall be explicitly identified and discussed. The certification of compliance shall include the confirmation that the references to the objective evidence provided in the RVTM and CILs have been checked by the Contractor's QA/QC process, and have been confirmed as complete and correct. The Contractor may choose to provide the content of the V&V report as part of the submittal letter.

Independent Conformity Assessment: The Contractor shall retain the services of qualified independent engineering consulting firm(s) to serve as its Independent Checking Engineer (ICE) and Independent Testing Engineer (ITE) performing Independent Verification and Validation (IV&V) for the duration of the Contract. The ICE/ITE shall not be associated in any way with, or be a subsidiary or affiliate of, any other firm engaged by the Contractor to perform any other Work under this Contract. The ICE/ITE shall not be involved in producing design documents or conducting production site supervision for the Contract. The ICE/ITE shall not Work directly for nor report to the Contractor's Project, Engineering/Design, Production, or Test Manager. The ICE/ITE shall be directly responsible to and report to senior management or similar level of the Contractor's organization not directly responsible for engineering/design, production, or testing. Furthermore, the ICE/ITE shall report directly to the Authority's representative. Each technical Contract submittal shall be fully checked by the ICE during design and by the ITE during production before submittal to the Authority. The ICE/ITE shall assess and evaluate the technical Contract submittals in order to be able to certify that the design meets the Contract requirements. The ICE/ITE shall submit the assessment report and certification to the Authority with a copy to the Contractor. The IV&V shall not relieve the Contractor from carrying out all the checks and reviews that a professional and prudent Contractor would normally carry out for the type of Work of this Contract.

12.3.3 Interface Management and Coordination

This Contract is part of the CHSTS project. Many external Interfaces and dependencies exist between this Contract and other project Contracts, including the guideway, trackwork, stations, storage and Maintenance facilities, traction electrification, signals, communications, and Operations, Maintenance, Safety, and security. These apply to the dedicated high speed train corridors as well as shared-corridors.

Interface Management: As part of the SEMP, the Contractor shall develop and implement a comprehensive Interface management (IM) process, defining how interfaces are identified, Specified, implemented, verified and validated, integrated, and certified. The IM process shall describe the management of both inter-contract as well as intra-contract Interfaces.

Interface Register: The Contractor shall create an Interface register with the contents in an Interface breakdown structure (IBS), including the following:

a) Level 1: Other project Contracts interfacing with this Contract.
b) Level 2: Subsystems of other project Contracts (e.g., civil, traction power, Operations, etc.).
c) Level 3: Interface categories (e.g., loads, clearances, spatial needs, Data Interfaces, etc.).
d) Level 4: Actual Interfaces.

The Contractor shall populate the Interface register initially with the Interfaces identified in HS RST TSI Section 4.3 (Functional and technical Specification of the Interfaces).

The Contractor shall manage the Interfaces top-down (e.g., the proposed Trainset dynamic envelope shall be compliant with the imposed CHSTS Trainset static and dynamic envelopes (Level 4) as identified in the Design Criteria Manual (DCM). Place the Interface in the guideway (Level 1) / trackway clearances (Level 2) / Vehicle clearance envelope (Level 3) category. Subdivide Interfaces if needed.). The Contractor shall manage the Interface register in the RM tool. All Interfaces are considered critical items. The Contractor shall demonstrate compliance using CILs.

Interface Control Documents: The Contractor shall develop an Interface Control Document (ICD) for each Interface, identifying the applicable Interface requirements, corresponding Interface design, and the planned Trainset V&V. An ICD shall provide a sufficient level of detail for independent conformity assessment and independent development and implementation of the interfacing entity. Many Interfaces are initially defined on a performance level. The Contractor shall Work with the interfacing Contracts and the Authority's representative in defining the details of each Interface as required for the ICDs. In the event that interfacing Contracts have yet to be executed, the Contractor shall Work with the Authority's representative in defining the details of each Interface as required for the ICDs.

The Authority's representative shall have the right to reject proposed Interface points if any of the following conditions apply:

a) An open Interface cannot be provided.
b) Proposed Interfaces will preclude effectively competitive Procurement in the future (e.g., due to a proprietary Interface).
c) Systems integration with a future Contract is deemed to be a high-risk.
d) CHSTS performance requirements are not met.

Interface Workshops: The Contractor shall form an Interface Control Team (ICT) and conduct regular Interface coordination workshops (ICW) with the Authority, interfacing Contractors, third parties, and other entities no less than monthly, or at other times as required.

a) The ICW will be used to discuss the specifics of the Interfaces, resolution of conflicts, and to monitor and track the incorporation of the Interfaces.
b) The ICT will demonstrate that the Trainset is being designed and executed such that facilities and Subsystems identified in the design criteria, Specifications, and/or drawings are being accommodated without functional or spatial constraints.
c) The workshops shall be used to identify new Interfaces which may affect the design, construction, and production, and to reach a common agreement on the management approach to addressing the Interface and any possible constraint on this or future Contract(s).
d) New Interfaces will be incorporated into the Interface register of the RM tool.

Progress Reporting: The Contractor shall produce and present a matrix or tracking sheet for the workshops that provides updates, activities and responsible parties of Interface and integration activities. The Contractor shall produce output reports from the RM Tool to demonstrate progress on Interface and integration activities.

12.3.4 Applicability of Authority's Design Criteria Manual

The Contractor shall use the Authority's DCM to define requirements for applicable Trainset interfaces. The Contractor shall work with the Authority in defining the requirements and interfaces within the DCM that are mandatory and applicable to the Trainset.

The Contractor shall be responsible for compliance with requirements of the DCM as specified in this Section. Variance to the requirements of the DCM shall be approved by the Authority.

12.3.5 System Alignment

The CHSTS segment from San Francisco to Los Angeles/Anaheim is approximately 840 km (520 mi). Future extensions to Sacramento and San Diego will complete the 1300 km (800 mi) System. The majority of the track is dedicated to high speed rail; however, there will be sections of corridor and/or track that will involve operation at lower speeds and sharing tracks with other rail Equipment and Operators.

A train consisting of a single Trainset or two coupled Trainsets shall operate satisfactorily over the entire System, inclusive of crossovers, sidings, station platforms, Maintenance facilities, etc.

12.3.6 Climatic and Environmental Conditions

The Trainset shall be able to operate in all climatic and environmental conditions present on the Authority's network. The Contractor shall demonstrate that the Trainset Equipment and Subsystems meet the performance requirements of the DCM to protect against the following, at a minimum, at the maximum Operating Speed:

a) Ingress and consequent damage, by water, dirt, dust, sleet, snow, ice, organisms, etc.
b) Heat degradation and/or power limitation while operating on gradients.
c) Damage by salty or polluted air.
d) Damage by flying ballast or similar objects from the track bed.
e) Damage by electrical spikes and surges to electrical and electronic Equipment.
f) Damage caused by lightning strikes or electromagnetic interference (EMI).
g) Seismic activities.
h) Heat and condensation.
i) Relative humidity.
j) Sudden changes in air temperature, particularly occurring when entering and leaving tunnels.
k) Changes in air pressure, particularly when entering and leaving tunnels.
l) Formation of ice on Equipment installed both inside and outside of the Trainset.
m) Noise and vibration.
n) Vandalism and debris strikes.
o) Damage by birds in flight or animals at ground level.

Trainset shall be able to operate in the following environments:

a) The altitude at which the Trainsets shall operate is between 43 m (140 feet) below sea level and 1400 m (4,600 feet) above sea level.
b) The external ambient air temperature in areas in which the Trainsets shall operate can range from -25 °C (-13 °F) to 50 °C (122 °F). External ambient air temperature in special locations (e.g., near the ballast, over the roof, etc.) may exceed the temperature identified and shall be accommodated in the design of the Equipment.
c) A maximum speed of wind shall be taken as 35 m/s (78 mph). Higher wind speed, up to a maximum of 50 m/s (112 mph), may occur.
d) A maximum rainfall in 24 hours of 26 cm (10.4 inches) and a maximum snowfall in 24 hours of 60 cm (23.6 inches) shall be accounted for in the areas in which Trainsets shall operate. The effect of rain and snow shall be considered, depending on the Equipment installation, together with wind and car movement.

e) Snow accumulations and other climatic characteristics occurring in Tehachapi, California (zip code: 93581) shall be accommodated. This location serves as the highest elevation on the Authority's dedicated right-of-way.
f) Equipment exposed to the effects of solar radiation shall remain unaffected. For Equipment directly exposed to solar radiation, the maximum level shall be considered as 1200 W/m^2 (380 $Btu/hour/ft^2$).

12.3.7 Seismic Events

The Trainset performance shall be designed to meet requirements of DCM Chapter 11 – Seismic, Section 11.5.1 (Seismic Performance Criteria) and Section 11.5.2 (Design Earthquakes) with consideration for the following key criteria:

a) Upon notification of an Operating Basis Earthquake (OBE) (86% probability of exceedance in 100 years), the Trainsets shall be able to brake safely from maximum Operating Speed to a complete stop. Post-event resumption of service (potentially with reduced speeds) shall be possible within several hours.
b) Under the Maximum Considered Earthquake (MCE) (10% probability of exceedance in 100 years), passenger Safety shall be maintained throughout the seismic event. In the event of a derailment, passengers shall be able to evacuate from the train safely after such event.

The Contractor shall provide Trainset System Specifications and Analysis methodology for ensuring that train operation and Safety performance requirements under OBE and MCE events can be met. Both Specifications and Analysis methodology must be shown to apply for the entirety of the Authority alignment, considering the range of subsurface conditions and seismic Hazard variations, as well as the range of permitted infrastructure designs per project design criteria.

Trainset System Specifications shall include dynamic Trainset characteristics and component details necessary for meeting seismic performance requirements. These dynamic characteristics and component details shall be supported by results from the proposed Analysis methodology and other calculations, as applicable. Trainset System Specifications shall include train operation processing Systems and procedures for response to seismic early warning Systems.

12.3.8 Electromagnetic Compatibility

The generation and distribution of electrical energy can interfere with onboard, wayside, and neighboring Equipment by conduction through the overhead contact System (OCS) and rail, by inductive coupling, and by electromagnetic radiation. In addition, onboard Equipment can interfere with onboard, wayside, and neighboring Equipment located on the CHSTS.

Trainset electromagnetic compatibility (EMC) provisions shall ensure the following:

a) Safe and dependable operation.
b) No interference within the train and with passenger Equipment on the train, with the ATC System, with or from radio communications, or with or from neighbors.
c) Compliance with human exposure limits including magnetic and electric fields and step and touch potentials.

Trainset Equipment shall conform to electrical Safety requirements. Design and Maintenance provisions shall ensure that EMI cannot compromise the Safety level of Operations achieved by the train System.

The Contractor shall document the achieved level of compliance of their Equipment to designated standards.

The Trainset shall comply with all criteria and design provisions of the DCM Chapter 26 – Electromagnetic Compatibility and Interference, Section 26.9 (Rolling Stock EMC Design Criteria) , including Section 26.9.8.2 (Current and Voltage Distortion Limits).

The Contractor shall manage the EMC interfaces between the Trainset and CHSTS elements per Section 12.3.3, Interface Management and Coordination.

12.3.9 Environmental Assessment

The Contractor shall perform an environmental assessment to determine those issues that may give rise to impacts on the environment. The Contractor shall, at a minimum, complete the following:

a) Collect Data to assess baseline conditions (e.g., actual noise, vibration, and air quality).
b) Review all available/relevant information and scheme options within the context of the issue being assessed.
c) Provide mitigating solutions.
d) Develop procedures for interior and exterior noise and vibration assessment and prediction models.
e) Develop noise and vibration prediction model software.

12.3.10 Track Geometry

Trainsets shall be able to operate on, at a minimum, the requirements of 49CFR Part 213 for each speed range defined for each class of track and up to the maximum testing speed of 390 km/h (242 mph) on Class 9 track.

Refer to DCM Chapter 4 – Track Geometry for requirements pertaining to required Trainset attributes and the Authority's rail line geometry on which the Trainset shall be able to operate.

In addition, the following Trainset requirements shall be met:

a) Trainsets shall accommodate a minimum horizontal curve radius of 175 m (575 feet).
b) Trainsets shall be able to operate on number 11 turnouts that will be used as the standard yard turnout. Number 9 turnouts may be used where geometric constraints make the use of Number 11 turnouts impractical.

