THIS PRINT COVERS CALENDAR ITEM NO.: 15

SAN FRANCISCO
MUNICIPAL TRANSPORTATION AGENCY

DIVISION: Transit

BRIEF DESCRIPTION:

Authorizing the Director of Transportation to execute Contract No. SFMTA-2021-06 with Nova Bus, a Division of Prevost Car (US) Inc., to procure three 40-foot low floor battery electric buses, along with associated spare parts, training, manuals, and special tools, in an amount not to exceed $4,772,266, and for a term not to exceed five years.

SUMMARY:

- The SFMTA is launching a battery electric bus pilot program to evaluate the performance, reliability, maintainability, and operability of these buses in San Francisco's unique operating environment, to develop relationships with a large pool of bus manufacturers, and to increase competition for future mass bus procurements.
- After a Request for Proposals (RFP) process in late 2018, the SFMTA entered into three contracts in December 2019, each for three low-floor, 40-foot battery electric buses, with New Flyer of America, Inc., BYD Coach & Bus LLC, and Proterra Inc.
- The successful operation of this pilot program is instrumental to the SFMTA's Zero Emission Bus Rollout Plan which was adopted by the Board on March 16, 2021.
- Nova Bus did not participate in the SFMTA's RFP for the battery electric bus pilot program as they did not have a long-range battery electric bus available at that time. Nova Bus represents a key opportunity to expand the SFMTA's pilot to include a large bus manufacturer that does not typically bid on San Francisco procurements.
- The SFMTA wishes to acquire three 40-foot, low-floor, battery electric buses, and associated spare parts, training, manuals, and special tools, as amended by the provisions of this Agreement.

ENCLOSURES:
1. SFMTA Board Resolution
2. Contract with Nova Bus
3. Zero Emission Bus Rollout Plan – https://www.sfmta.com/sites/default/files/reports-and-documents/2021/03/3-16-21_item_12_zero-emission_bus_rollout_plan.pdf

APPROVALS:		**DATE**
DIRECTOR		April 13, 2021
SECRETARY		April 13, 2021

ASSIGNED SFMTAB CALENDAR DATE: April 20, 2021

PURPOSE

Authorizing the Director of Transportation to execute Contract No. SFMTA-2021-06 with Nova Bus, to procure three 40-foot low-floor battery electric buses, along with associated spare parts, training, manuals, and special tools, in an amount not to exceed $4,772,266, and for a term not to exceed five years.

STRATEGIC PLAN GOALS AND TRANSIT FIRST POLICY PRINCIPLES

The item will support the following goals and objectives of the SFMTA Strategic Plan:

Goal 1: Create a safer transportation experience for everyone.
Objective No. 1.2: Improve the safety of the transit system.

Goal 2: Make transit and other sustainable modes of transportation the most attractive and preferred means of travel.
Objective No. 2.1: Improve transit service.

Goal 3: Improve the quality of life and environment in San Francisco and the region.
Objective No. 3.4: Provide environmental stewardship to improve air quality, enhance resource efficiency, and address climate change.

This item will support the following SFMTA Transit First Policy Principle:

2. Public transit, including taxis and vanpools, is an economically and environmentally sound alternative to transportation by individual automobiles. Within San Francisco, travel by public transit, by bicycle and on foot must be an attractive alternative to travel by private automobile.

BACKGROUND

The transportation sector is San Francisco's largest source of greenhouse gas (GHG) emissions and criteria air pollutants. As of 2018, transportation related GHG emissions accounted for nearly half of citywide emissions, over 70% of which are attributable to private auto use. Public transportation accounts for less than 2% of citywide emissions, and less than .01% of citywide emissions are attributable to the SFMTA's transit fleet. The SFMTA has been a global leader in supporting sustainable, reduced or zero emission revenue transit vehicles. It currently operates the largest fleet of zero emission electric trolley vehicles in North America, running on 100% greenhouse gas-free (GHG) electricity.

The Innovative Clean Transit (ICT) regulation was adopted by the California Air Resources Board (CARB) in December of 2018 and became effective October 1, 2019. The ICT regulation requires all public transit agencies in California to gradually transition their bus fleets to zero-emission

technologies with the goal of full transition to zero-emission buses by 2040.[1]

The ICT regulation requires that each agency prepare a Zero Emission Bus (ZEB) Rollout Plan (Enclosure 3). The purpose of the Rollout Plan is to ensure each agency has a strategy to comply with the 2040 requirement of a fully zero emission fleet.

Introducing battery electric buses into our fleet builds on our commitment to zero emission transit vehicles and is outlined in the SFMTA's Zero Emission Bus Rollout Plan, which was adopted by the SFMTA Board of Directors in March 2021. As outlined in the ZEB Rollout Plan, electric buses are an emerging technology that are yet to be tested in San Francisco's challenging operating environment, which includes steep hills and high passenger loads. The adoption of battery electric buses also requires significant investment in infrastructure, including retrofitting (and in some cases rebuilding) of our bus facilities. The SFMTA is launching a battery electric bus pilot program to evaluate the performance, reliability, maintainability, and operability of these buses in San Francisco's unique operating environment, to develop relationships with a large pool of bus manufacturers, and to increase competition for future mass bus procurements.

The SFMTA issued an RFP in November 2018 for a pilot program to test low-floor 40-foot battery electric buses. The RFP process concluded in 2019 with the SFMTA entering into three contracts, each for three battery electric buses, with the following manufacturers: New Flyer of America, Inc., BYD Coach & Bus LLC, and Proterra Inc. The SFMTA issued notices to proceed to the three manufacturers on December 12, 2019.

In this pilot program, the SFMTA will compare the battery buses from each original equipment manufacturer (OEM) to one another, as well as to our existing electric hybrid buses and trolley buses. The battery technology used in electric vehicles is rapidly evolving, and the SFMTA would like to test the best available battery technology offered by the leading electric bus manufacturers in North America. The pilot will be used to evaluate the bus-building ability of each OEM to ensure they can provide safe and reliable buses for our riding public.

The delivery of the battery electric buses for the pilot program has been delayed to Summer 2021 due to COVID-19, but the SFMTA has continued to make progress and has completed installation of a Battery Electric Bus charging unit at 1399 Marin and initiated construction of scalable charging infrastructure at Woods Division.

Nova Bus is a leading manufacturer of transit vehicles in North America. Nova Bus has delivered more than 12,000 buses to transit operators in North America over the last 20 years. Nova Bus did not respond to the SFMTA's RFP in 2018 as its proposed long-range battery electric bus was not available for sale at the time, but it is now available. Staff highly recommends that the SFMTA evaluate Nova Bus's battery electric bus offering as part of the Agency's pilot program for these key reasons:

[1] The Regulation does not apply to trolley buses.

- For its zero-emission propulsion system, Nova Bus has partnered with BAE Systems. The SFMTA currently operates over 300 hybrid electric buses powered by the BAE System. The familiarity with BAE System's propulsion system provides significant advantages for the Agency's maintenance crew.
- Nova Bus's experience as a leading bus OEM with a reliable bus platform and local support network.
- A further opportunity to increase competition and qualify another manufacturer who has the capacity and capabilities to produce at a large scale.

DESCRIPTION

Under Section 21.16 of the San Francisco Administrative Code, the SFMTA may utilize the competitive procurement process of any other public agency to make purchases of commodities under the terms established in that agency's procurement process and as agreed upon by the City and the procuring agency, upon making a determination that the other agency's procurement process was competitive and the use of the other agency's procurement process would be in the City's best interests.

The SFMTA would like to expedite the procurement of battery electric buses from Nova Bus in order to evaluate them concurrently with the other battery electric buses in the pilot program. Staff has determined that by purchasing battery electric buses through the Virginia Procurement, it is possible to achieve this objective. Often, cooperative purchasing arrangements result in cost and time savings to the purchasers. The Federal Transit Administration (FTA) encourages such arrangements provided that all FTA requirements are followed.

In March 2019, Virginia issued an Invitation for Bids (IFB) for 12-year-type,[2] low-floor battery-powered electric transit buses in different lengths (35', 45', 60'). The Virginia Procurement is available for interstate purchases from public entities and complies with the third-party procurement requirements of the FTA.

Nova Bus submitted a proposal for 40-foot battery-powered electric buses in response to the Virginia Procurement on April 15, 2019. Virginia accepted the proposal and issued Notification of Contract Award to CBS on or about July 1, 2019. The Virginia contract states that no assignment or other contractual arrangement with Virginia is required on the part of either Nova or the agency acquiring the buses. Nova Bus builds battery electric buses for the United States in their plant in New York and is a fully 12B compliant vendor.

The specifications of the buses in the Virginia Procurement are broad enough to allow the SFMTA to customize the vehicles to meet the needs of the SFMTA so long as the SFMTA's requirements do not require substantive changes to the design of the vehicles.

[2] Each bus was required to have a minimum life expectancy of 12 years.

Staff successfully negotiated terms with Nova Bus, including various enhancements to the basic bus, e.g., a closed circuit television (CCTV) system, a radio system from Conduent (the SFMTA's supplier), the Clipper® fare collection system, a passenger information system, a destination sign system, fareboxes, the ViriCiti telematics system, single forward-facing seats, wheelchair securement layout, a 3-position bike rack, fixed hand straps, upgraded electric doors, upgraded wheelchair ramp, and a more protective operator barrier due to the COVID-19 pandemic.

STAKEHOLDER ENGAGEMENT

The SFMTA conducted extensive public outreach to industry experts and other transit agency representatives to inform the vehicle design. Within the SFMTA, Fleet Engineering staff worked with transit operators and union leadership, vehicle maintenance personnel, Accessible Services, Information Technology, and Transit Planning. The SFMTA received feedback from stakeholders and incorporated them into the vehicle design. Based on the feedback received, the SFMTA opted to enhance driver safety with a more protective driver's barrier and updated video surveillance system, upgrade the ADA-compliant wheelchair ramp for easier boarding, improve cyclist safety with exterior mirror turn signals, and update the wheelchair securement system.

ALTERNATIVES CONSIDERED

The SFMTA considered the alternative of purchasing additional 40-ft battery electric buses under the New Flyer, BYD, and Proterra battery electric bus contracts during the SFMTA's pilot program. However, this would leave out Nova Bus, a prominent North American bus manufacturer, from consideration and evaluation in the pilot program. Leaving Nova Bus out of the electric bus pilot program would limit the experience gained during the program and might lessen the SFMTA's ability to select the best possible bus for future large-scale battery electric bus procurements.

Staff also considered purchasing vehicles through a regular RFP process. However, staff found it preferable to purchase them through the Virginia Procurement because it would take less time, and the Nova Bus vehicles could more easily be compared to the other buses during the pilot program.

FUNDING IMPACT

The SFMTA has budgeted $23,225,000 for the overall electric bus pilot program, which includes the vehicles, parts, training, manuals, special tools, taxes, project management, project engineering, maintenance support, and consultant support. The following is the detailed project budget and funding plan:

Contract		Amount
SFMTA-2019-02 (New Flyer)	$	4,452,536
SFMTA-2020-18 (BYD)	$	3,509,150
SFMTA-2020-19 (Proterra)	$	5,262,602
SFMTA-2021-06 (Nova)	$	4,772,266

Contract		**Amount**
Soft Costs – Includes planning, preliminary engineering, detail design, project administration, warranty support, consultant services	$	5,228,446
Total Project Cost	**$**	**23,225,000**

This project will be funded using a diverse array of revenue sources, outlined below.

Funding Sources		**Amount**
Operating Funds FY18	$	230,000
Population-Based General Fund Set-Aside (Prop. B - Transit Investments) Various FYs	$	5,630,078
Educational Revenue Augmentation Funds (ERAF) FY19	$	3,572,811
Low Carbon Transit Operations Program (LCTOP) FY19	$	9,715,915
Transportation Sustainability Fee (TSF) FY20	$	3,076,196
Federal Transit Administration (FTA) 5307- Urbanized Area Formula Grants FY20	$	1,000,000
Total	**$**	**23,225,000**

ENVIRONMENTAL REVIEW

On December 21, 2020, the SFMTA, under authority delegated by the Planning Department, determined that the Nova Bus Contract for Procurement of Three 40-Ft Battery Electric Buses is not a "project" under the California Environmental Quality Act (CEQA) pursuant to Title 14 of the California Code of Regulations Sections 15060(c) and 15378(b).

A copy of the CEQA determination is on file with the Secretary to the SFMTA Board of Directors and is incorporated herein by reference.

OTHER APPROVALS RECEIVED OR STILL REQUIRED

The City Attorney's Office has reviewed this calendar item.

RECOMMENDATION

Staff recommends that the SFMTA Board authorize the Director of Transportation to execute Contract No. SFMTA-2021-06 with Nova Bus, to procure three 40-foot low floor battery electric buses, along with associated spare parts, training, manuals, and special tools, in an amount not to exceed $4,772,266, and for a term not to exceed five years.