12.3.11 Gradients

Trains shall be able to start, operate, and stop on the maximum gradients on all the lines for which they are designed and over which they are likely to operate. Refer to DCM Chapter 4 – Track Geometry, Section 4.5.1 (Maximum Grades) for requirements pertaining to required Trainset operating grades with one exception listed below:

a) In mountainous area of the alignment (Bakersfield to Palmdale segment), an average grade over any 9.7 km (6 mi) of line will not exceed 3.5%.

12.3.12 Wheel/Rail Interface

The Authority's System will utilize continuously welded rail for dedicated high speed tracks. The proposed Trainset wheel profile shall be fully compatible with the system rail profile. The Trainset shall be capable of satisfactory Operations on the system track under all conditions.

The Contractor shall be responsible for specifying the wheel/rail Interface criteria (e.g., wheel profile, back-to-back dimensions, etc.) to provide smooth and safe movement of the Trainset, and of two Trainsets coupled together, at all speeds and track conditions experienced on the Authority's network.

The Contractor shall survey existing rail profiles in shared track territories and take this Data into consideration when optimizing wheel/rail Interface criteria.

The Trainset shall generate minimum damage to the track, inclusive of rolling contact fatigue and wear.

Space and/or Equipment shall be provided on the Trainset for the autonomous inspection of track (refer to Section 8.17.4). Track geometry shall be measured on a regular basis to determine the condition of the track and Maintenance required.

Refer to DCM Chapter 4 – Track Geometry and Chapter 5 – Trackwork for additional information.

12.3.13 Ride Comfort

Ride comfort shall be evaluated in accordance with the requirements identified in Section 8.19.10. The lateral and vertical comfort indices shall be defined by the Contractor and shall be a weighted acceleration. The Contractor shall define all filters, types, and bandwidths utilized in deriving the weighted acceleration.

Any vibration that is caused by Equipment operation (e.g., compressors, blowers, electromagnetic Equipment, circuit breakers, motors, etc.) and emitted by the Trainset shall not be a source of discomfort to the passengers.

12.3.14 Track Structure

The continuous minimum length of any trackform will not be less than the minimum length of alignment segment for a run time of 1.8 seconds at the design speed of the segment.

Both ballasted and non-ballasted track forms will be used. The rail section proposed for new tracks is 141RE. Other rail sections will be found in shared (blended operation) corridors.

The track modulus will be in the range of 20.7 MPa (3,000 lb/in/in) and 27.6 Mpa (4,000 lb/in/in).

Refer to DCM Chapter 5 – Trackwork for additional information.

12.3.15 Additional Rail Sections

Switch rails will be of the EN 60E1A3 section.

Check rails will be of the 33C1 (U69, UIC33, and RL 1-60) section.

12.3.16 Other Track Material

Fixed bumping post, similar to the Hayes type, will be installed at the end of track in yards and shops, and other tracks where the design speed for trains or Equipment is 32 km/h (20 mph) or less.

Bumping posts having either hydraulic or friction Devices allowing a movement of not less than 3.1 m (10 feet) will be used at the ends of all tracks that are designed to carry revenue trains. The bumping post will be capable of stopping a 400 m (1,312 feet) Trainset at a speed of 8 km/h (5 mph).

Each track that connects with a track carrying revenue passenger trains will be equipped with a switch point derail that is interconnected with the signal and train control system.

12.3.17 Static Axle Load

The Contractor shall design the Trainsets to achieve the lightest axle load compatible with meeting the functional and technical requirements identified.

The maximum static axle load on the track shall be 17 tonnes (18.75 tons) and shall meet the requirements for full load condition Specified in Section 8.2.2.

The maximum total static axle load of the train (total mass of the train) shall not be greater than 102% of the sum of all static axle loads of the train.

The maximum individual static axle load of any axle shall not be greater than 104% of the individual static axle load.

The difference in static wheel load between any wheel on the same Bogie or running gear shall not exceed 6% of the average wheel load of that Bogie or running gear.

Individual static axle loads shall not be less than 5 tonnes (5.5 tons).

12.3.18 Clearances

Authority Trainsets shall comply with the static gauge and the corresponding dynamic envelopes identified in DCM Chapter 3 – Trackway Clearances, Section 3.4 (Vehicle Clearance Envelopes) including appendices.

The Contractor shall demonstrate that the Trainset will not strike any wayside object, structure, platform, or passing train during operation, under all conditions identified below, at a minimum:

a) All Trainset load conditions.
b) All permissible wheel diameters.
c) All body build and suspension tolerances.
d) All Maintenance tolerance conditions (e.g., worn wheels, deflated or over-inflated air springs).
e) Damaged suspension components and structural detachments.
f) Track geometry tolerances.
g) All permitted speeds.
h) All aerodynamic effects (e.g., passing trains and wind effects).

12.3.19 Horizontal Clearances

Refer to DCM Chapter 3 – Trackway Clearances, Section 3.3.2 (Horizontal Clearances) for Trainset horizontal clearance requirements.

12.3.20 Vertical Clearances

Refer to DCM Chapter 3 – Trackway Clearances, Section 3.3.1 (Vertical Clearances) for vertical clearance requirements.

12.3.21 Track Center Spacing

Refer to DCM Chapter 3 – Trackway Clearances, Section 3.5 (Track Center Spacing) for track spacing requirements.

12.3.22 Platforms

Refer to DCM Chapter 14 – Stations, Section 14.3.2 (Platforms) for requirements of operating a Trainset at the station platform.

12.3.23 Tunnels

Authority tunnels will be designed to allow for train Operations at speeds of up to 354 km/h (220 mph).

Refer to DCM Chapter 13 – Tunnels, Section 13.3.4 (Tunnel Configuration) for considered tunnel configurations.

Refer to DCM Chapter 13 – Tunnels, Section 13.3.5 (Clearances) and Section 13.3.6 (Walkways) for requirements of clearances and walkways installed in the tunnels.

Refer to DCM Chapter 13 – Tunnels, Section 13.3.12 (Aerodynamic Considerations) and Section 13.3.13 (Minimum Tunnel Cross-Sectional Areas) for requirements on aerodynamic considerations, minimum tunnel cross-sectional areas, and for additional information.

12.3.24 Highway-Rail Grade Crossings

There will be no public highway-rail grade crossings on the dedicated portion of the system and the right-of-way will be fully access-controlled. Use of private highway rail grade crossings in the dedicated system will be limited to Authority Operations and Maintenance (O&M) personnel and will be controlled.

Level crossings will be encountered in shared territories where speed will be limited to a maximum of 201 km/h (125 mph). The Contractor shall demonstrate how the Trainset design will limit damage to the Trainset and enhance the Safety of the passengers and crew in the event of a collision with a highway Vehicle.

12.3.25 Emergency Egress

A method for emergency egress through external doorways shall be provided in each Vehicle (per the requirements of Section 8.2.16), capable of reaching all Authority walkway configurations (as defined in DCM Chapter 3 – Trackway Clearances). Devices to assist in evacuations at doorways (portable ladders, stairwells, etc.) shall be located in close proximity to doorways and stowed in readily accessible cabinets. Evacuation Devices shall be designed for deployment by passengers of average size and strength without the assistance of onboard crewmembers. Evacuation methods shall not require an external power source for activation.

Emergency egress though windows shall be in conformance with the requirements of Section 8.2.17.

12.3.26 Hazard Risk Assessment Criteria

The risk associated with Safety Hazards shall be assessed in conformance with the CHSTS Technical Memorandum 500.06 – Hazard Risk Acceptance Program. The Authority's Hazard Risk Acceptance Program will be refined and developed as requirements mature. The Contractor shall review the amended documents and shall ensure that the assessments performed are consistent and in conformance with the latest version of the Authority's Hazard Risk Acceptance Program Acceptance of residual risk is the responsibility of the Authority and must be consistent with the development of the balance of the System.

12.3.27 Fire Detection and Suppression

A fire detection system shall monitor for the presence of fire in passenger and crew compartments, electrical cabinets, and undercarriage compartments. Authority Trainsets shall be equipped with a fire suppression system to mitigate the effects of fire in passenger and crew compartments, and interior and undercarriage electrical compartments. The fire suppression system will enable the train to move to a point where passengers can be evacuated to a place of safe refuge.

The fire detection system shall be interfaced with the wayside fire alarm system. Refer to DCM Chapter 29 – Rolling Stock-Core Systems Interfaces, Section 29.7 (Communications Interfaces) for Interface requirements for the fire detection system.

12.3.28 Energy

The Trainset shall be energy efficient such that the power drawn from the traction supply is minimized when the Trainset is in operation and when stored in yards.

The Trainset shall be capable of controlling the impact of its demand for power on the quality of supply. The Trainset shall be complete with the required line filters, power factor Equipment, and harmonic filters to maintain the quality of supply for other Trainsets in the section.

Trainset propulsion and auxiliary Equipment shall be designed for operation at the OCS voltages without damage, Failure of the Equipment to function, or reduction of required service life.

Carborne Equipment shall be protected against damage from continued shutdowns caused by random interruptions of the OCS power due to isolation gaps, pantograph bounce, or other conditions. Under these conditions, the Equipment shall recover automatically without delay to restart.

Trainset Equipment shall be protected from transient voltages or when the OCS is subjected to lightning strikes.

For operation under reduced voltage conditions, the Trainset shall provide forced reduced performance further limiting the Trainset maximum line current. The operation of this

performance feature shall be automatic and controlled solely by the level of the line voltage at the Trainset. Refer to Section 12.3.30.

12.3.29 Traction Power Supply System

The traction power supply system (TPS) is described in DCM Chapter 20 – Traction Power Supply System.

The Trainsets shall be capable of operating on the 25 kV ac overhead contact system (OCS) and function normally for the range of system voltages detailed in DCM Chapter 20 – Traction Power Supply System, Section 20.6.1 (System Voltage) and Section 20.6.2 (Voltage Related Requirements).

The Trainset shall function normally for the range of system frequencies detailed in DCM Chapter 20 – Traction Power Supply System, Section 20.6.3 (Frequency).

12.3.30 Train Power and Current Limitation

The Trainset shall be designed to conform to train power and current limitations Specified in DCM Chapter 29 – Rolling Stock-Core Systems Interfaces, Section 29.4.3 (Train Power and Current Limitation).

For system voltages below 17.5 kV, auxiliary power shall be reduced linearly from 17.5 kV. The low voltage OCS block for the auxiliary power supply (APS) shall be set by the Contractor. The Contractor's design shall reduce the output voltage and frequency of the APS first prior to blocking the APS converter.

12.3.31 Regenerative Braking

General conditions on the use of Regenerative Brakes are identified below.

The Trainset's Regenerative Braking shall be facilitated by the following:

a) Transfer of braking energy back into the OCS for use by another Trainset that is drawing power from the OCS and is located in the same electrical section as the braking train.
b) Provision of a power management system on-board the Trainset to store and/or dissipate regenerated electrical energy.

Depending on the provisions on the wayside, Regenerative Braking may also be facilitated by the following:

a) Transfer of braking energy back to the power supply utility company's network in case Trainsets in the same electrical section do not draw the full regenerated power.
b) Provision of automatic assured receptivity unit braking resistors within TPS substations.

Refer to DCM Chapter 29 – Rolling Stock-Core Systems Interfaces, Section 29.4.4 (Regenerative Braking).

12.3.32 Power Factor

The Trainset design shall conform to the power factor requirements Specified in DCM Chapter 29 – Rolling Stock-Core Systems Interfaces, Section 29.4.5 (Power Factor).

12.3.33 Electrical Protection Coordination

The Trainset shall be designed to conform to the electrical protection coordination requirements between Trainset and TPS Specified in DCM Chapter 20 – Traction Power Supply System, Section 20.7.5 (Electrical Protection Coordination) and DCM Chapter 29 – Rolling Stock-Core Systems Interfaces, Section 29.4.6 (Electrical Protection Coordination). The Contractor shall work with the interfacing Contractor and/or Authority's representative to demonstrate that these requirements are met.

12.3.34 Overvoltages Generated by Harmonics

The Trainset shall be designed to conform to the harmonic distortion limits/overvoltages Specified in DCM Chapter 20 – Traction Power Supply System, Section 20.7.7 (Harmonic Distortion Limits). The Contractor shall interface with the interfacing Contractor and/or Authority's representative to demonstrate compliance with these requirements.

12.3.35 Overhead Contact System

The Trainset shall be designed to operate under the style and type of OCS Equipment detailed in DCM Chapter 21 – Overhead Contact System and Traction Power Return System.

Refer to DCM Chapter 29 – Rolling Stock-Core Systems Interfaces, Section 29.5 (Overhead Contact System Interfaces) for additional Trainset-to-OCS Interface criteria.

12.3.36 Phase Breaks

The Trainset shall be designed to operate with the design of the OCS phase breaks as detailed in DCM Chapter 21 – Overhead Contact System and Traction Power Return System and DCM Chapter 29 – Rolling Stock-Core Systems Interfaces, Section 29.5 (Overhead Contact System Interfaces) for additional Trainset-to-OCS Interface criteria.

12.3.37 Pantograph-OCS Interaction

The Trainset and pantograph shall be designed to optimize for quality of current collection, mean contact force, and percentage of arc duration in coordination with the OCS. Refer to DCM Chapter 21 – Overhead Contact System and Traction Power Return System for the criteria for the dynamic interaction between the pantograph and the OCS. Refer to DCM Chapter 29 – Rolling Stock-Core Systems Interfaces, Section 29.5 (Overhead Contact System Interfaces) for additional Trainset-to-OCS Interface criteria.

12.3.38 Signaling and Train Control Interfaces

The signaling and train control system, collectively known as the ATC system, includes all of the Safety-critical and non-Safety-critical functions of a high speed rail train control system, and will include positive train control (PTC) functions, as per 49CFR Part 236 Subpart I, as defined in DCM Chapter 24 – Automatic Train Control, Chapter 25 – Yard Signaling, and Chapter 29 – Rolling Stock-Core System Interfaces.

Because the CHSTS ATC system is not established at this time, the Trainset ATC Equipment is not included within the Contractor's scope, and will be designed, implemented and integrated with the Trainset by an interfacing Contractor.

The Contractor shall provide the Trainsets with provision of approved physical space, mountings, and electrical, signal, Data, system and other Interfaces for ATC onboard Equipment, per DCM Chapter 24 – Automatic Train Control, Sections 24.3 (General Design Requirements), 24.3.6 (Environmental Conditions), 24.3.10 (Safe Braking), 24.3.11 (Speed Limits), 24.3.12 (Hardware Requirements), 24.5.1 (Onboard Functions), and 24.7 (Onboard Equipment); and Chapter 29 – Rolling Stock-Core Systems Interfaces, Section 29.6 (Automatic Train Control Interfaces), so that the interfacing Contractor can provide and integrate the onboard ATC system.

All Interfaces between the Trainset and the onboard ATC shall be open and standards-based, or otherwise fully documented, and shall be approved per the process defined in Section 12.3.3.

12.3.39 Communications

The wayside communications systems provided by an interfacing contractor will consist of:

a) Wide area network.
b) Local area networks (including Wireless Local Area Networks).
c) Radio systems (including Operations radio system, broadband radio system, and public Safety trench and tunnel radio system).
d) Cable infrastructure.
e) Integrated information management platform.
f) Global positioning system network timing system,
g) Fire alarm system.
h) Public address and customer information sign system.
i) Telephone and intercom system.
j) Intrusion detection system.
k) Electronic access control system.

Refer to DCM Chapter 28 - Communications, Section 28.1 (Scope) for additional information on the wayside communications systems.

Trainset onboard systems that are provided by the Trainset Contractor that will have an Interface to and/or need to be integrated with the wayside communications systems to provide seamless functionality include, at a minimum:

a) Integrated Control Panel.
b) Public address/intercom system.
c) Passenger information system.
d) Passenger alarm system.
e) Fire alarm system.
f) Passenger emergency intercom.
g) Internal and external video cameras.
h) Internal and external electronic displays.
i) On-train monitor and diagnostics system.
j) Analog trainline network.
k) Digital trainline network.

The Trainset radio Equipment and Trainset GPS Network Timing System Equipment are not included within the Trainset Contractor's scope. These systems will be installed by an interfacing Contractor. However, the Trainset Contractor shall make spatial, mechanical, electrical and EMC provisions, and provide functional Interfaces for these systems' Equipment to be provided by a separate, multiple-vendor Procurement.

To that end, the Trainset Interfaces and protocols shall be non-proprietary, utilize open standards and/or be documented such that the onboard radio systems and wayside communications systems can be provided by a separate, multiple-vendor Procurement. No onboard systems' Interfaces, protocols, features, hardware or software shall preclude any interfacing Contractor from interfacing to the onboard systems and providing end-to-end functionality and performance.

Refer to DCM Chapter 29 – Rolling Stock-Core Systems Interfaces, Section 29.7 (Communications Interfaces) for detailed design criteria for the Trainset communications system Interfaces.

12.3.40 Reliability, Availability, and Maintainability

The Trainsets shall provide highly reliable, dependable passenger service. The Contractor shall achieve service Reliability performance by the design, manufacture, testing, commissioning, and Specified Maintenance over the life of the Trainset.

The Trainset design and manufacture shall minimize maintenance and repair times, and reduce Maintenance costs over the entire design life. The Trainset design shall incorporate simple to change, modular Equipment, and simple to manage diagnostics, condition monitoring and Data systems. The Trainset design shall enhance Maintenance and repairability, and provide features which enable Maintenance and repairs to be carried out quickly, safely, and effectively.

The Trainset design and manufacture shall provide the necessary functionality and redundancy to recover from or mitigate reasonably expected technical Failures and malfunctions, and to reduce impact to passenger service from a malfunctioning Trainset.

The Trainset design and manufacture shall consider passenger and operational staff interactions.

The Trainsets shall comply with the additional performance and RAM requirements and criteria of DCM Chapter 30, Section 30.4.5 (Rolling Stock RAM Design Criteria).

Trainset systems, Equipment, and functions shall be robust, highly reliable, fault tolerant, and of Service-Proven design. Trainset design and construction shall ensure that Failures are highly unlikely to cause service interruptions.

Trainset design and implementation shall ensure that, when needed because of a Failure, Corrective Maintenance can be completed quickly and with no impact on train service beyond that caused by the Failure. Trainset and infrastructure design and implementation shall enable fast detection, response, access, correction, and service restoration if a Failure occurs. The Trainset and its Equipment shall meet MTBSI, MTBF, and MTTRS requirements from the Contractor Reliability, Availability, and Maintainability Program Plan (CRAM).

12.3.41 RAM Program

The Contractor shall establish a Trainset RAM Program that achieves the following:

a) Results in Trainsets that meet the RAM requirements.
b) Guides and coordinates the RAM design, Analysis, test, documentation, and certification activities.
c) Ensures RAM integration between the Contractor RAM Program and the CHSTS project management, RAM Program, systems, and sections through all project phases.
d) Complies with applicable regulatory requirements, including RAM requirements in 49CFR Parts 200 thru 299, EN 50126-1 and CLC/TR 50126-3.

The Contractor's RAM Program work shall include the following:

a) Contractor and Supplier RAM Plans (CRMPs) for all participants in the Trainset Procurement whose Equipment can affect Trainset RAM. Each CRMP shall define scope, organization, responsibilities, tasks, deliverables, milestones, RAM requirements, RAM testing, Analysis, feedback, reporting, etc. for the covered element of the Trainset RAM Program.
b) Contractor and Supplier RAM design analyses for all design phases.
c) System integration RAM.
d) Monitoring and evaluation by project engineers and managers.

The Contractor shall implement a RAM Program, which provides the RAM Program contract deliverables (CDRLs) listed in Table 1.

Table 1 – Trainset RAM Program Deliverables

Item Number	Deliverable
1	Contractor RAM Program Plan (CRMP)
2	RAM Allocation Report (RAR)
3	Preliminary Reliability Analysis (PRA) including RAM Allocation Report (RAR)
4	RAM Design Checklist
5	Software Dependability Assurance
6	Historical Product Maintainability Report (HPMR)
7	Reliability Failure Modes and Effects Analysis (FMEA)
8	Reliability Fault Tree Analyses (FTA)
9	Reliability Prediction Report (RPR)
10	RAM Certifiable Items List (CIL)
11	RCM Decision Tool Report
12	Corrective Maintenance Analysis (CMA)
13	Preventive Maintenance Analysis (PMA)
14	Failure Reporting and Corrective Action System (FRACAS)
15	Maintainability Demonstration Test (MDT) Plan (MDTP) and Procedures
16	Recommended Spare Parts and Consumables List
17	Reliability Demonstration Test (RDT) Plan (RDTP) and Procedures
18	Special Tools List
19	RAM Verification and Validation (V&V) Report
20	Maintainability Demonstration for First Article Inspection (FAI)
21	Maintainability Demonstration for Pilots Cars
22	Maintainability Demonstration Test Report
23	Reliability Demonstration Test
24	Monthly Failure Report
25	Reliability Demonstration Test Report

The CRMP shall include the following:

a) RAM Program objectives.
b) RAM Program schedule.
c) Methodology to be used in RAM analyses.
d) Organization of personnel responsible for managing the RAM Program.
e) Controls for activities of Subcontractors and Equipment suppliers to ensure compliance with RAM Program methods.
f) Preliminary Reliability demonstration testing plans for verification of compliance when calculations and analyses are inconclusive, or when past performance records are incomplete or unavailable.
g) Reliability and Maintainability demonstration Program, including demonstration plans and procedures.
h) Failure Reporting and Corrective Action System (FRACAS).

The CRMP shall identify Program Interfaces and describe the Contractor's approach to integrate RAM with other project elements. RAM Program Interfaces include Trainset Program management, supplier control, project schedule, progress reporting, manuals and training, system Safety, railcar, system, and component design, design reviews, first article inspections (FAIs), test Program, quality assurance, warranty administration, configuration management, and design change control.

The Contractor shall update RAM analyses concurrent with Trainset design.

12.3.42 RAM Performance Requirements

RAM performance requirements shall be defined by the Contractor in accordance with the requirements in Section 6.1.1 and required by the Contract documents.

As required in Section 6.1.1, the Offeror's proposal for RAM Metric Values shall use the RAM Analysis Factors detailed in Table 1A.

Table- 1A

RAM Analysis Factors		
No.	RAM Factor	Authority Value
1	Revenue hours per day	18
2	Off-peak revenue hours per day	12
3	Peak revenue hours per day	6
4	Non-revenue train operating hours per day	1
5	Off-peak service headway minutes	10
6	Peak service headway minutes	6
7	Longest revenue service trip miles, one way	447
8	Longest trip time, all station stops, one way	3:41
9	Stations, per direction	10
10	Average annual trainset miles	458,941
11	Maximum daily revenue trainset miles	1,849
12	Average annual trainset operating hours	5,355
13	Average number of revenue service trainset trips per day	3.6
14	Average non-revenue service trainset miles per day	76.4
15	Average number of non-revenue service trainset trips per day	2.24

The Contractor shall submit for Approval a Reliability Prediction Report which analyzes and predicts the Trainset Mean Time between Service Interruption (MTBSI) and Mean Time to Restore Service (MTTRS). The Reliability Prediction Report shall also analyze and predict the Mean Time between Component Failure (MTBCF) and Mean Time to Repair for all Trainset Equipment.

The Contractor shall perform a Reliability demonstration that verifies the Trainsets meet the RAM performance requirements.
If the Reliability of the Trainset or one of its systems fails to meet Reliability requirements, the Contractor shall undertake the following:

a) Investigate to determine the cause of the Reliability problem.
b) Evaluate whether the problem is sustained or transitory.
c) If the problem is sustained and is caused by Equipment design defects, modify Equipment so that the modified Trainset will meet its Reliability requirement.
d) If modifications are required during the Reliability demonstration, extend the Reliability demonstration by an additional length of time to demonstrate that the modifications are effective.

12.3.43 Fleet Availability Requirements

The Offeror shall provide a Preventative Maintenance Plan and a Corrective Maintenance Plan for approval under which each trainset is unavailable for service no more than 400 hr per year for all corrective and preventative maintenance and inspection.

The Authority's Operating Plan requires Fleet Daily Roll-Out Availability of at least 90.3%, calculated as the number of trainsets in or available for morning service at 5 AM divided by the total number of trainsets in the fleet.

12.3.44 Maintenance Requirements

The Contractor shall develop a Maintenance plan applying Reliability Centered Maintenance (RCM) and covering Preventative Maintenance and Corrective Maintenance. The Contractor shall perform Preventative Maintenance Analysis (PMA), Corrective Maintenance Analysis (CMA), and RCM decision tool report.

Trainset Preventative Maintenance tasks shall conform to the intervals per Trainset shown in Table 2, or an approved equivalent table.