SAN FRANCISCO
MUNICIPAL TRANSPORTATION AGENCY
BOARD OF DIRECTORS

RESOLUTION No. _____

WHEREAS, The San Francisco Municipal Transportation Agency (SFMTA) has been a national leader in supporting sustainable, reduced, or zero-emission revenue transit vehicles; and

WHEREAS, The SFMTA is launching a battery electric bus pilot program to evaluate the performance, reliability, maintainability, and operability of these buses in San Francisco's unique operating environment, to develop relationships with a large pool of bus manufacturers, and to increase competition for future mass bus procurements; and

WHEREAS, After a Request for Proposals (RFP) process initiated in November 2018, the SFMTA entered into three contracts in 2019, each for three low-floor, 40-foot battery electric buses, with the following manufacturers: New Flyer of America, Inc., BYD Coach & Bus LLC, and Proterra Inc.; and

WHEREAS, The SFMTA desires to procure three Buses from Nova Bus to expand the SFMTA's battery electric bus pilot program and take advantage of this opportunity to increase competition and qualify another manufacturer with the capacity and capabilities to produce at scale; and

WHEREAS, On April 15, 2019, Nova Bus, a Division of Prevost Car (US) Inc. (Nova Bus), submitted a proposal for 40-foot low floor battery-powered transit buses (Buses) in response to the Virginia Procurement; DPS accepted the proposal and issued Notification of Contract Award to Nova Bus on or about July 1, 2019; and

WHEREAS, Under Section 21.16 of the San Francisco Administrative Code, the SFMTA may utilize the competitive procurement process of any other public agency to make purchases of commodities under the terms established in that agency's procurement process and as agreed upon by the City and the procuring agency, upon making a determination that the other agency's procurement process was competitive and the use of the other agency's procurement process would be in the City's best interests; and

WHEREAS, In 2019, the Commonwealth of Virginia, Division of Purchases and Supply (DPS), issued an Invitation for Bids for 12-year-type, low floor electric transit buses (the Virginia Procurement); the Virginia Procurement complies with the third party procurement requirements of the Federal Transit Administration and is available for interstate purchases from public entities; and

WHEREAS, Purchasing buses through the Virginia Procurement would allow the SFMTA to expedite the procurement of battery electric buses from Nova Bus in order to evaluate them concurrently with the other battery electric buses in the pilot program; and

WHEREAS, On December 21, 2020, the SFMTA, under authority delegated by the Planning Department, determined that the Nova Bus Contract for Procurement of 40-Ft Battery Electric Buses is not a "project" under the California Environmental Quality Act (CEQA) pursuant to Title 14 of the California Code of Regulations Sections 15060(c) and 15378(b); and

WHEREAS, A copy of the CEQA determination is on file with the Secretary to the SFMTA Board of Directors and is incorporated herein by reference; and

WHEREAS, SFMTA staff has negotiated an agreement with Nova Bus to purchase three Buses and associated spare parts, training, manuals, and special tools and incorporate the SFMTA's preferred technical specifications; now, therefore be it

RESOLVED, Based on the above, the San Francisco Municipal Transportation Agency Board of Directors finds the Virginia Procurement process was competitive, and that it is in the best interests of the City that the SFMTA procure the buses from Nova Bus through the Virginia Procurement; and be it further

RESOLVED, That the San Francisco Municipal Transportation Agency Board of Directors authorizes the Director of Transportation to execute Contract No. SFMTA-2021-06 with Nova Bus, to procure three 40-foot low floor battery electric buses, along with associated spare parts, training, manuals, and special tools, in an amount not to exceed $4,772,266, and for a term not to exceed five years.

I certify that the foregoing resolution was adopted by the San Francisco Municipal Transportation Agency Board of Directors at its meeting of April 20, 2021.

_____

Secretary to the Board of Directors
San Francisco Municipal Transportation Agency

City and County of San Francisco
Municipal Transportation Agency
One South Van Ness Ave., 7th Floor
San Francisco, California 94103

Agreement between the City and County of San Francisco and Nova Bus, A Division of Prevost Car (US) Inc. (Through the Commonwealth of Virginia)

For Procurement of Three (3) 40-Foot Battery Electric Coaches
Contract No. SFMTA-2021-06
CCO No. 21-1552

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City and County of San Francisco
Municipal Transportation Agency
One South Van Ness Ave., 7th Floor
San Francisco, California 94103

Agreement between the City and County of San Francisco and Nova Bus, A Division of Prevost Car (US) Inc.
Contract No. SFMTA-2021-06
CCO No. 21-1552

This Agreement is made on _____ in the City and County of San Francisco, State of California, by and between Nova Bus, a division of Prevost Car (US) Inc., a Delaware corporation authorized to do business in California. (Nova Bus or Contractor), and the City and County of San Francisco (City), a municipal corporation, acting by and through its Municipal Transportation Agency (SFMTA).

Recitals

A. In 2019, the Commonwealth of Virginia (Virginia), issued an invitation for bids (IFB) for a cooperative procurement for low floor, electric transit buses. The Virginia procurement complies with the third-party procurement requirements of the Federal Transit Administration (FTA).

B. Nova Bus submitted a bid that was opened on April 15, 2019. Virginia accepted the proposal and issued Notification of Contract Award to Nova Bus on or about July 1, 2019, Contract No. E194-81688.

C. Under S. F. Administrative Code Section 21.16, the SFMTA may utilize the competitive procurement process of any other public agency to make purchases of commodities under the terms established in that agency's competitive procurement process upon a finding that the procurement is in the City's best interests.

D. Under the authority of Administrative Code Section 21.16, the SFMTA now wishes to acquire three 40-foot, low floor battery-electric coaches, with options for up to three addditional coaches, and associated spare parts, training, manuals, ViriCiti licenses, and special tools, from Nova Bus through the Virginia procurement, and as superseded or amended by the provisions of this Agreement.

E. The SFMTA has requested various specification changes for the buses and has negotiated with the Contractor price increases for these items, as appropriate. Contractor has also agreed to additional terms and conditions as consideration for this Agreement.

Now, THEREFORE, the parties agree as follows:

Article 1 Definitions

The following definitions apply to this Agreement:

1.1 "Acceptance" means the formal written acceptance by the City that all Work, or a specific portion thereof, under the Contract has been satisfactorily completed.

1.2 "Agreement" or **"Contract"** means this contract document covering the performance of the Work and furnishing of labor, materials, equipment, tools, and services, including Work incidental to the procurement, to include the Technical Specifications, all Conformed Contract Documents, the Contract bonds or other security, any future amendments, all attached appendices, and all applicable City Ordinances and Mandatory City Requirements that are specifically incorporated into this Agreement by reference as provided herein.

1.3 "Award" means notification from the City to Contractor of acceptance of Contractor's Proposal, subject to the execution and approval of a satisfactory Contract and bond to secure the performance of the Contract, and to such other conditions as may be specified or otherwise required by law.

1.4 "Buses" or **"Coaches"** or **"Vehicles"** means the vehicles procured under this Contract.

1.5 "CCO" means SFMTA Contract Compliance Office.

1.6 "City" or **"the City"** means the City and County of San Francisco, a municipal corporation.

1.7 "City Data" or **"Data"** means all data given to Contractor by City in the performance of this Agreement.

1.8 "Conditional Acceptance" means the circumstance in which a Vehicle has been delivered to SFMTA and placed in revenue service despite not having met all requirements for Acceptance.

1.9 "Confidential Information" means confidential City information including, but not limited to, personally-identifiable information (PII), protected health information (PHI), or individual financial information (collectively, "Proprietary or Confidential Information") that is subject to local, state or federal laws restricting the use and disclosure of such information, including, but not limited to, Article 1, Section 1 of the California Constitution; the California Information Practices Act (Civil Code § 1798 et seq.); the California Confidentiality of Medical Information Act (Civil Code § 56 et seq.); the federal Gramm-Leach-Bliley Act (15 U.S.C. §§ 6801(b) and 6805(b)(2)); the privacy and information security aspects of the Administrative Simplification provisions of the federal Health Insurance Portability and Accountability Act (45 CFR Part 160 and Subparts A, C, and E of part 164); and San Francisco Administrative Code Chapter 12M (Chapter 12M).

1.10 "Conformed Contract Documents" means the Contract documents revised to incorporate information included in the Contractor's Proposal and accepted by the City.

1.11 "Contract Modification" means a written amendment to the Contract, agreed to by the City and Contractor, covering changes in the Conformed Contract Documents within the general scope of the Contract and establishing the basis of payment and time adjustments for the Work affected by the changes.

1.12 "**Contractor"** means NOVA Bus, A Division of Prevost Car (US) Inc., 260 Banker Road, Plattsburgh, NY 12901.

1.13 "Controller" means the Controller of the City.

1.14 "Correction" means the elimination of a Defect**.**

1.15 "Day" (whether or not capitalized) means a calendar day, unless otherwise designated.

1.16 "Defect" means any patent or latent malfunctions or failure in manufacture or design of any component or subsystem.

1.17 "Deliverables" mean Contractor's work product resulting from the Work that are provided by Contractor to City during the course of Contractor's performance of the Agreement, including without limitation, the work product described in the "Technical Specifications."

1.18 "Director" means the Director of Transportation of the SFMTA or his or her designee.

1.19 "**Effective Date**" means the date on which the City's Controller certifies the availability of funds for this Agreement as provided in Section 3.1.

1.20 "Engineer" means the SFMTA Engineer assigned to the Contract or his or her designated agent.

1.21 "Final Acceptance" means the formal written Acceptance by the Director of Transportation or his or her designee that all Contract Deliverables for the Contract have been satisfactorily completed and accepted.

1.22 "FTA" means the Federal Transit Administration.

1.23 "**Mandatory City Requirements**" means those City laws set forth in the San Francisco Municipal Code, including the duly authorized rules, regulations, and guidelines implementing such laws, which impose specific duties and obligations upon Contractor.

1.24 "Material and/or Equipment" means the Buses (including all parts and equipment installed in them) and other Deliverables furnished by the Contractor under the provisions of the Contract.

1.25 "Notice to Proceed" means written notice to the Contractor of the date on which it shall begin prosecution of the Work to be done under the Contract.

1.26 "**Party**" and "**Parties**" mean the City and Contractor, either individually or collectively.

1.27 "**Project Manager**" means the project manager assigned to the Contract for the SFMTA, or his or her designated agent.

1.28 "Proposal" means the technical and management information and prices submitted by Contractor in response to the RFP.

1.29 "**Purchase Order**" means the written order issued by the City to the Contractor, authorizing the Effective Date as provided in Section 2.1.

1.30 "Related Defect" means damages inflicted on any component or subsystem as a direct result of a Defect.

1.31 "Request for Proposals; RFP" means the Request for Proposals issued by the Commonwealth of Virginia on April 15, 2019, to procure 12-year low floor battery powered electric buses, as amended by addenda.

1.32 "Resident Inspector" means any inspector or inspectors who may be assigned by the SFMTA Project Manager for the inspection of Work to be done under this Contract.

1.33 "**San Francisco Municipal Transportation Agency**" or "**SFMTA**" means the agency of City with jurisdiction over all surface transportation in San Francisco, as provided under Article VIIIA of the City's Charter.

1.34 "Subcontractor" or **"Supplier"** means any individual, partnership, firm, or corporation that, under an agreement with Contractor, undertakes integrally on the Project the partial or total design, manufacture, performance of, or furnishes one or more items of work under the terms of the contract. As used in this Agreement, the terms Subcontractor and Supplier are synonymous.

1.35 "Technical Specifications" means the portion of the SFMTA's Technical Specifications (Exhibit F) that contain the specifications, provisions, and requirements that detail the Work and the materials, products (including the assembly and testing), and other requirements relative to the manufacturing and construction of the Work.

1.36 "Work" means the furnishing of all design, engineering, manufacturing, labor, supervision, services, products, materials, machinery, equipment, tools, supplies, and facilities and the performance of all requirements called for by the Contract and necessary to the completion and warranty of the Vehicles, including all services, labor, supervision, materials, equipment, actions and other requirements to be performed and furnished by Contractor under this Agreement.

1.37 "Working Days" means those Days during which regular business is conducted, excluding Saturdays, Sundays, and all Federal, State, and municipal holidays that are observed by the SFMTA during the duration of the Contract.

Article 2 Term of the Agreement

2.1 The term of this Agreement shall commence on the Effective Date, and expire five years thereafter, unless earlier terminated as otherwise provided herein.

2.2 The City has two options to renew the Agreement for a period of one year each. The City may extend this Agreement beyond the expiration date by exercising an option at the Director of Transportation's sole and absolute discretion and by modifying this Agreement as provided in Section 11.5 (Modification of this Agreement).

Article 3 Financial Matters

3.1 Certification of Funds; Budget and Fiscal Provisions; Termination in the Event of Non-Appropriation. This Agreement is subject to the budget and fiscal provisions of the City's Charter. Charges will accrue only after prior written authorization certified by the Controller in the form of a Purchase Order, and the amount of City's obligation hereunder shall not at any time exceed the amount certified for the purpose and period stated in such advance authorization. This Agreement will terminate without penalty, liability or expense of any kind to City at the end of any fiscal year if funds are not appropriated for the next succeeding fiscal year. If funds are appropriated for a portion of the fiscal year, this Agreement will terminate, without penalty, liability or expense of any kind at the end of the term for which funds are appropriated. City has no obligation to make appropriations for this Agreement in lieu of appropriations for new or other agreements. City budget decisions are subject to the discretion of the Mayor and the Board of Supervisors. Contractor's assumption of risk of possible non-appropriation is part of the consideration for this Agreement.

THIS SECTION CONTROLS AGAINST ANY AND ALL OTHER PROVISIONS OF THIS AGREEMENT.

3.2 Guaranteed Maximum Costs. The City's payment obligation to Contractor cannot at any time exceed the amount certified by City's Controller for the purpose and period stated in such certification. Absent an authorized Emergency per the City Charter or applicable Code, no City representative is authorized to offer or promise, nor is the City required to honor, any offered or promised payments to Contractor under this Agreement in excess of the certified maximum amount without the Controller having first certified the additional promised amount and the Parties having modified this Agreement as provided in Section 11.5 (Modification of this Agreement).

3.3 Compensation.

3.3.1 Payments. Contractor shall provide an invoice to the SFMTA pursuant to the Schedule set out in Exhibit C (Payment Milestones). Compensation shall be made for Work identified in the invoice that the Director of Transportation, or his or her designee, in his or her sole discretion, concludes has been satisfactorily performed. Payment shall be made within 30 Days of receipt of the invoice, unless the City notifies the Contractor that a dispute as to the

invoice exists. In no event shall the amount of this Agreement exceed Four Million, Seven Hundred Seventy-Two Thousand, Two Hundred Sixty-Six Dollars ($4,772,266). The breakdown of charges associated with this Agreement appears in Exhibit A (Schedule of Prices). In no event shall City be liable for interest or late charges for any late payments.

3.3.2 Progress Payments.

a. Progress payments shall be conditioned on either (i) transfer of title, free of encumbrances, to the City for the portion of the components, equipment or material paid for by the progress payment, plus a certificate of insurance required by Section 5.1 of this Agreement; or (ii) issuance of a letter of credit in conformance with the provision of Section 4.8.3 in the amount of the progress payment. Progress payments for which a letter of credit shall be required are as follows: Milestone set forth in Item 1(a) in Exhibit C for each Vehicle. Letter(s) of credit for such progress payments will be released upon Acceptance or Conditional Acceptance of 50 percent of the total Vehicles.

b. In lieu of a letter of credit to secure progress payments, Contractor may elect to increase its performance bond required under Section 4.8.1 of this Agreement by the amount of progress payments for the above milestone and any other items for which Contractor elects to submit security instead of transferring title. Such increase in the amount of the performance bond shall be included in the amount of the performance bond submitted at the time of Contract Award. This increase in the amount of the performance bond shall constitute security for all progress payments for which the bond is issued should Contractor default with respect to any provision of this Agreement. In lieu of an increase in the Performance Bond, an Advance Payment Bond, in a form acceptable to the City's Risk Manager, or other security acceptable to the City's Risk Manager, will also be accepted.

3.3.3 Retention. As described in Exhibit C, the City will withhold 2% of the Vehicle amount as retention until Final Acceptance and conclusion of the Agreement. The City will not make price adjustments to this Contract to protect Contractor from economic inflation; however, the City will negotiate with Contractor adjustments to the price of the Coaches resulting from legislation or regulations that become effective after the date of this Contract that affect the price of the Coaches.

3.3.4 Payment Limited to Satisfactory Work. Contractor is not entitled to any payments from City until the SFMTA approves Work, including any furnished Deliverables, as satisfying all of the requirements of this Agreement. Payments to Contractor by City shall not excuse Contractor from its obligation to replace unsatisfactory Deliverables, including equipment, components, materials, or Work even if the unsatisfactory character of such Deliverables, equipment, components, materials, or Work may not have been apparent or detected at the time such payment was made. Deliverables, equipment, components, materials and Work that do not conform to the requirements of this Agreement may be rejected by City and in such case must be replaced by Contractor without delay at no cost to the City.

3.3.5 Withhold Payments. If Contractor fails to provide Work in accordance with Contractor's obligations under this Agreement, the City may withhold any and all payments due Contractor until such failure to perform is cured, and Contractor shall not stop work as a result of City's withholding of payments as provided herein.

3.3.6 Invoice Format. Invoices furnished by Contractor under this Agreement must be in a form acceptable to the Controller and City, and must be sent to the address for City in Section 11.1 (Notices to Parties):

Each invoice shall include:

- Relevant milestones;
- Contract order number;
- Quantity of items;
- Description of items;
- Unit price;
- Total invoice amount.
- Supporting documentation and/or documentation referencing submittal or delivery.

City will make payment to Contractor as provided in Section 3.3.8, or in such alternate manner as the Parties have mutually agreed upon in writing.

3.3.7 Reserved. (LBE Payment)

3.3.8 Getting Paid for Goods and/or Work from the City.

All City vendors receiving new contracts, contract renewals, or contract extensions must sign up to receive electronic payments through the City's Automated Clearing House (ACH) payments service/provider. Electronic payments are processed every Working Day and are safe and secure. To sign up for electronic payments, visit www.sfgov.org/ach.

The following information is required to sign up: (a) the enroller must be their company's authorized financial representative, (b) the company's legal name, main telephone number and all physical and remittance addresses used by the company, (c) the company's U.S. federal employer identification number (EIN) or Social Security number (if they are a sole proprietor), and (d) the company's bank account information, including routing and account numbers.

3.3.9 Grant-Funded Contracts.

a. Disallowance. If Contractor requests or receives payment from City for Work, reimbursement for which is later disallowed by the State of California or United States Government, Contractor shall promptly refund the disallowed amount to City upon City's request. At its option, City may offset the amount disallowed from any payment due or to become due to Contractor under this Agreement or any other Agreement between Contractor and City.

b. Grant Terms. The funding for this Agreement is provided to the SFMTA in full or in part by a Federal or State grant. As part of the terms of receiving the funds, the SFMTA must incorporate some of the terms into this Agreement (Grant Terms). The incorporated Grant Terms may be found in the Federal Transit Administration/Fly America/Buy America Requirements in the Virginia contract. To the extent that any Grant Term is inconsistent with any other provisions of this Agreement such that Contractor is unable to comply with both the Grant Term and the other provision(s), the Grant Term shall apply.

As required by the Grant Terms, Contractor shall insert applicable provisions into each lower-tier subcontract. Contractor is responsible for compliance with the Grant Terms by any Subcontractor, lower-tier Subcontractor, or service provider.

3.4 Audit and Inspection of Records. Contractor agrees to maintain and make available to the City, during regular business hours, accurate books and accounting records relating to its Work. Contractor will permit City to audit, examine and make excerpts and transcripts from such books and records, and to make audits of all invoices, materials, payrolls, records or personnel and other data related to all other matters covered by this Agreement, whether funded in whole or in part under this Agreement. Contractor shall maintain such data and records in an accessible location and condition for a period of not fewer than five years after final payment under this Agreement or until after final audit has been resolved, whichever is later. The State of California or any Federal agency having an interest in the subject matter of this Agreement shall have the same rights as conferred upon City by this Section. Contractor shall include the same audit and inspection rights and record retention requirements in all subcontracts.

To the extent that Contractor believes any records provided to SFMTA or its agents in the course of an audit or inspection under this section are confidential or proprietary, Contractor shall clearly identify such information at the time the information is provided. In the event that the SFMTA receives a request for disclosure of records under the California Public Records Act (Govt. Code Sec. 6250 et seq.) or the San Francisco Sunshine Ordinance (SF Admin. Code Chapter 67) that seeks such records, the SFMTA shall endeavor to provide Contractor reasonable notice of such request. Contractor may at its option take whatever legal steps it deems appropriate to protect said information from disclosure to the public, but the SFMTA shall have no further obligation to protect such information from disclosure. However, if the SFMTA is required to incur legal fees and costs in such legal action, and if the Contractor does not prevail in such legal action, Contractor shall pay all legal fees and costs that the SFMTA incurs as a result of such legal action. The foregoing shall not restrict the ability of the SFMTA or any other governmental agency to use information obtained in the course of an audit or inspection under this section in an audit report.

3.5 Submitting False Claims. The full text of San Francisco Administrative Code Chapter 21, Section 21.35, including the enforcement and penalty provisions, is incorporated into this Agreement. Pursuant to San Francisco Administrative Code §21.35, any contractor or

subcontractor who submits a false claim shall be liable to the City for the statutory penalties set forth in that section. A contractor or subcontractor will be deemed to have submitted a false claim to the City if the contractor or subcontractor: (a) knowingly presents or causes to be presented to an officer or employee of the City a false claim or request for payment or approval; (b) knowingly makes, uses, or causes to be made or used a false record or statement to get a false claim paid or approved by the City; (c) conspires to defraud the City by getting a false claim allowed or paid by the City; (d) knowingly makes, uses, or causes to be made or used a false record or statement to conceal, avoid, or decrease an obligation to pay or transmit money or property to the City; or (e) is a beneficiary of an inadvertent submission of a false claim to the City, subsequently discovers the falsity of the claim, and fails to disclose the false claim to the City within a reasonable time after discovery of the false claim.

3.6 Reserved. (Payment of Prevailing Wages).

Article 4 Work and Resources

4.1 Work Contractor Agrees to Perform. This Agreement is for the procurement of three 40-ft. low floor battery electric Coaches with options for up to three additional 40-ft. low floor battery electric Coaches**Error! Reference source not found.**, as provided for in the Technical Specifications (Exhibit F) and according to the Project Delivery Schedule set forth in Exhibit B. Contractor agrees to perform the Work provided for in the Technical Specifications. Officers and employees of the City are not authorized to request, and the City is not required to reimburse the Contractor for, work beyond the Work provided in the Technical Specifications unless the Contract is modified as provided in Section 11.5 (Modification of this Agreement).

4.1.1 Spare Parts. The total Contract amount includes an allowance of $250,000 for spare parts, as per Schedule 1 of Exhibit A. The City may choose to purchase spare parts from the Contractor at its sole discretion from the list of spare parts included in Schedule 1A of Exhibit A. The City reserves the right to purchase spare parts that are not included in Schedule 1A from the Contractor at negotiated prices. The prices for spare parts listed in Schedule 1A shall be valid for at least two years from the Effective Date. Spare parts shall be delivered within 120 Days after the SFMTA provides written notice of intent to acquire the specified parts.

4.1.2 Special Tools. The total Contract amount includes an allowance of $50,000 for special tools, as per Schedule 1 of Exhibit A. The City may choose to purchase special tools from the Contractor at its sole discretion from the list of special tools included in Schedule 1B of Exhibit A. The City reserves the right to purchase special tools that are not included in Schedule 1B from the Contractor at negotiated prices. The prices for special tools listed in Schedule 1B shall be valid for at least two years from the Effective Date.

4.2 Qualified Personnel. Contractor shall utilize only competent personnel under the supervision of, and in the employment of, Contractor (or Contractor's authorized Subcontractors) to perform the Work. Contractor will comply with City's reasonable requests

regarding assignment and/or removal of personnel, but all personnel, including those assigned at City's request, must be supervised by Contractor. Contractor shall commit adequate resources to allow timely completion within the project schedule specified in this Agreement.

4.3 Subcontracting.

4.3.1 Subcontracts. Contractor may subcontract portions of the Work only upon prior written approval of City. Contractor is responsible for its Subcontractors throughout the course of the Work. All Subcontracts must incorporate the terms of Article 10 (Additional Requirements Incorporated by Reference) of this Agreement, unless inapplicable. Neither Party shall, on the basis of this Agreement, contract on behalf of, or in the name of, the other Party. Any agreement made in violation of this provision shall be null and void.

4.3.2 Prompt Payment to Subcontractors.

a. Contractor shall pay each of its Subcontractors within three Working Days after receipt of each progress payment from the City. Within five Working Days of such payment, Contractor shall provide the SFMTA with satisfactory evidence that it has promptly paid each Subcontractor for the Work that it has performed in that billing period. Failure to provide such evidence shall be cause for the SFMTA to suspend future progress payments to Contractor.

b. Within 30 Days of satisfactory completion of all Work required of the Subcontractor, Contractor shall release any retention withheld to the Subcontractor. A violation of the requirements of this Section shall constitute a violation of San Francisco Administrative Code section 6.22.Q. If Contractor does not pay a Subcontractor as required in this Section, Contractor shall pay directly to said Subcontractor a penalty of two percent per month of the amounts unpaid, as provided by Administrative Code section 6.22.Q.

c. In the event that there is a good faith dispute over all or any portion of the amount due on a progress payment from Contractor to a Subcontractor, the Contractor may withhold the disputed amount, but shall pay the undisputed amount.

d. Contractor shall include these payment requirements in its subcontracts and shall require every Subcontractor of every tier to include these payment requirements in its subcontracts with lower tier Subcontractors.

4.4 Independent Contractor; Payment of Employment Taxes and Other Expenses.

4.4.1 Independent Contractor. For the purposes of this Article 4, "Contractor" shall be deemed to include not only Contractor, but also any agent or employee of Contractor. Contractor acknowledges and agrees that at all times, Contractor or any agent or employee of Contractor shall be deemed at all times to be an independent contractor and is wholly responsible for the manner in which it performs the services and work requested by City under this Agreement. Contractor, its agents, and employees will not represent or hold themselves out to be

employees of the City at any time. Contractor or any agent or employee of Contractor shall not have employee status with City, nor be entitled to participate in any plans, arrangements, or distributions by City pertaining to or in connection with any retirement, health or other benefits that City may offer its employees. Contractor or any agent or employee of Contractor is liable for the acts and omissions of itself, its employees and its agents. Contractor shall be responsible for all obligations and payments, whether imposed by federal, state or local law, including, but not limited to, FICA, income tax withholdings, unemployment compensation, insurance, and other similar responsibilities related to Contractor's performing services and work, or any agent or employee of Contractor providing same. Nothing in this Agreement shall be construed as creating an employment or agency relationship between City and Contractor or any agent or employee of Contractor. Any terms in this Agreement referring to direction from City shall be construed as providing for direction as to policy and the result of Contractor's work only, and not as to the means by which such a result is obtained. City does not retain the right to control the means or the method by which Contractor performs work under this Agreement. Contractor agrees to maintain and make available to City, upon request and during regular business hours, accurate books and accounting records demonstrating Contractor's compliance with this section. Should City determine that Contractor, or any agent or employee of Contractor, is not performing in accordance with the requirements of this Agreement, City shall provide Contractor with written notice of such failure. Within five Working Days of Contractor's receipt of such notice, and in accordance with Contractor policy and procedure, Contractor shall remedy the deficiency. Notwithstanding, if City believes that an action of Contractor, or any agent or employee of Contractor, warrants immediate remedial action by Contractor, City shall contact Contractor and provide Contractor in writing with the reason for requesting such immediate action.

4.4.2 Payment of Employment Taxes and Other Expenses. Should City, in its discretion, or a relevant taxing authority such as the Internal Revenue Service or the State Employment Development Division, or both, determine that Contractor is an employee for purposes of collection of any employment taxes, the amounts payable under this Agreement shall be reduced by amounts equal to both the employee and employer portions of the tax due (and offsetting any credits for amounts already paid by Contractor which can be applied against this liability). City shall then forward those amounts to the relevant taxing authority. Should a relevant taxing authority determine a liability for past services performed by Contractor for City, upon notification of such fact by City, Contractor shall promptly remit such amount due or arrange with City to have the amount due withheld from future payments to Contractor under this Agreement (again, offsetting any amounts already paid by Contractor which can be applied as a credit against such liability). A determination of employment status pursuant to the preceding two paragraphs shall be solely for the purposes of the particular tax in question, and for all other purposes of this Agreement, Contractor shall not be considered an employee of City. Notwithstanding the foregoing, Contractor agrees to indemnify and save harmless City and its

officers, agents and employees from, and, if requested, shall defend them against any and all claims, losses, costs, damages, and expenses, including attorneys' fees, arising from this section.

4.5 Assignment. The Services to be performed by Contractor are personal in character. Neither this Agreement, nor any duties or obligations hereunder, may be directly or indirectly assigned, novated, hypothecated, transferred, or delegated by Contractor, or, where the Contractor is a joint venture, a joint venture partner, (collectively referred to as an "Assignment") unless first approved by City by written instrument executed and approved as required under City law and under the policy of the SFMTA Board of Directors. Such approval may not be unreasonably withheld; however, the City's approval of any such Assignment is subject to the Contractor demonstrating to City's reasonable satisfaction that the proposed transferee is: (a) reputable and capable, financially and otherwise, of performing each of Contractor's obligations under this Agreement and any other documents to be assigned, (b) not forbidden by applicable law from transacting business or entering into contracts with City; and (c) subject to the jurisdiction of the courts of the State of California. A change of ownership or control of Contractor or a sale or transfer of substantially all of the assets of Contractor shall be deemed an Assignment for purposes of this Agreement. Contractor shall immediately notify City about any Assignment. Any purported Assignment made in violation of this provision shall be null and void. Notwithstanding the foregoing, the Contractor shall be entitled to directly or indirectly assign, novate, hypothecate, transfer, or delegate its duties or obligations, to a subsidiary, parent or affiliate of the Contractor (a "Permitted Transferee"), with notice to, but without the consent of the City, as long as the Permitted Transferee remains a subsidiary, parent or affiliate of the Contractor. In the event of an Assignment to a Permitted Transferee, the Contractor, with its notice of the Assignment, shall submit to the City a letter from the Permitted Transferee guaranteeing that there will not be a reduction of staffing or services, or an increase in cost as result of the Assignment.