Table 2 – Trainset Preventative Maintenance Requirements

Item No.	Preventive Maintenance Interval	Comments
1	Daily	Pre-departure inspection tasks only. (e.g., air brake test, ATC/PTC daily departure test, interior and exterior cleaning).
2	30 Days	Replacement of consumables, interior and exterior cleaning, safety-critical inspections including ATC function test and ultrasonic wheel inspections/NDT of axles, and all communication and electronic system diagnostics.
3	92 Days	All required 49 CFR Parts 229 and 238 inspections.
4	1 Year and/or as optimized based on mileage.	Wheel truing and bogie inspections.
5	2 Years and/or as optimized based on mileage.	Wheel truing and bogie inspections. Bogies shall be removed from the Trainset and replaced with new or rebuilt Bogies. Bogies will undergo diagnostic tests and reworked so they may return to service.
6	4 Years	Overhaul General Inspection, focusing on the condition of the carbody, Subsystems, and all interior components and systems. This inspection also includes a more thorough Bogie inspection as well as exterior carbody painting.

The Contractor may propose alternate intervals for Approval, based on recommendations from the PMA, CMA, and RCM decision tool report tasks.

12.3.45 Maintenance Management Information System

The Contractor shall provide an integrated Maintenance Management Information System (MMIS) that facilitates Trainset-pertinent inspections, preventative maintenance, corrective maintenance, and asset management. At a minimum, the MMIS shall comprise of an asset register, a planning system, and a data and analysis system:

a) Asset register: the purpose of the asset register is to have a current record of all assets of the Trainset and the modification and maintenance status of each significant item, component, or system. The asset register will also be used as a basis for optimizing whole-life costs. The Contractor shall begin providing asset register information as specific assets become identifiable.
b) Planning system: at a minimum, the planning system shall:
    a. Devise Trainset rosters;
    b. Devise staff rosters;
    c. Plan train paths, including special trains and station stops;
    d. Plan technical incident control;
    e. Plan maintenance activities including:

i. System configuration tracking;
ii. Maintenance and new work planning, scheduling and control;
iii. Resource management;
iv. Materials management;
v. Cost and budgetary control.

c) Data and analysis system: the data and analysis system shall be available to provide statistical information over different user-defined time frames (e.g., daily, weekly, monthly, yearly) concerning, but not limited to:
   a. Numbers of trains running daily;
   b. Total daily mileage of each Trainset;
   c. Availability of Trainsets.

The MMIS shall permit the following tasks:

a) Financial control, through proper knowledge of costs and use of resources, allowing appropriate trade off decisions;
b) Status of Owner-owned spares, Contractor provided spares, consumable spares
c) Technical results, through efficient tracking of technical information;
d) Efficient scheduling and organization of activities;
e) Recording of all maintenance undertaken and scheduling of maintenance due on the Trainset;
f) Quality through compliance with ISO traceability requirements and delivery of current technical information to maintenance personnel;
g) Improvement results through proper global indicators allowing detection of trends and continuously improving maintenance performance;
h) Identification of endemic design or manufacturing defects;
i) Equipment availability and reliability improvement.

Details of the MMIS shall be included in the Contractor-developed Maintenance Program, as identified in Section 9.1.1, and shall address the following, at a minimum:

a) Information in the Trainset history books;
b) Information and details for the asset register, planning system, and data and analysis system;
c) Configuration management information;
d) Software;
e) Interface with the TMDS and response to faults and alarms;
f) Interface with Trainset communications for the relay of pertinent data/information to wayside facilities;
g) Generation of service requests from selected list of faults and alarms;
h) Management procedures for the receipt and processing of specific information relative to the operational integrity of the Trainset including operational and/or maintenance incidents with a potential to affect the safety integrity of the Trainset;
i) Operational duty profiles of the Trainset (including but not limited to total mi (km) traveled);

j) Security management processes for the protection and validation of the information systems.

12.3.46 RAM Design

The Contractor shall implement a structured design process to ensure that the Trainset design complies with all applicable RAM requirements. In summary:

a) The Trainset must meet the Trainset RAM performance requirements.
b) Trainset Equipment Fault tolerant provisions include multiple independent propulsion and braking systems, door systems, HVAC, communications, etc.
c) Preventative Maintenance will be performed at yard and shops per schedule.
d) If Corrective Maintenance is needed to restore service, then design and Maintenance provisions must ensure fast response, detection, access, correction, and restoration of service by Train Crew.
e) The Trainset must achieve adequate functional Safety under all conditions within the covered criteria.

The Contractor shall develop a RAM design checklist to show compliance with all RAM design requirements from this Specification and referenced Specifications and standards.

The Contractor shall report on RAM design compliance at design reviews and at FAIs.

12.3.47 RAM Verification and Validation

The Contractor shall develop and maintain a RAM CIL based on the Reliability FTA basic events table. The Contractor shall expand the RAM CIL as needed based on the FMEA and other analyses.

The Contractor shall provide a RAM V&V report to certify compliance with this Specification, Contract requirements, RAM plans, referenced standards and Specifications, design checklists, and CILs.

The Contractor shall perform Reliability and Maintainability demonstrations. The Contractor shall perform two series of Maintainability demonstrations:

a) Maintainability demonstrations for FAIs based on the PMA, CMA, and draft Maintenance manuals.
b) Maintainability demonstrations for Pilot Cars based on approved Maintenance manuals, with demonstrations coordinated with Maintenance training.

The Contractor shall identify fleet defects during the Reliability and Maintainability demonstration periods. A fleet defect is defined as cumulative Failures of 10% or more of any part, system, or component in the same or similar applications within a consecutive 12-month period, where such items are covered by warranty. The Contractor shall correct all fleet defects. Fleet defect corrective actions are subject to Approval.

12.3.48 Preliminary Vehicle/Track Analytical Simulation

A preliminary Vehicle/track analytical simulation is required to:

a) Demonstrate Offeror's expertise in FRA-mandated Vehicle/track computer simulations to identify dynamic performance issues and confirm Vehicle-track compatibility prior to operation.
b) Provide feasible potential Trainset parameters that serve as a basis for:
    a. Refining aerial guideway structure design criteria.
    b. Verification of infrastructure performance for Vehicle-track-structure interaction.
c) A preliminary Trainset design as denoted by Figure 1 shall be provided. Column (2) of Table 3 shall be completed for a minimum of one full Trainset. A single value shall be entered by the Offeror for each parameter in Column (2). A range of parameters will not be accepted.

Up to two additional full preliminary Trainset designs may be provided in Columns (3) and (4) of Table 3, to reflect alternative design concepts, to accommodate a range of parameters for different Trainsets, or to illustrate specific performance enhancements. A maximum of three preliminary Trainset designs may be proposed.

Each preliminary Trainset design shall be in general compliance with Authority-related performance requirements as defined in the Procurement documents, including this Specification.

For each Specified parameter in Table 3, the Offeror shall specify the expected required tolerance for final design and complete Columns (6) and (7). Excessive tolerances for final design require justification and may be rejected.

For each preliminary Trainset design, a preliminary Vehicle/track Analysis shall be performed using the methodology described in 49CFR Part 213 Appendix D. For purposes of preliminary Analysis only, the MCAT simulations shall be completed for the specific scenarios defined in Table 4. For a given preliminary Analysis scenario, relevant track perturbations and amplitudes shall be defined in accordance with 49CFR Part 213 Appendix D.

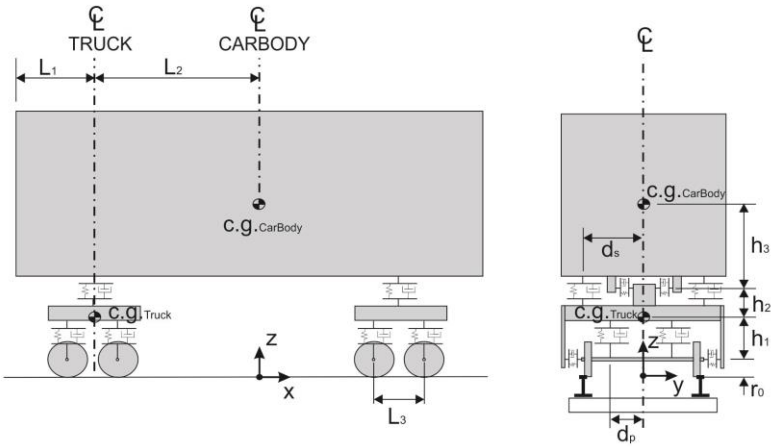
At a minimum, MCAT Analysis results shall be submitted for all parameters reflected in the Vehicle/track interaction (VTI) Safety limits table in 49CFR Part 213.333. It is expected that the Analysis results for each preliminary Trainset design shall be in general compliance with VTI Safety limits for all scenarios defined in Table 4.

The Offeror's proposal shall provide a preliminary evaluation of VTI Safety limits using Vehicle/track computer simulation methodology mandated by the FRA. The proposal requirements shall not be interpreted to reduce the scope of final design requirements as defined elsewhere in this Specification and 49CFR Part 213 Appendix D.

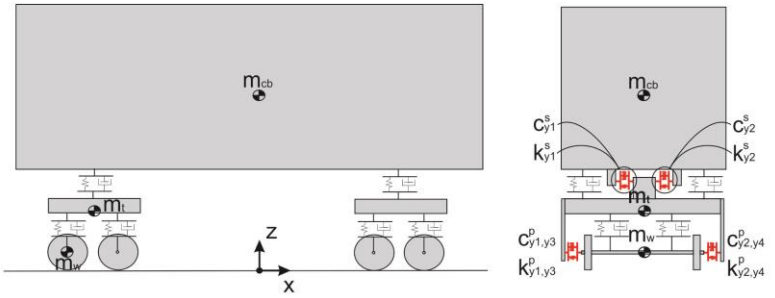
As part of final design, the Contractor shall complete Table 5 with information from the proposal and final Trainset design. Columns (2), (4), and (5) shall be completed with

relevant information from Table 3 previously submitted during the proposal. Column (6) shall be completed for each parameter requested using the final Trainset design. Final Trainset design parameters shall be within the Specified tolerances for final design submitted in the proposal.