4.6 Option Vehicles.

4.6.1 Options for Additional Coaches At the option of the City, the Contractor shall provide up to three 40-foot Buses in addition to the initial purchase(s). These options may be exercised at any time up to and including five years from the Effective Date, as set forth in Section 2.2. The maximum quantities of Buses that will be purchased for the subsequent years will be a shown in the Exhibit A (Schedule of Prices). City, at its exclusive option, may assign all or a portion of this option to another transit agency. Such assignment shall be effectuated by an assignment agreement between the City and the transit agency, with notice to Contractor. The assignment agreement may be executed by the Director on behalf of City. These option coaches shall be provided at the bid price(s) quoted in Schedule 1 of Exhibit A.

4.6.2 Uniformity of Option Vehicles. All items purchased under the options shall be identical in every way to those purchased under the base Contract. Any changes to items or components furnished under the options are subject to approval by the City. All conditions,

Technical Specifications, and requirements set forth in the Contract documents shall apply to the items purchased as options unless otherwise specified in this Agreement.

4.7 Liquidated Damages. By entering into this Agreement, the Contractor agrees that in the event deliveries are not completed within the number of days indicated in Section 4.1.1, in Exhibit B, and in the Technical Specifications (Exhibit F) or if Contractor fails to correct fleet defects in accordance with Technical Specifications (Exhibit F) as may be revised by Contract Modifications, City will suffer damages that will be impracticable or extremely difficult to determine; further, Contractor agrees that the amounts listed below for each day of delay beyond scheduled milestones and timelines are not a penalty, but are a reasonable estimate of the loss that City will incur based on the delay, established in light of the circumstances existing at the time this contract was awarded. Except where the delay is the result of an Unavoidable Delay, City may deduct a sum representing the liquidated damages from any money due to Contractor. Such deductions shall not be considered a penalty, but rather agreed monetary damages sustained by City because of Contractor's failure to deliver to City within the time fixed or such extensions of time permitted in writing by the SFMTA. Liquidated damages imposed under this Agreement shall be in addition to any other damages that are recoverable by the City specified elsewhere in the Contract.

Item No.	Milestone	Amount Per Day
1.	Submittal of Management Work Plan	$100
2.	Delivery of Lead Coach	$400
3.	Submittal of Training Lesson Plans	$200
4.	Submittal of Draft Operation, Maintenance, and Parts Manual	$200
5.	Delivery of 1st Production Coach	$400
6.	Delivery of last Production Coach	$400
7.	Spare Parts Delivery	$400
8.	Delivery of Special Tools	$300
9.	Submittal of Final Operation, Maintenance, and Parts Manuals	$400
10.	Warranty Fleet Defect Correction (see Technical Specifications, Section 10.1.5.2)	$250 per coach
11.	Contractor-Supplied Parts	2%*

* 2% per day of Contractor's list price for every Day a part is past the 72-hour delivery time (see Technical Specifications, Section 10.2.2.2).

4.8 Performance and Payment Security. The following provisions set forth financial guarantees that must be met by Contractor. Contractor may choose to meet the

requirements of this Section 4.8 by obtaining either the required bonds or an irrevocable letter of credit (Letter of Credit) in an equivalent amount.

4.8.1 Bonds

a. Within 20 days following the receipt of a notice of tentative award of contract, and until completion of all Contract obligations and Acceptance by City of the final Vehicle, the Contractor shall furnish to City a performance and a labor and materials bond each in an amount not less than 20 percent of the total Contract amount to guarantee Contractor's faithful performance of all obligations of the Contract, including warranty obligations in existence until the last Vehicle is Accepted, and to guarantee Contractor 's payment to all suppliers of labor and materials under this Contract, excluding the period covered by the warranty bond described in Subsection c. below**.**

b. One year after the City fully accepts the last Vehicle, the City will issue a letter releasing the obligations of the surety under the performance and labor and materials bonds, provided that all Deliverables have been performed and Accepted and a warranty bond or letter of credit meeting the requirements of Section 4.8.2 is in place. The original bond document(s) shall be retained by the City.

c. Contractor shall provide a two-year warranty or guaranty bond in the amount of 10 percent of the Contract price covering all of Contractor's warranty obligations under the Contract, which bond shall become effective upon release of the Performance Bond under subsection b. above. At City's election, and subject to approval of the surety issuing the bond, Contractor shall provide for up to two one-year extensions or renewals of the warranty or guaranty bond at an amount approved by the SFMTA and the City's Risk Manager. If the original surety declines to extend or renew the initial bond, Contractor shall in good faith try to obtain the required additional coverage from another surety and shall document to the City its efforts in this regard. At the expiration of the warranty bond, the City will release it in the same manner as it releases the performance and labor and materials bonds (see subsection b. above).

d. Within 20 days of receipt of a notice from the SFMTA of intention to exercise the option to purchase more Coaches, the Contractor shall furnish to City a separate performance bond and a labor and materials bond in the amount of 20 percent of the cost of the additional Coaches to be purchased, to guarantee performance of all Contract obligations with respect to such optional Vehicles. The Contractor shall provide a two-year warranty or guaranty bond with possible extensions for the option Coaches under the terms of subsection c. above. The City will release the warranty bond as provided above and retain the original bond documents.

4.8.2 Requirements for Bonds.

a. Bonding entities on the above bonds must be legally authorized to engage in the business of furnishing performance bonds in the State of California. All bonding entities must be satisfactory to the SFMTA and to the Controller and Risk Manager of the City.

b. During the period covered by the Agreement, if any of the sureties upon the bond shall have an AM Best rating that falls below A-, VIII, or become insolvent and unable to pay promptly the amount of such bond to the extent to which the surety might be liable, Contractor, within 30 days after notice given by the SFMTA to Contractor, shall by supplemental bond or otherwise, substitute another and sufficient surety approved by SFMTA in place of the surety becoming insolvent or unable to pay. If Contractor fails within such 30-day period to substitute another and sufficient surety, Contractor, if the SFMTA so elects, shall be deemed to be in default in the performance of its obligations hereunder and upon the said bond. The City, in addition to any and all other remedies, may terminate the Agreement or bring any proper suit or proceeding against moneys then due or which thereafter may become due Contractor under the Agreement. The amount for which the surety shall have justified on the bond and the moneys so deducted shall be held by City as collateral for the performance of the conditions of the bond.

4.8.3 Requirements for Letter of Credit.

a. General Requirements. Any Letter of Credit submitted as required security under this Agreement shall be a confirmed, clean, irrevocable Letter of Credit in favor of the City and County of San Francisco, a municipal corporation. It must have an original term of one year, with automatic renewals of the full amount (subject to modification to reflect the adjustments set forth above in Section 4.8.1) throughout the term of the Agreement and throughout the performance of Contractor's obligations under the Agreement. If Contractor fails to deliver the Letter of Credit as required, City will be entitled to cancel this Agreement. The Letter of Credit must provide that payment of its entire face amount, or any portion thereof, will be made to City upon presentation of a written demand to the bank signed by the Director of Transportation on behalf of the City.

b. Financial Institution. The Letter of Credit must be issued on a form and issued by a financial institution acceptable to the City in its sole discretion, which financial institution must (a) be a bank or trust company doing business and having an office in the City and County of San Francisco, (b) have a combined capital and surplus of at least $25,000,000, and (c) be subject to supervision or examination by federal or state authority and with at least a Moody's A rating. Should the financial institution fail to maintain such rating, Contractor shall replace the Letter of Credit within 30 days with a Letter of Credit from a financial institution with such a rating.

c. Demand on Letter of Credit. The Letter of Credit will constitute a security deposit guaranteeing faithful performance by Contractor of all terms, covenants, and conditions of this Agreement, including all monetary obligations set forth herein. If Contractor defaults with respect to any provision of this Agreement, the SFMTA may make a demand under the Letter of Credit for all or any portion thereof to compensate City for any loss or damage that they may have incurred by reason of Contractor's default, negligence, breach or dishonesty. Such loss or damage may include without limitation any damage to or restoration

of City property or property that is required to be constructed, maintained or repaired pursuant to this Agreement, payments to City, and claims for liquidated damages; provided, however, that City will present its written demand to said bank for payment under said Letter of Credit only after City first has made its demand for payment directly to Contractor, and five full Working Days have elapsed without Contractor having made payment to City. Should the City terminate this Agreement due to a breach by Contractor, the City shall have the right to draw from the Letter of Credit those amounts necessary to pay any fees or other financial obligations under the Agreement and perform the Work described in this Agreement until such time as the City procures another contractor and the agreement between the City and that contractor becomes effective. City need not terminate this Agreement in order to receive compensation for its damages. If any portion of the Letter of Credit is so used or applied by City, Contractor, within 10 Working Days after written demand by City, shall reinstate the Letter of Credit to its original amount; Contractor's failure to do so will be a material breach of this Agreement.

d. Expiration or Termination. The Letter of Credit must provide for 60 days notice to City in the event of non-extension of the Letter of Credit; in that event, Contractor shall replace the Letter of Credit at least 10 Working Days prior to its expiration. In the event the City receives notice from the issuer of the Letter of Credit that the Letter of Credit will be terminated, not renewed or will otherwise be allowed to expire for any reason during the period from the commencement of the term of this Agreement to 90 Days after the expiration or termination of this Agreement, or the conclusion of all of Contractor's obligations under the Agreement, whichever occurs last, and Contractor fails to provide the City with a replacement Letter of Credit (in a form and issued by a financial institution acceptable to the City) within 10 Working Days following the City's receipt of such notice, such occurrence shall be an event of default, and, in addition to any other remedies the City may have due to such default (including the right to terminate this Agreement), the City shall be entitled to draw down the entire amount of the Letter of Credit (or any portion thereof) and hold such funds in an account with the City Treasurer in the form of cash guarantying Contractor's obligations under this Agreement. In such event, the cash shall accrue interest to the Contractor at a rate equal to the average yield of Treasury Notes with one-year maturity, as determined by the Treasurer. In the event the Letter of Credit is converted into cash pursuant to this paragraph, upon termination of this Agreement, Contractor shall be entitled to a full refund of the cash (less any demands made thereon by the City) within 90 Days of the termination date, including interest accrued through the termination date.

e. Return of Letter of Credit. The Letter of Credit will be returned within 90 Days after the end of the term of this Agreement, provided that Contractor has faithfully performed throughout the life of the Agreement, Contractor has completed its obligations under the Agreement, there are no pending claims involving Contractor's performance under the Agreement and no outstanding disagreement about any material aspect of the provisions of this Agreement. In the event this Agreement is assigned, as provided for in Section 4.5, City will return or release the Letter of Credit not later than the effective date of the

assignment, provided that the assignee has delivered to the City an equivalent Letter of Credit, as determined by City.

f. Excessive Demand. If City receives any payments from the aforementioned bank under the Letter of Credit by reason of having made a wrongful or excessive demand for payment, City will return to Contractor the amount by which City's total receipts from Contractor and from the bank under the Letter of Credit exceeds the amount to which City is rightfully entitled, together with interest thereon at the legal rate of interest, but City will not otherwise be liable to Contractor for any damages or penalties.

Article 5 Insurance and Indemnity

5.1 Insurance.

5.1.1 Required Coverages. Without in any way limiting Contractor's liability pursuant to the "Indemnification" section of this Agreement, Contractor must maintain in force, during the full term of the Agreement, insurance in the following amounts and coverages:

a. Workers' Compensation, in statutory amounts, with Employers' Liability Limits not less than $1,000,000 each accident, injury, or illness; and

b. Commercial General Liability Insurance with limits not less than $5,000,000 each occurrence for Bodily Injury and Property Damage, including Contractual Liability, Personal Injury, Products and Completed Operations; and

c. Comprehensive or Business Automobile (Transit Coach, Truck, and other vehicles included) Liability Insurance with limits not less than $5,000,000 each occurrence Combined Single Limit for Bodily Injury and Property Damage, including Owned, Non-Owned and Hired auto coverage, as applicable.

d. During the course of this Agreement, should any Vehicles already Accepted by City, and in which title is vested in the City, be returned to Contractor for any reason, Contractor shall maintain, with respect to such vehicles, Garagekeepers' Legal Liability Insurance with limits not less than 100 percent of the value of City Vehicles and equipment in Contractor's care, custody, or control, including coverage's for fire, theft, riot and civil commotion, vandalism or malicious mischief, and collision; all-risk transportation insurance for the full value of all City-owned coaches in transit between Contractor and City premises; and any loss payable to the City as its interest may appear.

e. During the course of this Agreement, as title to components or Coaches is transferred to City (refer to Section 3.3.2), Contractor shall provide property insurance on such components against all risks of loss or damage for 100% of their replacement value, including City as a named insured and loss payee, as its interests may appear, and any deductible not to exceed $25,000 each loss.

5.1.2 Commercial General Liability and Commercial Automobile Liability Insurance policies must be endorsed to provide:

a. Name as Additional Insured the City and County of San Francisco, its Officers, Agents, and Employees.

b. That such policies are primary insurance to any other insurance available to the Additional Insureds, with respect to any claims arising out of this Agreement, and that insurance applies separately to each insured against whom claim is made or suit is brought.

5.1.3 All policies shall be endorsed to provide 30 days' advance written notice to the City of cancellation for any reason, intended non-renewal, or reduction in coverages. Notices shall be sent to the City address set forth in Section 11.1 (Notices to the Parties). All notices, certificates and endorsements shall include the SFMTA contract number and title on the cover page.

5.1.4 Should any of the required insurance be provided under a claims-made form, Contractor shall maintain such coverage continuously throughout the term of this Agreement and, without lapse, for a period of three years beyond the expiration of this Agreement, to the effect that, should occurrences during the contract term give rise to claims made after expiration of the Agreement, such claims shall be covered by such claims-made policies.

5.1.5 Should any of the required insurance be provided under a form of coverage that includes a general annual aggregate limit or provides that claims investigation or legal defense costs be included in such general annual aggregate limit, such general annual aggregate limit shall be double the occurrence or claims limits specified above.

5.1.6 Should any required insurance lapse during the term of this Agreement, requests for payments originating after such lapse shall not be processed until the City receives satisfactory evidence of reinstated coverage as required by this Agreement, effective as of the lapse date. If insurance is not reinstated, the City may, at its sole option, terminate this Agreement effective on the date of such lapse of insurance.

5.1.7 Before commencing any Work, Contractor shall furnish to City certificates of insurance and additional insured policy endorsements with insurers with ratings comparable to A-, VIII or higher, that are authorized to do business in the State of California, and that are satisfactory to City, in form evidencing all coverages set forth above. Approval of the insurance by City shall not relieve or decrease Contractor's liability hereunder.

5.1.8 The Workers' Compensation policy(ies) shall be endorsed with a waiver of subrogation in favor of the City for all work performed by the Contractor, its employees, agents and Subcontractors.

5.1.9 If Contractor will use any Subcontractor(s) to provide Work, Contractor shall require the Subcontractor(s) to provide all necessary insurance and to name the City and County of San Francisco, its officers, agents and employees and the Contractor as additional insureds.

5.2 Indemnification.

5.2.1 Contractor shall indemnify and hold harmless City and its officers, agents and employees from, and, if requested, shall defend them from and against any and all claims, demands, losses, damages, costs, expenses, and liability (legal, contractual, or otherwise) arising from or in any way connected with any: (a) injury to or death of a person, including employees of City or Contractor; (b) loss of or damage to property; (c) violation of local, state, or federal common law, statute or regulation, including but not limited to privacy or personally identifiable information, health information, disability and labor laws or regulations; (d) strict liability imposed by any law or regulation; or (e) losses arising from Contractor's execution of subcontracts not in accordance with the requirements of this Agreement applicable to Subcontractors; so long as such injury, violation, loss, or strict liability (as set forth in subsections (a) – (e) above) arises directly or indirectly from Contractor's performance of this Agreement, including, but not limited to, Contractor's use of facilities or equipment provided by City or others, regardless of the negligence of, and regardless of whether liability without fault is imposed or sought to be imposed on City, except to the extent that such indemnity is void or otherwise unenforceable under applicable law, and except where such loss, damage, injury, liability or claim is the result of the active negligence or willful misconduct of City and is not contributed to by any act of, or by any omission to perform some duty imposed by law or agreement on Contractor, its Subcontractors, or either's agent or employee. The foregoing indemnity shall include, without limitation, reasonable fees of attorneys, consultants and experts and related costs and City's costs of investigating any claims against the City.

5.2.2 In addition to Contractor's obligation to indemnify City, Contractor specifically acknowledges and agrees that it has an immediate and independent obligation to defend City from any claim which actually or potentially falls within this indemnification provision, even if the allegations are or may be groundless, false or fraudulent, which obligation arises at the time such claim is tendered to Contractor by City and continues at all times thereafter.

5.2.3 Contractor shall indemnify and hold City harmless from all loss and liability, including attorneys' fees, court costs and all other litigation expenses for any infringement of the patent rights, copyright, trade secret or any other proprietary right or trademark, and all other intellectual property claims of any person or persons arising directly or indirectly from the receipt by City, or any of its officers or agents, of Contractor's Work.

5.3 Notice of Claim; Tender of Defense. The City shall use its best efforts to give prompt written notice to Contractor of any claim for which it requires indemnification from Contractor and will not admit liability or fault as to the allegations of the claim. Provided Contractor accepts the City's tender of defense without reservations, City agrees to grant Contractor sole control over the defense and settlement of the claim and provide timely assistance to Contractor in the defense of the claim.

Article 6 Liability of the Parties

6.1 Liability of City. CITY'S PAYMENT OBLIGATIONS UNDER THIS AGREEMENT SHALL BE LIMITED TO THE PAYMENT OF THE COMPENSATION PROVIDED FOR IN SECTION 3.3.1 (PAYMENT) OF THIS AGREEMENT. NOTWITHSTANDING ANY OTHER PROVISION OF THIS AGREEMENT, IN NO EVENT SHALL CITY BE LIABLE, REGARDLESS OF WHETHER ANY CLAIM IS BASED ON CONTRACT OR TORT, FOR ANY SPECIAL, CONSEQUENTIAL, INDIRECT OR INCIDENTAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, LOST PROFITS, ARISING OUT OF OR IN CONNECTION WITH THIS AGREEMENT OR THE SERVICES PERFORMED IN CONNECTION WITH THIS AGREEMENT.

6.2 Liability for Use of Equipment. City shall not be liable for any damage to persons or property as a result of the use, misuse or failure of any equipment used by Contractor, or any of its Subcontractors, or by any of their employees, even though such equipment is furnished, rented or loaned by City.

6.3 Liability for Incidental and Consequential Damages. Except for liquidated damages, Contractor shall not be responsible for incidental and consequential damages resulting in whole or in part from Contractor's acts or omissions.

6.4 Limitation of Liability. Except as provided herein, Contractor's aggregate liability to the City under this Agreement shall be limited to the Contract amount stated in Section 3.3.1, as that amount may be modified by a properly approved and executed Contract Modification. Said limitation on liability shall not apply to:

6.4.1 damages and other liability caused by Contractor's willful, intentional acts or omissions;

6.4.2 liability arising under or for violation of any applicable statute, City ordinance, regulation, or other laws;

6.4.3 damages and other liability arising under claims by third parties, including indemnity or contribution for claims brought by a third party (see Section5.2.1);

6.4.4 damages and other liability for infringement of any intellectual property right as provided in Section 5.2.3.

Article 7 Payment of Taxes

7.1 Contractor to Pay All Taxes. Except for any applicable California sales and use taxes charged by Contractor to City, Contractor shall pay all taxes, including possessory interest taxes levied upon or as a result of this Agreement, or the Services delivered pursuant hereto. Contractor shall remit to the State of California any sales or use taxes paid by City to Contractor under this Agreement. Contractor agrees to promptly provide information requested by the City to verify Contractor's compliance with any State requirements for reporting sales and use tax paid by City under this Agreement.

7.2 Possessory Interest Taxes. Contractor acknowledges that this Agreement may create a "possessory interest" for property tax purposes. Generally, such a possessory interest is not created unless the Agreement entitles the Contractor to possession, occupancy, or use of City property for private gain. If such a possessory interest is created, then the following shall apply:

7.2.1 Contractor, on behalf of itself and any permitted successors and assigns, recognizes and understands that Contractor, and any permitted successors and assigns, may be subject to real property tax assessments on the possessory interest.

7.2.2 Contractor, on behalf of itself and any permitted successors and assigns, recognizes and understands that the creation, extension, renewal, or assignment of this Agreement may result in a "change in ownership" for purposes of real property taxes, and therefore may result in a revaluation of any possessory interest created by this Agreement. Contractor accordingly agrees on behalf of itself and its permitted successors and assigns to report on behalf of the City to the County Assessor the information required by Revenue and Taxation Code section 480.5, as amended from time to time, and any successor provision.

7.2.3 Contractor, on behalf of itself and any permitted successors and assigns, recognizes and understands that other events also may cause a change of ownership of the possessory interest and result in the revaluation of the possessory interest. (see, e.g., Rev. & Tax. Code section 64, as amended from time to time). Contractor accordingly agrees on behalf of itself and its permitted successors and assigns to report any change in ownership to the County Assessor, the State Board of Equalization or other public agency as required by law.

7.2.4 Contractor further agrees to provide such other information as may be requested by the City to enable the City to comply with any reporting requirements for possessory interests that are imposed by applicable law.

7.3 Withholding. Contractor agrees that it is obligated to pay all amounts due to the City under the San Francisco Business and Tax Regulations Code during the term of this Agreement. Pursuant to Section 6.10-2 of the San Francisco Business and Tax Regulations Code, Contractor further acknowledges and agrees that City may withhold any payments due to Contractor under this Agreement if Contractor is delinquent in the payment of any amount required to be paid to the City under the San Francisco Business and Tax Regulations Code. The City will pay Contractor any monies withheld under this paragraph, without interest, when Contractor comes into compliance with its obligations.

Article 8 Termination and Default

8.1 Termination for Convenience

8.1.1 Exercise of Option. City shall have the option, in its sole discretion, to terminate this Agreement, at any time during the term hereof, for convenience and without cause. City shall exercise this option by giving Contractor written notice of termination. The notice shall specify the date on which termination shall become effective.

8.1.2 Contractor Actions. Upon receipt of the notice of termination, Contractor shall commence and perform, with diligence, all actions necessary on the part of Contractor to effect the termination of this Agreement on the date specified by City and to minimize the liability of Contractor and City to third parties as a result of termination. All such actions shall be subject to the prior approval of City. Such actions shall include, without limitation:

a. Halting the performance of all Work under this Agreement on the date(s) and in the manner specified by the SFMTA.

b. Terminating all existing orders and subcontracts, and not placing any further orders or subcontracts for materials, Work, equipment or other items.

c. At the SFMTA's direction, assigning to City any or all of Contractor's right, title, and interest under the orders and subcontracts terminated. Upon such assignment, the SFMTA shall have the right, in its sole discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts.

d. Subject to the SFMTA's approval, settling all outstanding liabilities and all claims arising out of the termination of orders and subcontracts.

e. Completing performance of any Work that the SFMTA designates to be completed prior to the date of termination specified by the SFMTA.

f. Taking such action as may be necessary, or as the SFMTA may direct, for the protection and preservation of any property related to this Agreement which is in the possession of Contractor and in which the SFMTA has or may acquire an interest.

8.1.3 Contractor Invoice. Within 30 days after the specified termination date, Contractor shall submit to the SFMTA an invoice, which shall set forth each of the following as a separate line item:

a. The reasonable cost to Contractor, without profit, for all Work prior to the specified termination date, for which Work the SFMTA has not already tendered payment. Reasonable costs may include a reasonable allowance for actual overhead, not to exceed a total of 10% of Contractor's direct costs for Work. Any overhead allowance shall be separately itemized. Contractor may also recover the reasonable cost of preparing the invoice.

b. A reasonable allowance for profit on the cost of the Work described in the immediately preceding subsection (a), provided that Contractor can establish, to the satisfaction of the SFMTA, that Contractor would have made a profit had all Work under this Agreement been completed, and provided further, that the profit allowed shall in no event exceed 5% of such cost.

c. The reasonable cost to Contractor of handling material or equipment returned to the vendor, delivered to the SFMTA or otherwise disposed of as directed by the SFMTA.

d. A deduction for the cost of materials to be retained by Contractor, amounts realized from the sale of materials and not otherwise recovered by or credited to the SFMTA, and any other appropriate credits to the SFMTA against the cost of the Work or other work.

8.1.4 Non-Recoverable Costs. In no event shall the City be liable for costs incurred by Contractor or any of its Subcontractors after the termination date specified by the SFMTA, except for those costs specifically enumerated and described in Section 8.1.3. Such non-recoverable costs include, but are not limited to, anticipated profits on the Work under this Agreement, post-termination employee salaries, post-termination administrative expenses, post-termination overhead or unabsorbed overhead, attorneys' fees or other costs relating to the prosecution of a claim or lawsuit, prejudgment interest, or any other expense which is not reasonable or authorized under Section 8.1.3.

8.1.5 Deductions. In arriving at the amount due to Contractor under this Section, the SFMTA may deduct: (a) all payments previously made by the SFMTA for Work covered by Contractor's final invoice; (b) any claim which the SFMTA may have against Contractor in connection with this Agreement; (c) any invoiced costs or expenses excluded pursuant to the immediately preceding subsection 8.1.4; and (d) in instances in which, in the opinion of the SFMTA, the cost of any Service performed under this Agreement is excessively high due to costs incurred to remedy or replace defective or rejected Work, the difference between the invoiced amount and the SFMTA's estimate of the reasonable cost of performing the invoiced Work in compliance with the requirements of this Agreement.

8.1.6 Survival. The City's payment obligation under this Section shall survive termination of this Agreement.

8.2 Termination for Default; Remedies.

8.2.1 Event of Default. Each of the following shall constitute an immediate event of default (Event of Default) under this Agreement:

a. Contractor fails or refuses to perform or observe any term, covenant or condition contained in any of the following Sections of this Agreement:

3.5	Submitting False Claims.
4.5	Assignment
Article 5	Insurance and Indemnity
Article 7	Payment of Taxes
9.4	Proprietary Materials
9.5	Management of City Data and Confidential Information
10.10	Alcohol and Drug-Free Workplace
11.10	Compliance with Laws

b. Contractor fails or refuses to perform or observe any other term, covenant or condition contained in this Agreement, including any obligation imposed by ordinance or statute and incorporated by reference herein, and such default continues for a period of 10 days after written notice thereof from the SFMTA to Contractor.

c. Contractor (i) is generally not paying its debts as they become due; (ii) files, or consents by answer or otherwise to the filing against it of a petition for relief or reorganization or arrangement or any other petition in bankruptcy or for liquidation or to take advantage of any bankruptcy, insolvency or other debtors' relief law of any jurisdiction; (iii) makes an assignment for the benefit of its creditors; (iv) consents to the appointment of a custodian, receiver, trustee or other officer with similar powers of Contractor or of any substantial part of Contractor's property; or (v) takes action for the purpose of any of the foregoing.

d. A court or government authority enters an order (i) appointing a custodian, receiver, trustee or other officer with similar powers with respect to Contractor or with respect to any substantial part of Contractor's property, (ii) constituting an order for relief or approving a petition for relief or reorganization or arrangement or any other petition in bankruptcy or for liquidation or to take advantage of any bankruptcy, insolvency or other debtors' relief law of any jurisdiction or (iii) ordering the dissolution, winding-up or liquidation of Contractor.

8.2.2 Remedies. On and after any Event of Default, City shall have the right to exercise its legal and equitable remedies, including, without limitation, the right to terminate this Agreement or to seek specific performance of all or any part of this Agreement. In addition, where applicable, City shall have the right (but no obligation) to cure (or cause to be cured) on behalf of Contractor any Event of Default; Contractor shall pay to City on demand all costs and expenses incurred by City in effecting such cure, with interest thereon from the date of incurrence at the maximum rate then permitted by law. City shall have the right to offset from any amounts due to Contractor under this Agreement or any other agreement between City and Contractor: (a) all damages, losses, costs or expenses incurred by City as a result of an Event of Default; and (b) any liquidated damages levied upon Contractor pursuant to the terms of this Agreement; and (c), any damages imposed by any ordinance or statute that is incorporated into this Agreement by reference, or into any other agreement with the City.

8.2.3 No Waiver. All remedies provided for in this Agreement may be exercised individually or in combination with any other remedy available hereunder or under applicable laws, rules and regulations. The exercise of any remedy shall not preclude or in any way be deemed to waive any other remedy. Nothing in this Agreement shall constitute a waiver or limitation of any rights that City may have under applicable law.

8.2.4 Notice of Default. Any notice of default must be sent by registered mail to the address set forth in Article 11.

8.3 Non-Waiver of Rights. The omission by either party at any time to enforce any default or right reserved to it, or to require performance of any of the terms, covenants, or provisions hereof by the other party at the time designated, shall not be a waiver of any such default or right to which the party is entitled, nor shall it in any way affect the right of the party to enforce such provisions thereafter.