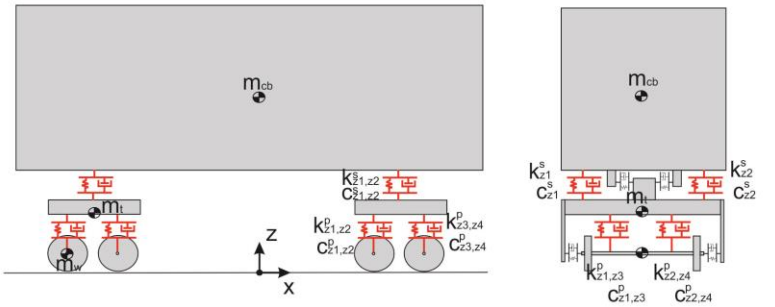
Car Body Dimensions



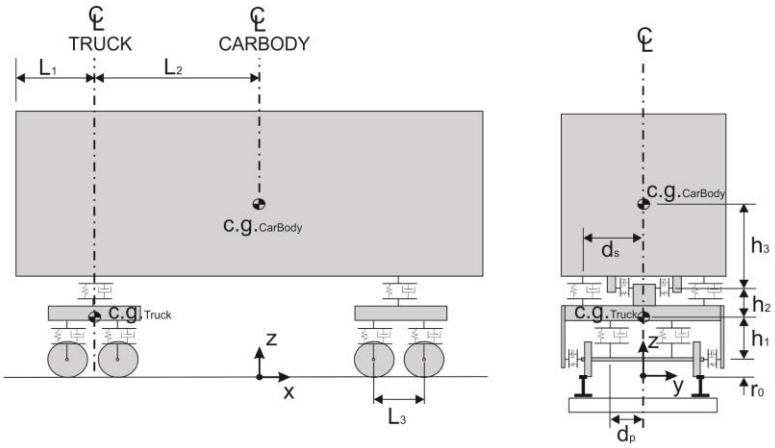
Lateral Suspension Information



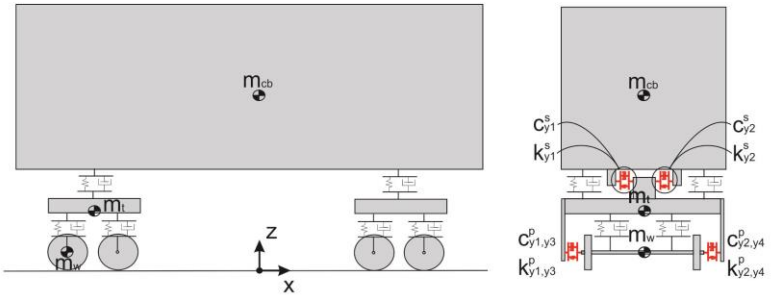
Vertical Suspension Information



Car Body Dimensions



Lateral Suspension Information



Vertical Suspension Information

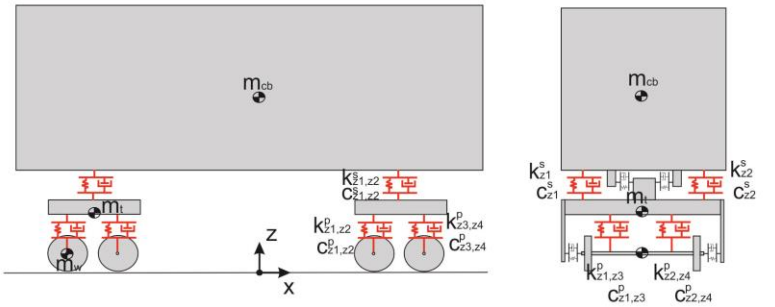


Figure 1 – Preliminary Trainset Design Schematic

Table 3 – Preliminary Trainset Design Parameters

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Parameter	**Notation**	**Value [1,2]**			**Units**	**Tolerance for Final Design (%)**	
		Trainset 1 (Required)	Trainset 2 (Optional)	Trainset 3 (Optional)		+	-
Length Dimensions							
end of carbody to centerline truck	L_1				ft		
centerline truck to centerline car	L_2				ft		
wheel spacing	L_3				ft		
Height Dimensions							
c.g. lateral secondary to c.g. car body	h_3				ft		
c.g. truck to c.g. lateral secondary	h_2				ft		
c .g. lateral primary to c.g. truck	h_1				ft		
Nominal Radius of Wheel	r_o				ft		
Width Dimensions							
centerline truck to vertical primary	d_p				ft		
centerline truck to vertical secondary	d_s				ft		
Masses							
Mass of Car Body	m_{cb}				lbf*s^2/ft		
Mass of Truck	m_t				lbf*s^2/ft		
Mass of Wheelset (including axle)	m_w				lbf*s^2/ft		
Mass Moments of Intertia (MMI)							
MMI of car body about x axis	I_{cbx}				lbf*s^2*ft		
MMI of car body about y axis	I_{cby}				lbf*s^2*ft		
MMI of car body about z axis	I_{cbz}				lbf*s^2*ft		
MMI of truck about x axis	I_{tx}				lbf*s^2*ft		
MMI of truck about y axis	I_{ty}				lbf*s^2*ft		
MMI of truck about z axis	I_{tz}				lbf*s^2*ft		
MMI of wheelset about x axis	I_{wx}				lbf*s^2*ft		
Stiffnesses							
Stiffness of Vertical Primary Suspension System	k^p_{z1} (Typ. of 4)				lbf/ft		
Stiffness of Vertical Secondary Suspension System	k^s_{z1} (Typ. of 2)				lbf/ft		
Stiffness of Lateral Primary Suspension System	k^p_{y1} (Typ. of 4)				lbf/ft		
Stiffness of Lateral Secondary Suspension System	k^s_{y1} (Typ. of 2)				lbf/ft		
Damping							
Damping of Vertical Primary Suspension System	c^p_{z1} (Typ. of 4)				lbf*s/ft		
Damping of Vertical Secondary Suspension System	c^s_{z1} (Typ. of 2)				lbf*s/ft		
Damping of Lateral Primary Suspension System	c^p_{y1} (Typ. of 4)				lbf*s/ft		
Damping of Lateral Secondary Suspension System	c^s_{y1} (Typ. of 2)				lbf*s/ft		

Notes:

1) Linear stiffness and damping characteristics are anticipated to be used for the preliminary Vehicle/track analytical simulation. Complex nonlinear behavior, including gaps, stoppers, etc. may be provided as a supplement/attachment to the proposal.
2) Equivalent Preliminary Trainset Design parameters may be developed from other relative properties.

Table 4 – Preliminary MCAT Simulation Scenarios

Scenario No.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Load Condition	Fully Seated Loading Condition											
Suspension State	Normal Inflation											
Track Gage	56.5 inches											
Track Model Type	Tangent (straight) Track						Curved Track					
Cant Deficiency (E_u)	n/a						3 inches					
Superelevation	n/a						6 inches					
Degree of Curvature (D)	n/a						1.42			0.27		
Train Speed (V)	95 mph			220 mph			95 mph			220 mph		
Track Class	Class 6			Class 9			Class 6			Class 9		
Perturbation Wavelengths [1] (λ)	31ft	62ft	124ft	31ft	62ft	124ft	31ft	62ft	124ft	31ft	62ft	124ft
Scenario No.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*

Notes:

1) Perturbation wavelengths shown are intended for variable perturbation wavelengths only. Fixed wavelengths for hunting and short warp perturbations shall also be evaluated in accordance with 49CFR Part 213 Appendix D.

Table 5 – Final Trainset Design Compliance Check

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Parameter	**Notation**	**PRELIM. TRAINSET DESIGN**		**Tolerance for Final Design At Proposal (%) [2]**		**FINAL TRAINSET DESIGN**	
		Value At Proposal [1]	**Units**	+	-	**Value At Final Design [3]**	**Units**
Length Dimensions							
end of carbody to centerline truck	L_1		ft				ft
centerline truck to centerline car	L_2		ft				ft
wheel spacing	L_3		ft				ft
Height Dimensions							
c.g. lateral secondary to c.g. car body	h_3		ft				ft
c.g. truck to c.g. lateral secondary	h_2		ft				ft
c .g. lateral primary to c.g. truck	h_1		ft				ft
Nominal Radius of Wheel	r_o		ft				ft
Width Dimensions							
centerline truck to vertical primary	d_p		ft				ft
centerline truck to vertical secondary	d_s		ft				ft
Masses							
Mass of Car Body	m_{cb}		lbf*s^2/ft				lbf*s^2/ft
Mass of Truck	m_t		lbf*s^2/ft				lbf*s^2/ft
Mass of Wheelset (including axle)	m_w		lbf*s^2/ft				lbf*s^2/ft
Mass Moments of Intertia (MMI)							
MMI of car body about x axis	I_{cbx}		lbf*s^2*ft				lbf*s^2*ft
MMI of car body about y axis	I_{cby}		lbf*s^2*ft				lbf*s^2*ft
MMI of car body about z axis	I_{cbz}		lbf*s^2*ft				lbf*s^2*ft
MMI of truck about x axis	I_{tx}		lbf*s^2*ft				lbf*s^2*ft
MMI of truck about y axis	I_{ty}		lbf*s^2*ft				lbf*s^2*ft
MMI of truck about z axis	I_{tz}		lbf*s^2*ft				lbf*s^2*ft
MMI of wheelset about x axis	I_{wx}		lbf*s^2*ft				lbf*s^2*ft
Stiffnesses							
Stiffness of Vertical Primary Suspension System	k^p_{z1} (Typ. of 4)		lbf/ft				lbf/ft
Stiffness of Vertical Secondary Suspension System	k^s_{z1} (Typ. of 2)		lbf/ft				lbf/ft
Stiffness of Lateral Primary Suspension System	k^p_{y1} (Typ. of 4)		lbf/ft				lbf/ft
Stiffness of Lateral Secondary Suspension System	k^s_{y1} (Typ. of 2)		lbf/ft				lbf/ft
Damping							
Damping of Vertical Primary Suspension System	c^p_{z1} (Typ. of 4)		lbf*s/ft				lbf*s/ft
Damping of Vertical Secondary Suspension System	c^s_{z1} (Typ. of 2)		lbf*s/ft				lbf*s/ft
Damping of Lateral Primary Suspension System	c^p_{y1} (Typ. of 4)		lbf*s/ft				lbf*s/ft
Damping of Lateral Secondary Suspension System	c^s_{y1} (Typ. of 2)		lbf*s/ft				lbf*s/ft

Notes:

1) Trainset 1, 2, or 3 from Table 3 (i.e., Columns (2), (3), or (4) as applicable).
2) Values from Table 3 Columns (6) and (7).
3) Equivalent linear stiffness and damping characteristics across multiple components and complex behavior are acceptable. Detailed supplements shall be provided to justify selection/comparison of parameters to compare with preliminary Trainset design.

12.4 APPENDIX D – AMTRAK'S DESIGN AMBITION FOR VEHICLE INTERIORS

12.4.1 Requirements and Information

This Appendix is used to describe the "soft" aspirations for the interior design and passenger facilities for the Vehicle interior. It is included as an Appendix to enable it to be compiled by the Interior Design specialists who will be leading this area. It may include technical details such as expectations for in-seat features (e.g., reclining, power sockets, styling), but at this stage these are presented as ideas and expectations to inform the Offerors proposals rather than "hard requirements." It can also include illustrations that Amtrak may want to offer of how they expect the interior to look, in terms of layout, color, material, finish, and any specific styling "cues" that Amtrak wants to include.

As part of the negotiations phase with the Preferred Offeror, the proposed design and fit-out of the interior as agreed between the client and supplier will be contractualized by including it as a defined schedule in the Purchase Agreement.

Keeping the detail of the interior fit-out and finishes in a separate Section enables the development and final Specification of the interior to be effectively ring-fenced (recognizing that there are important Interfaces) from the engineering Specification of the Trainsets.

Section/Req. No.	Design Ambition
Environment	
1	Materials preferably should be made with anti-microbial properties for seating and surfaces
2	It is preferable that windows have an auto-tinting feature
3	It is preferable that general cabin lighting should adjust automatically to changes in the external environment (i.e., tunnel entrance and exit and day vs. night) such that the interior setting is maintained.
4	At-seat reading lights preferably should have a dimming capability.
Restrooms	
1	All restroom water taps, electric hand dryers, paper towel dispensers, soap dispensers, and toilet flushers should be no-touch, preferably.
2	Restrooms should have a self-cleaning capability, preferably.
3	It is preferable that an anti-bacterial hand cleanser dispenser or wall-mounted trash receptacle with a hands-free lid should be provided by the exit door to enable passengers to exit with clean hands

First Class	
1	First Class seats should be designed to offer enhanced privacy (e.g., via a retractable privacy screen and/or center console)
2	Privacy preferably should be provided with wing chair or pod-like seating
3	The car layout should include a meeting space that can be reserved by passengers
4	Individual video screens may be present at the seat and located in a convenient, easy-to-use location, such as the armrest, in order to provide train information, food service information and content such as news, weather, and entertainment
Business Class	
1	Video screens should be located in convenient, easy-to-view locations, and enclosed within a dropdown ceiling compartment at appropriate intervals throughout the car, in order to provide train information, food service information (and preferably ordering capabilities) and content such as news, weather and entertainment
2	Car design should accommodate at-seat delivery of food and beverage services, if provided
Seating - Non Food Service Car	
1	Under-seat storage should be preferable
2	It is preferable that armrests in all classes of service should be retractable, except in cases where the armrest is located in a center console
3	Tray tables preferably should be large, skid-free, have raised edges to prevent spills and a depressed cup-holder integrated into the design.
Storage	
1	Overhead luggage storage preferably should be designed to improve visibility of the contents and enhance security, while minimizing the impact on the overall ambience of the Vehicle.
Furnishing and Fixtures	
1	It is preferable that FRP or Melamine-faced panels should be used for window coverings.

12.5 APPENDIX E – ADA

12.5.1 Requirements and Information

Americans with Disabilities Act of 1990, 42 U.S.C. 12101, et seq., as amended ("ADA"), and the Rehabilitation Act of 1973, 29 U.S.C. section 701, et seq. ("Rehab Act"), and all applicable regulations under both laws.

Applicable regulations under the ADA are contained in 49CFR Parts 37 and 38. Applicable regulations under the Rehab Act are contained in 49CFR Part 27. With respect to the Rehab Act regulations, Equipment must comply with the non-discrimination provisions in 49CFR Part 27.7, including the requirement that "aids, benefits, and services, to be equally effective, are not required to produce the identical result or level of achievement for handicapped and non-handicapped persons, but must afford handicapped persons equal opportunity to obtain the same result, to gain the same benefit, or to reach the same level of achievement, in the most integrated setting that is reasonably achievable."