8.4 Rights and Duties upon Termination or Expiration.

8.4.1 Survival of Sections. This Section and the following Sections of this Agreement listed below, shall survive termination or expiration of this Agreement:

3.3.4	Payment Limited to Satisfactory Work
3.3.9(a)	Grant Funded Contracts - Disallowance
3.4	Audit and Inspection of Records
3.5	Submitting False Claims
Article 5	Insurance and Indemnity
6.1	Liability of City
6.3	Liability for Incidental and Consequential Damages
Article 7	Payment of Taxes
8.1.6	Survival
8.2.2	Remedies
9.1	Ownership of Results
9.2	Works for Hire
9.4.	Proprietary Materials
9.5	Management of City Data and Confidential Information
11.6.3	Resolution of Disputes
11.7	Agreement Made in California; Venue
11.8	Construction
11.9	Entire Agreement
11.10	Compliance with Laws
11.11	Severability

8.4.2 Contractor Duties. Subject to the survival of the Sections identified in Section 8.4.1 above, if this Agreement is terminated prior to expiration of the term specified in Article 2, this Agreement shall be of no further force or effect. Contractor shall transfer title to City, and deliver in the manner, at the times, and to the extent, if any, directed by City, any work in progress, completed work, supplies, equipment, and other materials produced as a part of, or acquired in connection with the performance of this Agreement, and any completed or partially completed work which, if this Agreement had been completed, would have been required to be furnished to City.

Article 9 Rights In Deliverables

9.1 Ownership of Results. Any interest of Contractor or its Subcontractors, in the Deliverables, including any materials, equipment, drawings, plans, specifications, blueprints, studies, reports, memoranda, computation sheets, computer files and media or other documents prepared by Contractor or its Subcontractors for the purposes of this Agreement, shall become the property of and will be transmitted to City. However, unless expressly prohibited elsewhere in this Agreement, Contractor may retain and use copies for reference and as documentation of its experience and capabilities. For clarity of purposes, although ownership of the items listed above will become the property of the City, the intellectual property contained within those items shall remain with the Contractor or its Subcontractors and shall be deemed confidential and protected information, (a) unless and to the extent an item is designed exclusively for the City (e.g., modified AROW driver door), and (b) subject to the provisions of Section 9.4.1. For those items listed above that are not designed exclusively for the City, Contractor grants City a license to use them as provided in Section 9.3.5.

9.2 Not used. (Works for Hire).

9.3 Licenses Granted

9.3.1 Computerized Software and Systems. To the extent that software, firmware, systems designs, computerized manuals, training modules, or other such Deliverables are not designed specifically for City's purposes in connection with the Agreement, Contractor grants City a perpetual, non-exclusive, non-transferable, license at all locations owned or controlled by City to use all such Deliverables, or portions thereof. City shall also be authorized to modify or prepare derivative works of the Deliverables and make copies of such Deliverables for internal use only. Any such modifications shall become the property of the City unless such modifications are not used exclusively for internal purposes. City agrees not to remove or destroy any proprietary markings or proprietary legends placed upon or contained within the Deliverable(s) or any related materials or documentation. Contractor warrants that it has title to and/or the authority to grant a license of such Deliverables to the City.

9.3.2 IP Transfer. In the event that Contractor is (a) unable or fails to meet its warranty or service obligations, excluding any such failure that results from Contractor's good faith dispute with City as to the validity of a warranty claim, or (b) Contractor (i) shall make an assignment for the benefit of creditors, or (ii) shall file in any court or agency of competent jurisdiction, a petition in bankruptcy or insolvency (each, an "IP Transfer Trigger Event"), Contractor shall deliver any software, firmware, systems designs, computerized manuals, training modules, or other such information necessary to enable City to perform the maintenance and operation of the Vehicles (collectively, the "Specified Contractor IP"). No later than 30 days after an IP Transfer Trigger Event, City shall have the right to receive from Contractor, and Contractor shall deliver to City, one copy of the Specified Contractor IP, and Contractor grants to City a non-exclusive, royalty-free right and license to use the Specified Contractor IP solely as necessary for City to perform the maintenance and operation of the Vehicles.

9.3.3 Bankruptcy. All rights and licenses granted in respect of the Specified Contractor IP are, and shall be deemed to be, for purposes of Section 365(n) of the Bankruptcy Code, 11 U.S.C. § 101 et seq., licenses of rights to "intellectual property" as defined under Section 101(35A) of the Bankruptcy Code; and the Specified Contractor IP is, and shall be deemed to be, "embodiment[s]" of "intellectual property" for purposes of same. City shall retain and may fully exercise all of its rights and elections under the Bankruptcy Code or equivalent legislation in any other jurisdiction. Without limiting the generality of the foregoing, Contractor acknowledges that the rights and license granted to City pursuant to this Section 9.3 shall not be affected by Contractor's rejection of this Agreement in bankruptcy and shall continue subject to the terms and conditions of this Agreement.

9.3.4 License for Data. Except as provided below, the City grants to Contractor a license to inspect, examine, and otherwise obtain any information or data available from components provided by the Contractor, including, but not limited to, any electronic control modules or other data-collection devices, to the extend necessary to enable the Contractor to perform reliability maintenance analysis, corrective actions, and/or other engineering work for the Buses. This grant of license does not apply to any data or information obtained through or downloaded from the following systems:

a. Passenger Information System
b. CAD/AVL System
c. Automatic Passenger Counter System
d. Video Surveillance System

9.3.5 Other Deliverables. Contractor grants City a perpetual, non-exclusive, non-transferable license to use, retain, and reproduce at all locations controlled by the SFMTA, for internal use only, all copies (whether in hard copy or electronic format) of drawings, plans, specifications, schematics, studies, reports, memoranda, computation sheets and all other documents that are (a) prepared by Contractor or its Subcontractors or Suppliers (but not exclusively for City); and (b) subject to any restrictions set forth herein, required to be provided to City in connection with this Agreement. Contractor warrants that it has title to and/or the authority to grant a license of such Deliverables to the City.

9.4 Proprietary Materials.

9.4.1 Contractor Information. To the extent that the Contractor considers any document or Deliverable to be a trade secret or otherwise proprietary, Contractor shall so mark them. SFMTA shall require individuals using such proprietary documents to maintain the confidentiality of the documents, and if necessary, sign a confidentiality agreement regarding use of highly sensitive documents. For purposes of this Agreement, the Specified Contractor IP (see Section 9.3.2) shall be considered a trade secret under this Section and subject to the provisions of this Section. Contractor shall hold the City harmless from and defend the City against all claims, suits or other proceedings instituted against the City for copyright infringement, misuse or misappropriation of a trade secret, or for access to the documents or Deliverables under the

City's Sunshine Ordinance or the California Public Records Act. The SFMTA will give Contractor prompt notice if it receives a request for such records under the Sunshine Ordinance or the California Public Records Act to allow Contractor the opportunity to contest the request. Contractor will pay the costs and damages awarded in any such action or proceeding, or the cost of settling such action or proceeding, provided that Contractor shall have sole control of the defense of any such action and all negotiations or its settlement or compromise. If notified promptly in writing of any informal claim (other than a judicial action) brought against City based on an allegation that City's use of the buses, spare parts, documents or Deliverables constitutes infringement, Contractor will pay the costs associated with resolving such claim and will pay the settlement amount (if any), provided that Contractor shall have sole control of the resolution of any such claim and all negotiations for its settlement.

9.4.2 City Information.

a. If this Agreement requires City to disclose "Private Information" to Contractor within the meaning of San Francisco Administrative Code Chapter 12M, Contractor and its subcontractors shall use such information only in accordance with the restrictions stated in Chapter 12M and in this Agreement and only as necessary in performing the Services. Contractor is subject to the enforcement and penalty provisions in Chapter 12M.

b. In the performance of Work, Contractor may have access to City's proprietary or Confidential Information, the disclosure of which to third parties may damage City. If City discloses proprietary or Confidential Information to Contractor, such information must be held by Contractor in confidence and used only in performing the Agreement. Contractor shall exercise the same standard of care to protect such information as a reasonably prudent contractor would use to protect its own proprietary or Confidential Information.

9.5 Management of City Data and Confidential Information.

9.5.1 Access to City Data. City shall at all times have access to and control of City Data, and shall be able to retrieve it in a readable format, in electronic form and/or print, at any time, at no additional cost.

9.5.2 Use of City Data and Confidential Information. Contractor agrees to hold City's Confidential Information received from or created on behalf of the City in strictest confidence. Contractor shall not use or disclose City's Data or Confidential Information except as permitted or required by the Agreement or as otherwise authorized in writing by the City. Any work using, or sharing or storage of, City's Confidential Information outside the United States is subject to prior written authorization by the City. Access to City's Confidential Information must be strictly controlled and limited to Contractor's staff assigned to this project on a need-to-know basis only. Contractor is provided a limited non-exclusive license to use the City Data or Confidential Information solely for performing its obligations under the Agreement and not for Contractor's own purposes or later use. Nothing herein shall be construed to confer any license or right to the City Data or Confidential Information, by implication, estoppel or otherwise,

under copyright or other intellectual property rights, to any third party. Unauthorized use of City Data or Confidential Information by Contractor, subcontractors or other third parties is prohibited. For purpose of this requirement, the phrase "unauthorized use" means the data mining or processing of Data, stored or transmitted by the service, for commercial purposes, advertising or advertising-related purposes, or for any purpose other than security or service delivery analysis that is not explicitly authorized.

9.5.3 Disposition of Confidential Information. Upon termination of Agreement or request of City, Contractor shall within 48 hours return all Confidential Information, which includes all original media. Once Contractor has received written confirmation from City that Confidential Information has been successfully transferred to City, Contractor shall, within 10 Working Days, purge all Confidential Information from its servers, any hosted environment Contractor has used in performance of this Agreement, work stations that were used to process the Data or for production of the Data, and any other work files stored by Contractor in whatever medium. Contractor shall provide City with written certification that such purge occurred within five Working Days of the purge.

Article 10 Additional Requirements Incorporated by Reference

10.1 Laws Incorporated by Reference. The full text of the laws listed in this Article 10, including enforcement and penalty provisions, are incorporated by reference into this Agreement. The full text of the San Francisco Municipal Code provisions incorporated by reference in this Article and elsewhere in the Agreement (Mandatory City Requirements) are available at http://www.amlegal.com/codes/client/san-francisco_ca.

10.2 Conflict of Interest. By executing this Agreement, Contractor certifies that it does not know of any fact which constitutes a violation of Section 15.103 of the City's Charter; Article III, Chapter 2 of City's Campaign and Governmental Conduct Code; Title 9, Chapter 7 of the California Government Code (Section 87100 *et seq.*), or Title 1, Division 4, Chapter 1, Article 4 of the California Government Code (Section 1090 *et seq.*), and further agrees promptly to notify the City if it becomes aware of any such fact during the term of this Agreement.

10.3 Prohibition on Use of Public Funds for Political Activity. In performing the Work, Contractor shall comply with San Francisco Administrative Code Chapter 12G, which prohibits funds appropriated by the City for this Agreement from being expended to participate in, support, or attempt to influence any political campaign for a candidate or for a ballot measure. Contractor is subject to the enforcement and penalty provisions in Chapter 12G.

10.4 Consideration of Salary History. Contractor shall comply with San Francisco Administrative Code Chapter 12K, the Consideration of Salary History Ordinance or "Pay Parity Act." Contractor is prohibited from considering current or past salary of an applicant in determining whether to hire the applicant or what salary to offer the applicant to the extent that such applicant is applying for employment to be performed on this Agreement or in furtherance of this Agreement, and whose application, in whole or part, will be solicited, received, processed

or considered, whether or not through an interview, in the City or on City property. The ordinance also prohibits employers from (a) asking such applicants about their current or past salary or (b) disclosing a current or former employee's salary history without that employee's authorization unless the salary history is publicly available. Contractor is subject to the enforcement and penalty provisions in Chapter 12K. Information about and the text of Chapter 12K is available on the web at https://sfgov.org/olse/consideration-salary-history. Contractor is required to comply with all of the applicable provisions of 12K, irrespective of the listing of obligations in this Section.

10.5 Nondiscrimination Requirements

10.5.1 Non Discrimination in Contracts. Contractor shall comply with the provisions of Chapters 12B and 12C of the San Francisco Administrative Code. Contractor shall incorporate by reference in all subcontracts the provisions of Sections 12B.2(a), 12B.2(c)-(k), and 12C.3 of the San Francisco Administrative Code and shall require all Subcontractors to comply with such provisions. Contractor is subject to the enforcement and penalty provisions in Chapters 12B and 12C.

10.5.2 Nondiscrimination in the Provision of Employee Benefits. San Francisco Administrative Code 12B.2. Contractor does not as of the date of this Agreement, and will not during the term of this Agreement, in any of its operations in San Francisco, on real property owned by San Francisco, or where work is being performed for the City elsewhere in the United States, discriminate in the provision of employee benefits between employees with domestic partners and employees with spouses and/or between the domestic partners and spouses of such employees, subject to the conditions set forth in San Francisco Administrative Code Section 12B.2.

10.6 Reserved. (Local Business Enterprise)

10.7 Minimum Compensation Ordinance. Contractor agrees to pay covered employees no less than the minimum compensation required by San Francisco Administrative Code Chapter 12P. Contractor is subject to the enforcement and penalty provisions in Chapter 12P. By signing and executing this Agreement, Contractor certifies that it is in compliance with Chapter 12P.

10.8 Health Care Accountability Ordinance. Contractor agrees to choose and perform one of the Health Care Accountability options set forth in San Francisco Administrative Code Chapter 12Q.3, and to comply with the HCAO as set forth in Chapter 12Q.

10.9 First Source Hiring Program. Contractor must comply with all of the provisions of the First Source Hiring Program, Chapter 83 of the San Francisco Administrative Code, that apply to this Agreement, and Contractor is subject to the enforcement and penalty provisions in Chapter 83.

10.10 Alcohol and Drug-Free Workplace. City reserves the right to deny access to, or require Contractor to remove from, City facilities personnel of any contractor or subcontractor who City has reasonable grounds to believe has engaged in alcohol abuse or illegal drug activity which in any way impairs City's ability to maintain safe work facilities or to protect the health and well-being of City employees and the general public. City shall have the right of final approval for the entry or re-entry of any such person previously denied access to, or removed from, City facilities. Illegal drug activity means possessing, furnishing, selling, offering, purchasing, using or being under the influence of illegal drugs or other controlled substances for which the individual lacks a valid prescription. Alcohol abuse means possessing, furnishing, selling, offering, or using alcoholic beverages, or being under the influence of alcohol.