In addition to the standards and requirements set forth in 49CFR Parts 37 and 38, the Department of Transportation has published a guidance document setting forth its position regarding the standards that should be applied to rail Vehicle features for which no particular standard is identified in the ADA regulations. In part, this guidance states as follows:

In a situation in which no specific standard is found in Part 38, passenger railroads should meet their nondiscrimination obligation by designing and building rail cars compliant with the standards available for comparable elements in buildings and facilities. . . . In designing and building rail cars, passenger railroads should refer to the ADAAG standards design features not contained in Part 38, except where doing so is infeasible because of particular geometric constraints of the rail car design, rail car Safety, or operational considerations unique to rail transportation.

ADAAG standards can be found here http://www.access-board.gov/guidelines-and-standards. Note that the DOT guidance states that it applies to features that a passenger might use, such as a Café Vehicle countertop, but does not apply to features that are intended to be used only by railroad employees.

Any questions about the meaning or interpretation of any regulatory standard or guidance may be submitted in writing to Amtrak's ADA Coordinator in the Amtrak Law Department.

12.5.2 Principles for Accessible Train Design – Introduction

This guidance document is being provided as background regarding the Americans with Disabilities Act and principles of accessibility. The principles described in this document set out a "best practices" view of accessible rail Vehicles, by which all passengers, including passengers with a disability, have equal and integrated access to all features, amenities and information that are provided, without the need for assistance by train personnel. Some of the guidance contained in this document describes the existing legal requirements in general terms, and other parts convey best practices. This guidance should be used in conjunction with the regulations identified in the RFP.

While adherence to the minimum legal requirements is mandatory in order to proceed in the RFP process, adherence to the broad accessibility principles described herein (which, in some cases, means going beyond the minimum legal requirements) will yield additional points.

Note that nothing in this document (including the use of the word "must") should necessarily be interpreted as conveying a legal mandate or an absolute requirement for this RFP.

12.5.3 Accessibility Principles and Considerations

Section 504 of the Rehabilitation Act (1973) and the Americans with Disabilities Act (ADA), which was signed into law on July 26, 1990, by President George H.W. Bush, are civil rights laws mandating that people with disabilities are able to benefit from and fully participate in society, including in public transportation. The principles of accessibility and inclusiveness found in this RFP reflect the mandates of the Rehabilitation Act and the American with Disabilities Act.

There is great diversity within the disabled community. It includes people who use various assistive ambulatory and wheeled mobility Devices and it includes people who may have a cognitive or sensory disability and may be deaf or hearing impaired, blind or vision impaired or deaf and blind. Because passengers include people of all ages and abilities, applying the principles of Universal Design and Transgenerational Design to the greatest extent possible will insure and enhance the long-term utility, accessibility and Safety of the Trainset.

Designing passenger rail Vehicles that are used for public transportation requires thoughtful attention to the implementation of the requirements found in the ADA as defined herein. There also are various ways that people with different types of disabilities might use the features and amenities found on passenger trains. All passengers, including passengers with a disability, must have equal access to and equal opportunity to use all features, amenities and information provided.

The following general accessibility principles must be considered when designing an accessible and inclusive rail Vehicle. These principles should not be construed to require less than the minimums found in the applicable regulations and guidelines.

a) **Passenger Activities**:

   a. **Boarding and alighting** – Rail Vehicles must be integrated with platforms to minimize gaps (horizontal and vertical) and minimize and ideally eliminate the need for operational interventions to facilitate the safe, quick, and integrated boarding by passengers with a disability, including those who use wheeled mobility Devices.

   b. **Seating** – Seating areas must be available in all classes of service offered (e.g., Business, First class, etc.) and in all types of Vehicles (e.g., food service, if provided) and each must be designed to accommodate passengers with disabilities, including those who sit/transfer into a Vehicle seat and those

who wish to stay seated in a wheeled mobility Device. Occupied wheeled mobility Device seating and transfer accessible seating must be comfortable and include access to the same amenities offered to all other passengers in all classes of service and in all types of Vehicles.

c. **Eating** – Dining and snacking amenities and features throughout the train must be equally available to all passengers, including an accessible hard surface on which to eat.

d. **Moving throughout the train** – All passengers must be able to get onto and off of the train and access different spaces, features and amenities. Persons using mobility Devices must be able to move easily to Vehicles immediately adjacent to the Vehicle into which they boarded or to transfer readily to other sections of the train without assistance while the train is parked at stations. Food service Vehicle(s), if provided, must be fully accessible to persons using mobility Devices from end-to-end and to the adjacent Vehicle at either end of the food service Vehicle.

e. **Restroom** – All passengers must have ready access to accessible restroom facilities. Because passengers may choose to move to a non-adjacent food service or other Vehicle while the train is parked at a station, and may not be able to move back to their usual location until the next station stop, consideration must be given to the placement of accessible restrooms so that passengers who choose to do this have access to an accessible restroom even when they are not in their usual location.

f. **Communicating with train personnel** – All passengers must have access to the same information from train personnel regarding the trip and services as well as an equal opportunity to communicate with personnel (e.g., accessible call Device and Intercoms).

g. **Other** – All services, features, and amenities available to passengers without disabilities must be available to passengers with disabilities.

b) General Principles:

a. **Walking, operating and maneuvering space (including turning)** – Doorways, vestibules, and passageways must be sized to meet or exceed regulation requirements to ensure that people with a disability can safely and quickly navigate through these spaces using wheeled mobility Devices. Clearances must be sufficient to allow wheeled mobility Devices of a minimum footprint of 760 mm (30 inches) by 1220 mm (48 inches) and with different operational functionality (e.g., turning radiuses, power, etc.) to move through these spaces.

b. **Clear space** – There must be sufficient space for a person using a wheeled mobility Device to enter into the space and remain seated in his/her Device (for all classes of service and in all types of Vehicles), with adjacent controls and amenities (outlets, air, lights, tables, etc.) within proper reach ranges or heights. In addition, this space must be designed with consideration for protrusions by adjacent seats (recline, swivel, etc.) or other features.

c. **Transfer seating and storage space** – Accessible seating that a person with a wheeled mobility Device uses must be transfer-accessible into and out of, provide sufficient adjacent clear space and flexibility to account for differences in preferences and abilities in transferring, and provide nearby sufficient storage space in the same car and area for the unoccupied wheeled mobility Device (at a minimum, seating and storage space shall accommodate a passenger who wishes to remain in the wheeled mobility Device and a passenger who wishes to move to the transfer seat and store the folded wheeled mobility Device).

d. **Reach ranges** – Reach ranges for all controls (e.g., environmental, entertainment, lighting, communications, restroom fixtures and products), service locations (e.g., food service counters) and self-service elements (e.g., ice machines, food, water dispensers) must be designed to be within the required reach ranges and usable by persons using wheeled mobility Devices as well as people of different statures.

e. **Height of seating and table surfaces** – Seat and table heights must be designed to accommodate persons who remain seated in their wheeled mobility Devices and/or persons who transfer from their wheeled mobility Devices into the seat.

f. **Actuators** – Actuators for doors, faucets (water taps), locks, toilet seats, and other movable elements must not require grasping and must be operable must be operable with minimal force. The effort required to operate these Devices must be minimized, and if possible, automated or powered.

g. **Support and stability, ease of movement** – Movement onto and through the train and transfers to and from seating must be level, stable, firm and slip resistant and support should be provided (e.g., handrails, non-slip floor surfaces, lighting, contrasting thresholds).

h. **Communication elements** – Safety, journey information, service (e.g., food or entertainment service), signals (e.g., door closing) and other information that is conveyed to passengers must be conveyed through different Systems simultaneously (e.g., audio, visual, Braille, induction loops, closed captioning), so that all passengers have the ability to receive the same

information regardless of any communication-related disability. Messaging must be automated to the extent possible to minimize required intervention by personnel (e.g., text to audio and audio to text conversion, station arrival information via GPS), and should be made available through installed displays and Systems as well as any personal electronic Devices (open Data) that the passenger may wish to use. All such Systems shall be designed so that they are easily visible or audible to all seats and spaces.

i. **Safety and security** – Needs of passengers with disabilities must be factored into all emergency Systems and contingency features and included in an Emergency Response Plan. For example, in cases of evacuation, emergency evacuation chairs and in some cases transfer bridges may be needed; in cases of power loss, backup power should be distributed with consideration for the potentially greater need of persons with disabilities (e.g., persons using oxygen, persons using powered doors, persons relying on electronic messaging for critical communications); fire alarms must have audio and visual signals.

12.6 APPENDIX F – REQUIREMENTS FOR TRAINSET COMMUNICATIONS, PASSENGER INFORMATION, AND INTERFACES

12.6.1 Onboard Wireless Internet Access [See Section 8.16.26]

The solution must:

a) Integrate and aggregate all sources of bandwidth.
b) Dynamically allocate bandwidth equally or in a controlled manner to passengers.
c) Provide the ability to segregate and prioritize traffic based on priority and classification (i.e., passenger, security, operational).
d) Control content allowed.
e) Support VPN.
f) Have the ability to prioritize the selection and use of available sources of bandwidth, with priority being given to the fastest reliable connection possible.
g) Provide remote monitoring, troubleshooting capabilities, and analytical reporting.
h) Provide a single SSID for all on-train passenger Wi-Fi networks.
i) Deliver gigabyte speed within the on-train network.
j) Ability to support a tiered service delivery model to enable provision of free or paid access.
k) Document expected available bandwidth within each car, within the Trainset, and for the Trainset as a whole.

12.6.2 Food Service Point-of-Sale [See Section 8.16.27]

For Amtrak, the Point-of-Sale System at a minimum shall have a securely mounted cash drawer, customer facing display, receipt printer, touchscreen Interface, barcode scanner, uninterrupted power supply and credit card authorization.

12.6.3 Train Communications Network [See Section 8.16.28]

The on-train network shall be comprised of an IP-based fiber backbone that runs the length of the Trainset, with car-to-car connections that optimize the capacity and throughput of the on-train network as a whole.

To increase Reliability and capacity of the on-train network, provider shall also provide for redundancy in the network design.

12.7 APPENDIX G – AMTRAK ACSES, CAB SIGNAL, AND ATC FUNCTIONAL REQUIREMENTS

12.7.1 Train Safety

Train Safety shall be the prime consideration in the design of the Cab signal and train control Systems and in the selection of their components, including insulated wire, wire terminals, binding posts, housings, conduits, resistors, capacitors, transformers, inductors, and other similar items, as well as Devices with moving components.

Each entire System shall meet the requirements of Section 12.7.1.1, or the System shall consist of Subsystems, each of which shall meet the requirements of either Section 12.7.1.1 or Section 12.7.1.2, assembled in a manner meeting the requirements of Section 12.7.1.1. In this section, the terms "restrictive" and "permissive" are used in connection with the binary outputs of two-position components or Subsystems and denote such alternatives as: stop/proceed, lower speed/higher speed, deceleration/acceleration, brakes applied/brakes released, alarm/no alarm, and similar combinations.

12.7.1.1 Safety Considerations

Important considerations in the design of those portions of the System or a Subsystem affecting train Safety are listed below:

a) Only components that have high Reliability and predictable Failure modes and that have been proven in conditions similar to the projected service are to be utilized.
b) Components must be combined in a manner that ensures that a restrictive rather than a permissive condition shall result from a component Failure.
c) Component or System Failures shall cause the train to stop or run at a more restrictive speed than that permitted with no Failure.
d) System Safety Equipment design shall be such that any single independent component or Subsystem Failure or any combination of similar single independent component or Subsystem Failures results in a safe condition. Failures that are not independent (those Failures which in turn always cause others) must be considered in combination as a single Failure and must not cause an unsafe condition.
e) Any component or wire becoming grounded shall not cause an unsafe condition.
f) Wherever possible, built-in checks shall be included that impose a restriction and/or actuate an alarm whenever a Device fails to assume its restrictive position when conditions require that it should.
g) All System software shall be considered Safety critical.
h) All requirements, specifications, standards, and practices of the American Railway Engineering & Maintenance- of –Way Association (AREMA) Communications and Signals Manual shall be met, where applicable.

12.7.1.2 Alternate Safety Consideration

As an alternate, certain portions of the System affecting train Safety shall include not less than two entirely independent, non-similar, parallel channels to perform each function and require a permissive decision from both channels (if only two are provided) or a permissive decision from a majority (if more than two are provided) before a permissive decision can be obtained from the combination.

The arrangement for comparing channel decisions shall meet the requirements of Section 12.7.1.1. The design of the channels shall ensure that an event modifying one channel such that it is no longer capable of withholding the permissive decision under all System states in which permission is not safe shall not cause any other channel to be modified in a way that would permit the other channel to reach an unsafe permissive decision. When such an event occurs, it must be detected and alarmed immediately. If, subsequent to such an event, there remains only one properly functioning channel, the combination must be prevented, from providing a permissive output under any condition.

Should an alternative for a relay Specified for Vital circuits, as defined by the American Railway Engineering and Maintenance-of-Way Communications and Signals (AREMA C&S) Manual part 1.1.1, be proposed for use that is an independent direct item replacement for the relay Specified, the alternative shall be subject to Amtrak Approval evaluated on the basis of its physical materials and construction, electrical characteristics, circuit Analysis, and Reliability.

Should an alternative be proposed for a Specified System, or components thereof, whose function affects the Safety of train operation and because of its magnitude and integration parameters precludes absolute fail-safe engineering Analysis, Amtrak will require definitive factory and field tests and documentation of research and development tests, prior to granting Approval of the alternative. Fail-safe Equipment proposed must be proven by in-service experience or made available for type acceptance testing.

12.7.1.3 Safety Analysis

The Contractor shall analyze the entire Cab signal/train control System, its Subsystems, and components in a systematic manner to determine the possible Failure modes and their effect on Safety.

This Analysis shall cover at least the following levels of concern:

a) Theoretical circuit behavior.
b) Hardware design.
c) Random component Failures.
d) Electrical interference.
e) Systematic component Failures.
f) Software errors.
g) User-dependent Hazards.

The Analysis shall be recorded in a single document that shall describe in detail the procedures used and the results. This document shall be controlled, updated throughout the

period of performance of this Contract, and shall be available for reference and delivered prior to acceptance of the first Trainset.

12.7.1.4 Systems Installation

Train control Equipment shall be provided at an accessible location in each leading and trailing Vehicle.

12.7.1.5 Calibration

Tolerance for all overspeed settings in this Specification shall be 4.8/-0 km/h (+3/-0 mph) including production variations between individual replacement boards or other components which are required to be fully interchangeable without re-calibration.

Overspeed settings shall be established in software with provision for properly authorized changes of settings. Adjustable potentiometers, rheostats, electrolytic capacitors and mechanical or pneumatic timers shall not be used.

12.7.2 Operating and Functional Requirements

The operating and functional requirements for the CS/SC System are as follows.

12.7.2.1 System

The combined Cab signal/speed control System shall provide for train operation under control of the Operator but with automatic enforcement of train protection speed limits imposed by the railroad signal System and displayed by the Cab signal.

12.7.2.2 Cab Signal Aspect Display

There shall be a continuously controlled, constantly visible speed-limit aspect Cab signal display in each Cab. This display shall show the speed-limit information transmitted through the rails in coded carrier form by the railroad signal System. Display must be visible by the Operator, in a Normal seated position. Display must continuously show the ACSES speed information as referenced in Section 12.7.3.3.

12.7.2.3 Audible Warning and Acknowledging

When an aspect changes to a more restrictive speed, an audible alarm shall sound within 1 second. The Operator shall be required to acknowledge the reduction in a positive manner within 5 seconds of the beginning of the audible alarm. Failure to acknowledge shall result in a penalty brake application, with power knockout. An audible warning shall sound until the reduction has been acknowledged. The penalty brake shall be forestalled if the brake handle is in suppression position, in which case the acknowledgement must be made before releasing the brake to avoid penalty brake application.

From the initial zero speed, when train speed increases above zero and when the Cab signal is displaying a restricting (32 km/h (20 mph)) aspect, the audible alarm shall sound. The Operator shall be required to acknowledge within 5 seconds of the beginning of the

audible alarm. Failure to acknowledge shall result in a penalty brake application, with power knockout.

12.7.2.4 Automatic Train Stop (ATS)

A full service penalty brake application and power knockout shall be made if the Operator fails to acknowledge an audible signal when 5 seconds have elapsed. The penalty application shall not be able to be released until the aspect reduction has been acknowledged, the throttle has been moved to the "0" position and the brake control lever has been moved to the suppression position. However release of a penalty brake application from ATS shall be possible without stopping the train when above conditions are met.

12.7.2.5 Automatic Speed Control (ASC)

The speed control function shall continuously compare the actual speed of the train with the speed permitted by the Cab signal aspect. If the speed of the train rises 4.8 km/h (3 mph) or more above the speed permitted by the Cab signal, an audible alarm shall sound within 1 second.

When train speed is 4.8 km/h (3 mph) or more above the speed permitted by the Cab signal aspect, a penalty brake shall be applied automatically and the power removed if the Operator fails to suppress this penalty within 5 seconds of the start of the overspeed condition. Suppression shall require manipulation of the controls to produce a deceleration rate which shall be determined during Proof-of-Design testing. Moving the brake control to suppression position and an acknowledgement of the alerter switch shall silence the audible alarm.

12.7.2.6 Release of Penalty Application

Release of a penalty brake application from overspeed shall be possible without stopping: by reducing the train speed to below the speed limit enforced by moving the throttle to the "0" position and brake control lever to the suppression position and an acknowledgement of the alerter switch.

12.7.2.7 Overspeed Indicator

An indicator shall be lighted when the train exceeds the speed limit displayed by the Cab signal. In addition, the light shall flash when a penalty brake application has been made by the ATS or ASC. Flashing shall continue until the CS/SC System is reset, ATS is acknowledged, or until the ASC has determined the train is under speed.

12.7.2.8 Stop Signal Aspect

Provision shall be made for a full stop function to be provided within the Cab signal/speed control System. If the train approaches a location where a positive stop is required, the System shall immediately initiate a full service brake application. Release of this application shall not be possible until train speed is zero and shall then require a reset action.

12.7.2.9 Speed Sensing System Cut Out

In the event of malfunction of the Speed Sensing System, it shall be possible to cut out this function, permitting train operation with Cab signals and enforced acknowledgment, but with no automatically enforced speed limit. Provision shall be made for the cut out control to be sealed in the non-cut out position as required by 49CFR.

12.7.2.10 ATS Cut Out

In the event of malfunction of the ATS and ASC Systems, it shall be possible to cut out both the ASC function and the ATS enforced acknowledgment, permitting operation without Cab signals. Provision shall be made for the cut out control to be sealed in the non-cut out position as required by 49CFR.

12.7.2.11 Non-Cab Signal Territory

Provision shall be made to permit operation in territory without Cab signals. When an input is provided to the Cab signal/speed control System indicating entry to non-Cab signal territory, the System shall darken all Cab signal aspects, deactivate acknowledgment circuits and impose a 127 km/h (79 mph) speed limit through the ASC System. Upon entering Cab signal equipped coded territory, any code received shall cancel the cutout condition and cause the Cab signal to be displayed. At this time it shall be necessary to place the "Territory" switch in the "cut-in" position and reset the acknowledging circuits. The 127 km/h (79 mph) speed limit shall be removed and the speed limit shall be as determined by the Cab signal.

12.7.2.12 Aspects, Indications, and Authorized Speeds – NEC

Some Cab signal aspects require two carrier frequencies, designated F1 and F2, as shown in the Table 1. Other aspects require only the F1 carrier. The Cab signal Equipment shall decode each carrier independently. Aspects requiring both carriers shall be permitted only when the F1 and F2 code rates are the same and code pulses on the two carriers are applied alternately. A steady or simultaneously occurring F2 code rate shall not be accepted as the two-code aspect.

The Cab signal System shall decode the carrier frequency and code rate combinations listed in Table 1. Wayside Carrier/Code Rates and aspects for authorized speeds in excess of 241 km/h (150 mph) will be discussed at the design review.

The aspects and authorized speeds for the various frequency/code combinations are as follows:

Table 1 - Aspects, Indications, and Authorized Speeds – NEC

Wayside Carrier/Code Rates		Aspect	Authorized Speed
F-1	F-2		
180	180	CLEAR 160	160
180	XXX	CLEAR 125	125
270	270	CLEAR 100	100
120	120	CAB SPEED 80	80
270	XXX	CAB SPEED 60	60
120	XXX	APPROACH LIMITED	45
75	75	APPROACH MEDIUM	30
75	XXX	APPROACH	30
XXX	XXX	RESTRICTING	20
XXX *Wayside Transponder	XXX	STOP SIGNAL	0
XXX	XXX	DARK	(non-Cab signal territory)

*Loss of input from ACSES during no-code, as described in the last paragraph of this Section.

A single speed display shall be provided. When the Cab signal-authorized speed is equal to or lower than the ACSES-authorized speed, the Cab signal-authorized speed shall be displayed.

When the ACSES-authorized speed is equal to or lower than the Cab signal-authorized speed, the ACSES-authorized speed shall be displayed. The determination of which authorized speed is higher shall be made independently in the Cab signal and ACSES Systems. The Cab signal-authorized speeds shall always be displayed.

The stop aspect shall be displayed when no code is received and an input from ACSES is removed. ACSES will read the transponder and provide this normally energized input until the braking point is reached. Removal of this input will trigger the "Stop" aspect and require braking to 0 km/h (0 mph).

12.7.2.13 Response Times and Values

The response times, values, and limits for the Cab signal and speed control Systems shall be as follows:

a) Maximum time from receipt of any speed code (one or both carriers) to the display of the new aspect and speed limit shall be 3 seconds.
b) When less restrictive code changes occur in the rail, the aspect shall change to the appropriate indication within 3 seconds. A "single stroke" audible signal shall occur, not needing acknowledgment.

c) Minimum time in advance of pickup of the F1 code relay of any code for the F2 code relay of the same code to pick up shall be one-half the code period.
d) Minimum time after dropout of any F1 code relay, for the F2 code relay of the same code to drop out shall be one-half the code period of the code present at that time.
e) The elapsed time between receipt of the speed information by the ASC System and a penalty brake application due to Failure to acknowledge shall be 5 seconds, maximum.
f) The elapsed time between the occurrence of an overspeed condition and its recognition by the ASC System shall be 0.5 second, maximum.
g) The elapsed time between the occurrence of an overspeed condition and the commencement of a penalty brake application (due to lack of proper suppression) shall be 5 seconds, maximum.

12.7.2.14 Wayside Interface

12.7.2.14.1 Worst-Case Condition

The Cab signal Equipment shall respond to any favorable or restrictive code change with no significant change in response times with the worst case combination of intolerance values of carrier frequencies and levels, code rates and duty cycles, power supply voltages, and track receiver height above rail.

12.7.2.14.2 Signal Carriers

The Cab signal Equipment shall operate using two carrier frequencies: F-1, a 100 Hz or 91.67 Hz and F-2, a250 Hz.

Operation shall be such that the Equipment shall interpret the F-1 carrier as specific speed commands for each coding rate and shall interpret the same F-1 coding rates as separate and distinct higher speed commands when the F-2 carrier is present during the "off" coding periods of the F-1 carrier.

The Cab signal Equipment shall respond to and operate successfully with the following carrier frequencies and tolerances:

a) F-1 100 Hz Range 96.5 Hz to 101.5 Hz.
b) F-1 91.67 Hz Range 90.2 Hz to 93.2 Hz.
c) F-2 250 Hz Range 247 Hz to 253 Hz.

The minimum in-rail coded carrier current over which the Cab signal Equipment shall successfully operate are:

a) F-1 2.0 A.
b) F-2 1.25 A.

The calibration point is 1.5 A for F1 and 0.9 A for F2. The operating margins will be obtained by the fact that the actual minimum in-rail coded current level will be maintained at 25% above the calibration levels.

The System shall be arranged to provide an indication to the event recorder, diagnostic and monitoring functions if the in-rail coded carrier current is sensed to be more than 20 A or less than the minimum tolerances for F-1 or F-2. The Cab signal from the pickup bars shall be monitored and recorded for current level, code and carrier frequency. This may take the form of a numerical read-out that stores Data based upon a signal change or loss or low input current. The geographic location, when available and time shall also be indicated recorded.

12.7.2.14.3 Codes

The two (2) in-rail carriers will be coded at four code rates with the F-2 carrier either present or not present during the "off' portion of the F-1 code. The Cab signal Equipment shall respond to these code rates. Certified test records are required as part of the first article inspection.

The Cab signal Equipment shall operate successfully with the following code rate ranges, stated in Pulses Per Minute (PPM):

a) 75 PPM, range 71 to 77 PPM.
b) 120 PPM, range 118 to 125 PPM.
c) 270 PPM, range 268 to 283 PPM.
d) 180 PPM, range 178 to 188 PPM.