Contractor agrees in the performance of this Agreement to maintain a drug-free workplace by notifying employees that unlawful drug use is prohibited and specifying what actions will be taken against employees for violations; establishing an on-going drug-free awareness program that includes employee notification and, as appropriate, rehabilitation. Contractor can comply with this requirement by implementing a drug-free workplace program that complies with the Federal Drug-Free Workplace Act of 1988 (41 U.S.C. § 701) and the California Drug-Free Workplace Act of 1990, Cal. Gov. Code, Sections 8350 et seq., if state funds involved.

10.11 Limitations on Contributions. By executing this Agreement, Contractor acknowledges its obligations under section 1.126 of the City's Campaign and Governmental Conduct Code, which prohibits any person who contracts with, or is seeking a contract with, any department of the City for the rendition of personal services, for the furnishing of any material, supplies or equipment, for the sale or lease of any land or building, for a grant, loan or loan guarantee, or for a development agreement, from making any campaign contribution to (a) a City elected official if the contract must be approved by that official, a board on which that official serves, or the board of a state agency on which an appointee of that official serves, (b) a candidate for that City elective office, or (c) a committee controlled by such elected official or a candidate for that office, at any time from the submission of a proposal for the contract until the later of either the termination of negotiations for such contract or twelve months after the date the City approves the contract. The prohibition on contributions applies to each prospective party to the contract; each member of Contractor's board of directors; Contractor's chairperson, chief executive officer, chief financial officer and chief operating officer; any person with an ownership interest of more than 10% in Contractor; any subcontractor listed in the bid or contract; and any committee that is sponsored or controlled by Contractor. Contractor certifies that it has informed each such person of the limitation on contributions imposed by Section 1.126 by the time it submitted a proposal for the contract, and has provided the names of the persons required to be informed to the City department with whom it is contracting.

10.12 Reserved. (Slavery Era Disclosure)

10.13 Reserved. (Working with Minors)

10.14 Consideration of Criminal History in Hiring and Employment Decisions

10.14.1 Contractor agrees to comply fully with and be bound by all of the provisions of Chapter 12T (City Contractor/Subcontractor Consideration of Criminal History in Hiring and Employment Decisions) of the San Francisco Administrative Code (Chapter 12T), including the remedies provided, and implementing regulations, as may be amended from time to time. The provisions of Chapter 12T are incorporated by reference and made a part of this Agreement as though fully set forth herein. The text of the Chapter 12T is available on the web at http://sfgov.org/olse/fco. Contractor is required to comply with all of the applicable provisions of 12T, irrespective of the listing of obligations in this Section. Capitalized terms used in this Section and not defined in this Agreement shall have the meanings assigned to such terms in Chapter 12T.

10.14.2 The requirements of Chapter 12T shall only apply to a Contractor's or Subcontractor's operations to the extent those operations are in furtherance of the performance of this Agreement, shall apply only to applicants and employees who would be or are performing work in furtherance of this Agreement, and shall apply when the physical location of the employment or prospective employment of an individual is wholly or substantially within the City of San Francisco. Chapter 12T shall not apply when the application in a particular context would conflict with federal or state law or with a requirement of a government agency implementing federal or state law.

10.15 Reserved. (Public Access to Nonprofit Records and Meetings).

10.16 Food Service Waste Reduction Requirements. Contractor shall comply with the Food Service Waste Reduction Ordinance, as set forth in San Francisco Environment Code Chapter 16, including but not limited to the remedies for noncompliance provided therein.

10.17 Reserved. (Sugar-Sweetened Beverage Prohibition).

10.18 Tropical Hardwood and Virgin Redwood Ban. Pursuant to San Francisco Environment Code Section 804(b), the City urges Contractor not to import, purchase, obtain, or use for any purpose, any tropical hardwood, tropical hardwood wood product, virgin redwood or virgin redwood wood product.

Contractor shall comply with San Francisco Environment Code Chapter 8, which provides that except as expressly permitted by the application of Sections 802(b) and 803(b) of the San Francisco Environment Code, Contractor shall not provide any items to the City in performance of this contract which are tropical hardwoods, tropical hardwood wood products, virgin redwood or virgin redwood wood products. Contractor is subject to the penalty and enforcement provisions of Chapter 8.

10.19 Preservative Treated Wood Products. Contractor shall comply with the provisions of San Francisco Environment Code Chapter 13, which requires that each Contractor purchasing preservative-treated wood products on behalf of the City, shall only purchase such

products from the list of alternatives adopted by the Department of the Environment pursuant to Section 1302 of Chapter 13, unless otherwise granted an exemption by the terms of that Chapter.

Article 11 General Provisions

11.1 Notices to the Parties. Unless otherwise indicated in this Agreement, all written communications sent by the Parties may be by U.S. mail or e-mail, and shall be addressed as follows:

To City: San Francisco Municipal Transportation Agency
Transit Division Fleet Engineering
700 Pennsylvania Avenue Building B 2/F., San Francisco, CA 94107
Attention: Bhavin Khatri, Project Manager
bhavin.khatri@sfmta.com

To Contractor: Nova Bus, A Division of Prevost Car (US) Inc.
260 Banker Road, Plattsburgh, NY 12901
Attention: Martin Gagnier, Customer Project Manager
martin.gagnier@volvo.com

Any notice of default must be sent by registered mail or overnight delivery service or courier. Either Party may change the address to which notice is to be sent by giving written notice thereof to the other Party. If email notification is used, the sender must specify a receipt notice.

11.2 Compliance with Americans with Disabilities Act. Contractor shall provide the Work in a manner that complies with the Americans with Disabilities Act (ADA), including, but not limited to, Title II's program access requirements, and all other applicable federal, state and local disability rights legislation.

11.3 Reserved.

11.4 Sunshine Ordinance. Contractor acknowledges that this Agreement and all records related to its formation, Contractor's performance of Work, and City's payment are subject to the California Public Records Act, (California Government Code §6250 et. seq.), and the San Francisco Sunshine Ordinance, (San Francisco Administrative Code Chapter 67). Such records are subject to public inspection and copying unless exempt from disclosure under federal, state or local law. See also Section 3.4 for Contractor's legal obligations for requests under the Sunshine Ordinance.

11.5 Modification of this Agreement. This Agreement may not be modified, nor may compliance with any of its terms be waived, except as noted in Section 11.1 (Notices to Parties) regarding change in personnel or place, and except by written instrument executed and approved as required under City law and under the policy of the SFMTA Board of Directors. Contractor shall cooperate with the SFMTA to submit to the CCO any amendment, modification,

supplement or change order that would result in a cumulative increase of the original amount of this Agreement by more than 20% (CMD Contract Modification Form).

11.6 Authority of Project Manager; Claims; Disputes . The Project Manager shall decide all questions which may arise as to the quality or acceptability of materials furnished and work performed and as to the manner of performance and rate of progress of the work; all questions, which may arise as to the acceptable fulfillment of the Contract on the part of the Contractor; and all questions as to compensation. In discharging the responsibilities outlined above, the Project Manager shall at all times act fairly and reasonably. Any appeal of the Project Manager's decisions shall be in accordance with the provisions of Section 11.9 of this Agreement. As with any claim, change, extra or additional work, Contractor shall be paid in accordance with the payment provisions set out in Section 3.3.1 of this Contract when the dispute is finally resolved.

Should any questions arise as to the meaning and intent of the Contract, the matter shall be referred to the Project Manager, who, in consultation with other City representatives, as applicable, and with input the Contractor, shall decide the true meaning and intent of the Contract. The Project Manager's decision in this regard shall be administratively final and conclusive.

11.6.1 Claims for Additional Compensation.

a. Contractor shall not be entitled to the payment of any additional compensation for any action, or failure to act, by the SFMTA, including failure or refusal to issue a Contract Modification or for the happening of any event, thing, occurrence, or other cause, unless Contractor shall have given the Project Manager due written notice of potential claim.

b. The written notice of potential claim shall set forth the reasons for which Contractor believes additional compensation will or may be due, the nature of the costs involved, and insofar as possible, the amount of the potential claim. The said notice as above required must have been given to the Project Manager prior to the time that Contractor shall have performed the work giving rise to the potential claim for additional compensation, or in all other cases, within 30 Days after the happening of the event, thing, occurrence, or other cause giving rise to the potential claim.

c. It is the intention of this Section 11.6.1 that differences between the Parties arising under and by virtue of the Contract be brought to the attention of the SFMTA at the earliest possible time in order that such matters may be settled, if possible, or other appropriate action promptly be taken. Contractor agrees that it shall have no right to additional compensation for any claim that may be based on any such act, failure to act, event, thing, or occurrence for which no written notice of potential claim as herein required was filed.

11.6.2 Other Claims. For any dispute involving a question of fact that does not involve a claim for additional compensation, the aggrieved party shall furnish the other party

with a notice of dispute within 15 Days of the determination of the dispute. The party receiving a notice of dispute shall submit a written reply with 15 Days of delivery of the notice. The notice and response shall contain the following: (a) a statement of the party's position and a summary of the arguments supporting that position, and (b) any evidence supporting the party's position.

11.6.3 Resolution of Disputes. Disputes arising in the performance of this Agreement that are not resolved by negotiation between the parties shall be decided in writing by the SFMTA Project Manager. The Project Manager's decision shall be administratively final and conclusive unless within 10 Working Days from the date of such decision, the Contractor mails or otherwise furnishes a written appeal to the Director of Transit, or his/her designee. In connection with such an appeal, the Contractor shall be afforded an opportunity to be heard and to offer evidence in support of its position. The decision of the Director of Transit shall be administratively final and conclusive. This section applies to all disputes unless a specific provision of this Agreement provides that the Project Manager's decision as to a particular dispute is final.

11.6.4 No Cessation of Work. Pending final resolution of a dispute hereunder, the Contractor shall proceed diligently with the performance of its obligations under this Agreement in accordance with the written directions of the Project Manager.

11.6.5 Alternative Dispute Resolution. If agreed to by both parties, disputes may be resolved by a mutually agreed to alternative dispute resolution process. If the parties do not mutually agree to an alternative dispute resolution process or such efforts do not resolve the dispute, then either Party may pursue any remedy available under California law. Neither Party will be entitled to legal fees or costs for matters resolved under this section.

11.6.6 Disputes Among Contractor's Partners. The resolution of any contractual disputes related to Contractor's Joint Venture or Association partners (if any) shall be the sole responsibility of the Contractor. Each party of the Joint Venture or Association shall resolve all such disputes within 30 calendar days of when the dispute first surfaced so as not to impact the performance of the contract with the City. Any such disputes which impact the Project and which are left unresolved for more than one month shall be cause for the City to withhold and/or reduce invoice payments to the Contractor's Joint Venture or Association firms until the dispute is resolved.

11.6.7 Government Code Claim Requirement. No suit for money or damages may be brought against the City until a written claim therefor has been presented to and rejected by the City in conformity with the provisions of San Francisco Administrative Code Chapter 10 and California Government Code Section 900, et seq. Nothing set forth in this Agreement shall operate to toll, waive or excuse Contractor's compliance with the California Government Code Claim requirements set forth in San Francisco Administrative Code Chapter 10 and California Government Code Section 900, et seq.

11.7 Agreement Made in California; Venue. The formation, interpretation and performance of this Agreement shall be governed by the laws of the State of California. Venue for all litigation relative to the formation, interpretation and performance of this Agreement shall be in San Francisco.

11.8 Construction. All paragraph captions are for reference only and shall not be considered in construing this Agreement.

11.9 Entire Agreement. This Contract sets forth the entire agreement between the parties, and supersedes all other oral or written provisions. This Agreement may be modified only as provided in Section 11.5 (Modification of this Agreement).

11.10 Compliance with Laws. Contractor shall keep itself fully informed of the City's Charter, codes, ordinances and duly adopted rules and regulations of the City and of all state, and federal laws in any manner affecting the performance of this Agreement, and must at all times comply with such local codes, ordinances, and regulations and all applicable laws as they may be amended from time to time.

11.11 Severability. Should the application of any provision of this Agreement to any particular facts or circumstances be found by a court of competent jurisdiction to be invalid or unenforceable, then (a) the validity of other provisions of this Agreement shall not be affected or impaired thereby, and (b) such provision shall be enforced to the maximum extent possible so as to effect the intent of the parties and shall be reformed without further action by the parties to the extent necessary to make such provision valid and enforceable.

11.12 Cooperative Drafting. This Agreement has been drafted through a cooperative effort of City and Contractor, and both Parties have had an opportunity to have the Agreement reviewed and revised by legal counsel. No Party shall be considered the drafter of this Agreement, and no presumption or rule that an ambiguity shall be construed against the Party drafting the clause shall apply to the interpretation or enforcement of this Agreement.

11.13 Order of Precedence. Contractor agrees to perform the services described below in accordance with the terms and conditions of this Agreement. Any inconsistency in requirements of the Contract documents shall be resolved by giving precedence in the following order:

a. This Contract document, including Appendices
b. Technical Specifications, including the warranty provisions

11.14 Time of Essence. Time is of the essence in this Agreement.

11.15 Notification of Legal Requests. Contractor shall immediately notify City upon receipt of any subpoenas, service of process, litigation holds, discovery requests and other legal requests (Legal Requests) related to City Data, or which in any way might reasonably require access to City Data, and in no event later than 24 hours after it receives the request. Contractor shall not respond to Legal Requests related to City without first notifying City other than to

notify the requestor that the information sought is potentially covered under a non-disclosure agreement. Contractor shall retain and preserve City Data in accordance with the City's instruction and requests, including, without limitation, any retention schedules and/or litigation hold orders provided by the City to Contractor, independent of where the City Data is stored

Article 12 Deliveries and Acceptance

12.1 Deliveries

12.1.1 Predelivery Tests and Inspections. Pre-delivery tests and inspections shall be performed prior to shipment to the SFMTA. Such tests and inspections shall be performed in accordance with the procedures defined in Verification Section 12.2.3 of the Technical Specifications, and they may be witnessed by the SFMTA Resident Inspector. When a Coach passes these tests and inspections, the Resident Inspector shall authorize release of the Coach for shipment. Such authorization does not imply Acceptance of the Vehicle by the SFMTA.