The Cab signal Equipment shall operate successfully with an F1 code duty cycle where "on time" ranges between 30% and 70% of the total code period.

12.7.2.15 Display

The display unit shall include civil speed aspects for ACSES. The display unit must be approved by Amtrak during the design review.

In addition to the Cab signal aspect display, the Cab signal System shall include the following displays:

a) Overspeed/Penalty Indication (red) - Indicates an overspeed or more restrictive condition (constant light) or penalty condition (flashing light).
b) Cab Signal Cut -Out Indication (yellow) - Indicates that a Cab signal penalty application has been manually disabled with the cut out control.
c) Self-Test Light - Indicates self-test in progress.
d) Suppression Indication (yellow) - Indicates that suppression has been achieved. No penalty application shall occur when suppression is achieved within 6 to 8 seconds after the code rate is received or 3 to 5 seconds after initiation of an audible alarm.
e) No Motion Indication (blue or green) - Indicates that there is a no speed indication from the no motion function.

12.7.2.16 Suppression

Suppression of a penalty brake application shall require that the controls are operated so as to produce a defined deceleration rate.

12.7.2.17 Event Recorder Interface

The appropriate Cab signal indications including the aspect displays and civil speed information shall be provided to the Interface of the Cab event recorder for compliance with FRA rules.

12.7.2.18 Signal/Speed Control Equipment

The Cab signal Equipment for each controlling Vehicle shall include:

a) Receiver bar Assembly.
b) Train Control Enclosure.
c) Aspect Display Unit.
d) Audible alarm.
e) Acknowledging switches (foot and console).
f) All necessary control switches.
g) Speed input signal.

12.7.2.19 Receiver Bar Assembly

There shall be one set of receiver bars at the operating end of each controlling Vehicle. Each receiver coil shall have 210 to 250 ohms DC resistance, with a maximum total of 500 ohms.

12.7.2.20 Cab Signal Enclosure

The Cab signal Equipment shall be housed in a cabinet sealed against dirt and contamination encountered in Normal railroad operation. Sufficient cooling shall be provided to the enclosure of train control System. The construction of the System shall be modular, using solid-state technology.

12.7.2.21 Display Unit and Controls

An Aspect Display Unit shall be fitted in each Cab. The Aspect Display Unit shall provide the aspects and indications required by this technical Specification.

The following controls shall be provided:

a) Acknowledge Switch – There shall be a foot switch and a hand switch. Operation of either switch shall provide acknowledgment. The foot switch shall be under the console and conveniently operated by either foot. If the hand switch is held in an acknowledge position for three seconds, the alarm shall sound and a penalty shall result if no release occurs in 5 seconds after the sounding of the alarm.

b) Self-Test Function – A function key on the Operator's console shall initiate self-test.
c) Pneumatic Cut-Out – A pneumatic cutout valve to disable the penalty application shall be provided. When the valve is cut out, the Cab signal System shall continue to function with the exception that a penalty application shall be inhibited (aspect display, audible alarm, over speed, and acknowledge shall still function).
d) Non-Cab Signal Territory Selection – Operation of this control shall indicate the transition from Cab Signal territory to Non-Cab Signal territory.

12.7.2.22 Self-Test

The Cab Signal Logic and Speed Control shall include an automatic self-test sequence, calibration check, and System diagnostics. The self-test shall be sufficient to ensure the integrity of the Cab signal and speed control System. Self-test shall meet the FRA requirements for a terminal test.

It shall be possible to initiate the self-test anywhere on the railroad irrespective of presence of valid Cab signal aspect. It shall not be possible to initiate the self-test unless the following conditions are met:

a) Parking brake is applied.
b) The no motion indication is present.
c) Cab signal territory is selected.

The console display shall illuminate and the System shall proceed to test itself, including as many Operator and mechanical Interfaces as practical. The following shall be included together with all electronic module verifications:

a) Receiver bar integrity.
b) Power supply.
c) Aspect display unit.
d) Audible alarm.
e) Overspeed indicator.
f) Deceleration rate sensor.
g) Speed sensor.
h) External vital inputs and outputs.
i) Speed aspect upward and downward progressions.
j) Brake System Interfaces.
k) Acknowledge switch.

The test Data shall be displayed on the Cab display screen and shall be easily accessible to Maintenance personnel via the diagnostic and monitoring System.

12.7.2.23 Fault and Event Log Capability

The System shall have memory log(s). The event log shall record events such as Cab signal aspects; various input/output oriented functions, overspeed, and similar events. Details will be developed with the supplier based on final System configuration and the current FRA regulations. The event log shall keep a record of these events for at least 100 hours.

There shall be a Fault memory log which shall be determined by the Trainset builder and approved by Amtrak.

12.7.2.24 Power Supply

The Cab signal Equipment described in this Specification shall be powered from an isolating power supply. The power supply shall provide complete isolation between all Cab signal and speed control Systems and all other Vehicle circuits.

12.7.3 Advanced Civil Speed Enforcement System (ACSES)

12.7.3.1 Equipment Installation

The ACSES System shall have independent Interfaces with the propulsion and braking System, speed sensing System, event recorder, and the diagnostic and monitoring System. The ACSES System shall be used for the management of catenary gaps, voltage and frequency changes on the right-of-way.

12.7.3.2 Equipment Case

Equipment case shall be designed per Section 12.7.2.20 of this Specification. Sufficient cooling shall be provided to the ACSES enclosure.

12.7.3.3 Display Unit and Controls

The Cab signal aspect display unit shall display the indications of the ACSES; this shall be subject to a design review.

12.7.3.4 Interfaces with Other Systems

The ACSES will provide an overspeed function to enforce speed restrictions. The speed measuring System shall provide a speed input signal to the ACSES System. ACSES shall interface with the propulsion and braking control Systems in the same manner as the Cab signal and speed control Systems. The acknowledging switches of the Cab signal/speed control System shall acknowledge a signal from the ACSES System.

12.7.3.5 ACSES System Definition

ACSES System shall be fully in compliance with FRA ACSES II Type Approval including all the Amtrak FRA PTC Type Approved Variances. ACSES System hardware, software and operating parameters shall be same as present application and per the Amtrak operating rule book.

The System shall include logic to compare the distance between transponders with wheel revolutions as recorded in the speed sensing System. The System shall be used to calibrate the speed sensing System for wheel diameter adjustments and display the wheel diameter information via the monitoring System.

Outputs from the System shall be made available to Trainset Systems as required.

12.7.3.6 Positive Train Stop Override (PTSO)

The ACSES System shall provide a means for the Operator to initiate a PTSO at Home Signals displaying a Stop Indication. The switch must be located in a position that requires the Operator to physically leave the seated position. The PTSO will permit the train to move at restricted speed throughout the Interlocking Limits after receiving permission from the Dispatcher.

12.7.4 Alerter System

Alerter shall be a microprocessor based System to enhance the safe operation of the Trainset by monitoring the alertness of the Operator. The System shall continuously monitor the action of the Operator. After a predetermined time, in the absence of detectable movement, the System shall request an acknowledgement by means of audio/visual alarms. Failure to acknowledge (reset) in 5 seconds, results in a penalty brake application with power knock out. The alerter System shall comply with the requirements of 49CFR.

An alerter reset is generated every time the Operator makes a cruise control or throttle change, a brake adjustment, acknowledges a Cab signal, speed control or ACSES alarm, rings the bell, releases the horn sequencer (Operator only), or depresses the alerter Acknowledge switch.

The alerter shall become dormant if the parking brake is applied, a brake application of suppression or greater occurs, or the Cab is deactivated.

12.7.5 Speed Sensing

Speed sensing System(s) shall be provided on each Trainset to provide axle speed and train speed information as required by the Cab signal/speed control System, ACSES, no-motion function, event recorder, speed display in the Cab and any other Systems or displays requiring Vital speed information. The System shall provide inputs to Safety-critical Systems and shall be treated as Safety-critical.

12.7.5.1 Axle Speed Sensing

Each Trainset shall be equipped with adequate speed sensors to provide redundancy in the event a speed sensor or speed sensors fail.

12.7.5.2 Wheel Diameter Calibration

The speed sensing System shall provide automatic calibration for wheel diameter by the use of inputs from the Position Transponder System (PTS). The System may also consider the

relative speeds of individual axles when the train is coasting. Provision shall also be made for manual inputs which shall remain in effect until corrected through the PTS.

12.7.5.3 Train Speed Determination

Using an approved calculation process, the System shall compute train speed based on all the axle speeds. The calculation process may discard individual axle speeds which appear to be in error, but shall record a Fault for any such speed.

12.7.5.4 No-Motion Circuit

Safety critical circuits and software shall provide zero-speed output signals to indicate when the Trainset is not moving. There shall be checks which verify the no-motion signal and if an error exists for a predetermined time interval, this circuit shall cause the door control Systems to revert to a safe state. The check is based on more than one speed sensor.

The output of the no-motion circuits shall control other appropriate Trainset Systems. The Contractor shall coordinate the number, type and capacity of outputs required.

A no-motion bypass switch shall be included as part of the no-motion circuit, in the Cab area. This switch shall be enabled only when the brake cylinder pressure indicates a full service brake application. The bypass shall automatically disengage when the brakes are released and must be re-activated for each successive bypass. This bypass circuit shall permit Normal no-motion circuit status to be indicated to other Systems, including but not limited to, the door control and propulsion circuits. This reset action shall not prevent the no-motion check circuit from functioning and indicating a no-motion circuit Failure the next time that a no-motion circuit Failure occurs.

12.7.5.5 Speedometer

A speedometer shall be provided in the console of each Cab, integrated within the Primary Operating Display screen. The speedometer shall have 1.6 km/h (1 mph) resolution, with a digital readout in the lower portion of the dial, and shall be illuminated. A second (outer) pointer shall be provided, which shall be used to indicate the cruise speed control set point. The speedometer motion shall be smooth, continuous movement which shall accurately depict Trainset speed in real time. The digital speed readout shall be presented so as not to flicker unnecessarily between values and cause a distraction.

12.7.5.6 Crew Office and Passenger Area Speed Displays

The speed sensing System shall have the capability to provide a speed signal to displays in the crew office and in passenger areas of the train. This signal shall be isolated from the operational functions of the speed sensing System so that no Fault in this display System will degrade the operational functions.

12.7.5.7 Fault Sensing

The speed sensing System shall continuously compare all axle speeds with the train speed, taking wheel diameter calibration Data into account. If any axle departs from its expected

speed for a period of time longer than the time out of the wheel slip control System, this condition shall be signaled to the Operator through the diagnostic and monitoring System.

12.7.6 Software Management Control Plan

The supplied train control Equipment shall comply with 49CFR Part 236.18 and shall allow Maintenance personnel to easily obtain information for Amtrak's Software Management Control Plan (SMCP). The supplier may propose an automated method for providing the information needed for Amtrak's Software Management Control Plan (SMCP).

13 ATTACHMENTS

The following documents are attached to this Specification.

13.1 AMTRAK ATTACHMENTS

a. Journey Time

This file is mentioned in Section 5.1 and contains the following:

- Next Generation DC to NYP Route Profile.xls;
- Next Generation NYP to Boston South Station Route Profile.xls;
- Next Generation TPC Data Form.xls.

b. Amtrak Clearance Diagram 05-1355 Rev. E.

c. NGHSR Design Vision

d. Amtrak On-board Signage Manual

e. Amtrak Drawing No. AM 73195-A

f. Amtrak Rail Profile

g. Amtrak Wheel Profile NRCC

h. Amtrak Drawing D-12-7191

i. Amtrak Trainwash Facilities

j. Amtrak Drawing A-60-7659

k. Amtrak Wheel Truing Drawings

l. Amtrak Operating Plan

13.2 AUTHORITY ATTACHMENTS

a. Authority's San Jose-LA Union Station Alignment

- 2.San Jose - Merced.xls
- 3.Merced to Fresno.xlsx
- 4.Fresno - Bakersfield.xls
- 5.Bakersfield - Palmdale.xls
- 6.Palmdale - Los Angeles.xlsx
- Representative CHSRA Alignment.doc

b. Authority's Design Criteria Manual

- DCM_RSProcurement_01132014.pdf

c. Authority's Safety and Security Management Plan

- SSMP 130408 No Signatures.pdf

d. Authority's Hazard Risk Acceptance Program

- TM 500 06 Hazard Risk Acceptance Program 130809 No Signatures.pdf