12.1.2 Delivery Procedure. Delivery shall be determined by signed receipt of the SFMTA Engineer at the point of delivery and may be preceded by a cursory inspection of the Vehicle. The point of delivery shall be:

Three 40-ft Battery Electric Coaches
1098 23rd Street San Francisco, California 94107

Contractor shall deliver Coaches during weekday working hours at a time mutually agreeable to the SFMTA and Contractor, or as otherwise specified in writing by the SFMTA. Contractor shall provide at least five Working Days' notice to the SFMTA prior to delivery. Delivery of the Coaches shall be F.O.B. point of delivery, freight pre-paid and allowed. Contractor shall ensure that all Coaches are fully operable when they are delivered. Contractor shall deliver a maximum of three coaches per week.

12.1.3 Condition of Coaches. Drivers shall keep a complete and accurate maintenance log while enroute, which shall be delivered to the SFMTA Project Manager / Representative with the Coach. The log shall show the driver's compliance with the tire manufacturer's highway operating procedures. If the Coaches are towed, the rear axle shafts shall be removed during the towing and re-coupled by the Contractor after arrival at the point of delivery. Contractor shall deliver each Coach with a full tank of fuel and fully cleaned (exterior, interior, underside, and topside) prior to presentation for inspection. Also, if the Coaches are towed from the Contractor's facility to the SFMTA, highway-type tires shall be installed. Upon arrival at an SFMTA maintenance facility or within the City/County of San Francisco, Contractor, at its expense, shall install city-type tires.

12.1.4 Spare Parts Delivery Procedure. Composition of spare parts is subject to SFMTA approval. Contractor shall provide the SFMTA with one-week advance notice before shipment of spare parts. Such notice shall include a packing list clearly identifying all parts and their quantity in the shipment.

Delivery of spare parts shall be acknowledged by signed receipt of the SFMTA representative at the point of delivery and may be preceded by a cursory inspection of the parts. Within 20 Days of delivery, the SFMTA will issue a notification of Acceptance, non-Acceptance, or Conditional Acceptance of the spare parts. The point of delivery shall the location for the applicable Coach provided in Section 12.1.2.

Delivery of spare parts shall be F.O.B. point of delivery, freight pre-paid and allowed.

12.2 Acceptance of Vehicles

12.2.1 Procedure.

a. Contractor shall ensure that the Coach's underside is washed and cleaned prior to being presented to SFMTA for Acceptance.

b. After arrival at the designated point of delivery, each Coach shall undergo pre-Acceptance and Acceptance tests by the SFMTA as defined in the Quality Assurance Section of the Technical Specifications. The SFMTA shall make a good faith effort to begin the Acceptance process within 20 Days after delivery of each Coach. When a Coach passes all tests, SFMTA will provide written Acceptance of the Coach to the Contractor. Contractor shall transfer title to the Coach to the City on the day of Acceptance, or Conditional Acceptance, if the Coach is not fully Accepted. Acceptance of one Coach does not imply Acceptance of any other delivered Coaches.

c. If a Coach fails the Acceptance tests, the Coach shall not be Accepted until the repair procedures defined in Section 12.3, of this Agreement have been carried out and the Coach has been retested and passes all applicable tests. All deliveries of Coaches shall be halted whenever two or more Coaches have failed or have not been Accepted or Conditionally Accepted and are awaiting repairs or Corrections.

d. After completion of post-delivery testing, the SFMTA will issue a notification of Acceptance, non-Acceptance or Conditional Acceptance.

12.2.2 Conditional Acceptance. If a Coach does not meet all requirements for Acceptance, the SFMTA may, at its exclusive option, "conditionally accept" the Coach and place it into revenue service, pending receipt of Contractor-furnished materials and/or labor necessary to effectuate corrective action for Acceptance. For any Conditionally Accepted Vehicle, payments shall be made as provided in Section 3.3.1 above.

12.2.3 Assumption of Risk of Loss. Prior to delivery as described in Section 12.1 of this Agreement, and regardless whether title has passed to the City, the Contractor shall bear risk of loss of the Coach, including any damage sustained during transportation to the

delivery site. Risk of loss will pass to the SFMTA upon delivery of each Coach except that loss or damage to the Coach resulting from acts or omissions of the Contractor shall be the responsibility of the Contractor until Acceptance of the Vehicle.

12.2.4 Title . At the time each Coach is delivered, Contractor shall provide the SFMTA Project Manager with adequate documents for securing the title for the Coach in the State of California. Unless full unencumbered title transfers earlier under Section 3.3.2, upon Acceptance of each Coach, title to each Coach shall pass to the City, which title Contractor warrants shall be free and clear of all liens, mortgages and encumbrances, financing statements, security agreements, claims, and demands of any character.

12.3 Repairs Prior To Acceptance. The SFMTA Project Manager may require the Contractor, or its designated representative, to perform repairs after non-Acceptance or Conditional Acceptance, or the Contractor may request that the repairs be done by SFMTA personnel with reimbursement by the Contractor. Contractor shall inform the SFMTA in advance of any modifications made to the Coach during the Acceptance period.

12.3.1 Repairs by Contractor. If the SFMTA Project Manager requires the Contractor to perform repairs after non-Acceptance or Conditional Acceptance of the Vehicle, the Contractor's representative must begin the repair within five Days after receiving notification from the SFMTA Project Manager of failure of Acceptance tests.

The Contractor shall provide, at its own expense, all spare parts, tools, and labor required to complete the repairs. At the SFMTA Project Manager's option, the Contractor may be required to remove the Coach from SFMTA property while repairs are being effected. The Contractor shall then provide a space to complete the repairs, shall diligently pursue the repairs, and shall assume risk of loss while the Coach is under its control.

12.3.2 Repairs by SFMTA.

a. If the SFMTA Project Manager agrees to a request by the Contractor for SFMTA to perform repairs on a Contractor-owned Coach prior to SFMTA Acceptance, the SFMTA shall correct or repair the Defect using parts supplied by the Contractor specifically for this repair. Monthly, or at a period to be mutually agreed upon, reports of all repairs covered by this procedure shall be submitted by the SFMTA Project Manager to the Contractor for actual cost reimbursement of parts. The Contractor shall provide forms for these reports.

b. If the Contractor supplies parts for repairs being performed by the SFMTA before Acceptance of the Coach, Contractor shall deliver these parts prepaid to the SFMTA within 10 Working Days after receipt of the request for the parts. The Contractor may request that Defective components covered by this provision be returned to the manufacturing plant. Contractor shall bear all expenses for supplying such parts and for any associated costs.

c. Contractor shall reimburse the SFMTA for all costs of labor and materials (including taxes) for repairs made or caused to be made by the SFMTA. If the SFMTA performs the repairs itself, the amount shall be determined by multiplying the number of person-hours actually required to Correct the Defect by the current technician's hourly overtime wage rate, which includes fringe benefits and overhead, plus the cost of towing the Coach if such action was necessary. If the SFMTA requires the service of an outside repair facility, Contractor shall reimburse the SFMTA for all such repair invoices. Contractor shall also reimburse the SFMTA for administrative costs incurred in performing the repairs. The use of SFMTA labor will not relieve the Contractor from the responsibility to ensure that repairs are carried out in accordance with proper procedures.

d. SFMTA may deduct the cost of repairs from any monies due or that may become due to the Contractor under the Agreement, or if such monies are insufficient, the Contractor or its surety shall pay to the SFMTA any deficiency.

12.4 Unavoidable Delays

12.4.1 Definition. An Unavoidable Delay is an interruption of the work beyond the control of the Contractor, which the Contractor could not have avoided by the exercise of care, prudence, foresight, and diligence. Such delays include, and are limited to, acts of God; floods; windstorms; tornadoes; wars; riots; insurrections; epidemics; quarantine restrictions; strikes and lockouts; freight embargoes; acts of a governmental agency; priorities or privileges established for the manufacture, assembly, or allotment of materials by order, decree, or otherwise of the United States or by any department, bureau, commission, committee, agent, or administrator of any legally constituted public authority; changes in the Work ordered by the City insofar as they necessarily require additional time in which to complete the entire work; the prevention by the City of the Contractor's commencing or prosecuting the work. The duration of said Unavoidable Delays shall be limited to the extent that the commencement, prosecution, and completion of the Work are delayed thereby, as determined by the City.

12.4.2 Notification of Delay. The Contractor shall notify the SFMTA as soon as the Contractor has, or should have, knowledge that an event has occurred that will delay deliveries. Within five Days, the Contractor shall confirm such notice in writing, furnishing as much detail as is available.

12.4.3 Request for Extension. The Contractor agrees to supply, as soon as such data are available, any reasonable proof that is required by the SFMTA to make a decision on any request for extension. The SFMTA shall examine the request and any documents supplied by the Contractor and shall determine if the Contractor is entitled to an extension, and if so, the duration of such extension. The SFMTA shall notify the Contractor of its decision in writing.

The granting of an extension of time because of Unavoidable Delays shall in no way operate as a waiver on the part of the City of the right to collect liquidated damages for other delays or of any other rights to which the City is entitled.

Article 13 SFMTA Conditions

13.1 Large Vehicle Driver Safety Training Requirements.

13.1.1 Contractor agrees that before any of its employees and Subcontractors drive large vehicles within the City and County of San Francisco, those employees and Subcontractors shall successfully complete either (a) the SFMTA's Large Vehicle Urban Driving Safety training program or (b) a training program that meets the SFMTA's approved standards for large vehicle urban driving safety. The SFMTA's approved standards for large vehicle urban driving safety is available for download at www.SFMTA.com/largevehicletrainingstandards. This requirement does not apply to drivers providing delivery services who are not employees or subcontractors of the Contractor. For purposes of this section, "large vehicle" means any single vehicle or combination of vehicle and trailer with an unladen weight of 10,000 pounds or more, or a van designed to carry 10 or more people.

13.1.2 By entering into this Agreement, Contractor agrees that in the event the Contractor fails to comply with the Large Vehicle Driver Safety Training Requirements, the City will suffer actual damages that will be impractical or extremely difficult to determine; further, Contractor agrees that the sum of up to One Thousand Dollars ($1,000) per employee or Subcontractor who is permitted to drive a large vehicle in violation of these requirements is not a penalty, but is a reasonable estimate of the loss that City will incur based on the Contractor's failure to comply with this requirement, established in light of the circumstances existing at the time this Contract was awarded. City may deduct a sum representing the liquidated damages from any money due to Contractor. Such deductions shall not be considered a penalty, but rather agreed monetary damages sustained by City because of Contractor's failure to comply.

Article 14 MacBride Principles and Signature

14.1 MacBride Principles -Northern Ireland. The provisions of San Francisco Administrative Code §12F are incorporated herein by this reference and made part of this Agreement. By signing this Agreement, Contractor confirms that Contractor has read and understood that the City urges companies doing business in Northern Ireland to resolve employment inequities and to abide by the MacBride Principles, and urges San Francisco companies to do business with corporations that abide by the MacBride Principles.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on the day first mentioned above.

CITY	CONTRACTOR
San Francisco **Municipal Transportation Agency** _____ Jeffery P. Tumlin Director of Transportation Authorized By: Municipal Transportation Agency Board of Directors Resolution No: _____ Adopted: _____ Attest: _____ Secretary, SFMTA Board of Directors Approved as to Form: Dennis J. Herrera City Attorney By: _____ Robin M. Reitzes Deputy City Attorney	**Nova Bus, A Division of Prevost Car (US) Inc.** _____ Martin Larose Vice President and General Manager martin.larose@volvo.com _____ Krzysztof Trembecki Vice President and Secretary krzysztof.trembecki@volvo.com Acknowledgement of Large Vehicle Driver Safety Training Requirements: By signing this Agreement, Contractor acknowledges that it has read and understands Section 13.1: Large Vehicle Driver Safety Training Requirements. City vendor number: 0000044839

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Exhibits

A: Schedule of Prices
B: Project Delivery Schedule
C: Payment Milestones
D: Changes to Meet SFMTA Technical Specifications
E: Technical Specifications

Exhibit A
Schedule 1 - Schedule of Prices

City is exempt from federal excise taxes. State, local sales, and use taxes are not to be included in these prices.

No.	Qty.	Description	Unit Price	Total Price
1	3	40-ft Low Floor Coaches	$1,305,834	$3,917,502
2	LS	Allowance for regulatory mandated changes, requested passenger enhancements and system modifications resulting from changes to project interface.	N/A	$75,000
3	N/A	Intentionally left blank.		
4	3	ViriCiti User License for two years. License includes basic vehicle, driver behavior, maintenance, basic charging station and smart charging.	$6,761	$20,283
5	1	Training for 40-ft Low Floor Coaches*	N/A	$250,000
6	LS	Interactive Multimedia Training for 40-ft Low Floor Coaches (Section 9.1.10 of the Technical Specifications)	N/A	$207,195
7	LS	Operating, Maintenance and Parts Manuals for 40-ft Low Floor Coaches	N/A	$2,286
8	LS	Spare Parts For 40-ft Low Floor Coaches	N/A	$250,000
9	LS	Special Tools For 40-ft Low Floor Coaches	N/A	$50,000
Grand Total				**$4,772,266**

* Hourly rate of $87.50 for qualified training instructor from NOVA. Hourly rates from Supplier representatives may vary.

Option Prices:

10	3	Option for 3 40-ft Low Floor Coaches, including ViriCiti subscription (see item #4)	$\underline{\$1,312,591}$ + PPI (1)	$\underline{\$3,937,773}$ + PPI (1)

(1) PPI: Producer's Price Index (WPU 1413), to be determined at the time the options are exercised.

Schedule 1A - Spare Parts List

The Contractor shall submit a recommended spare parts list with prices for the SFMTA's approval. The SFMTA reserves the right to add or remove items from the spare parts list.

Classification	Part No.	Description	Qty per Bus	Unit Price (USD)
Recommended Stocking List (Subject to Change)				
Damage /Loss	N10661	HANDLE, ACCESS DOOR	1	$8.00
Damage /Loss	N36398	RIVNUT, SKIRT PANEL	25	$189.41
Damage/Loss	N49354	CLIP, PANEL MOULDING	25	$31.84
Wear/Tear	N74151	WIPER ARM RH	1	$96.44
Wear/Tear	N74153	WIPER ARM LH	1	$94.36
Wear/Tear	N70276	WIPER BLADES,	2	$52.95
Wear/Tear	N86403	LINKAGE ASM	1	$153.04
Wear/Tear	N82396	WIPER MOTOR	1	$223.72
Damage/Loss	N32989	SEALANT, WINDSHIELD - BUTYL	1	$5.85
Damage/Loss	N10712	RETAINING GASKET KIT, WINDSHIELD	1	$306.78
Damage/Loss	N10713	INSERT RUBBER, WINSHIELD	36ft	$74.02
Wear/Tear	N8893342	PRESSURE PIECE REPAIR KIT	4	$184.33
Wear/Tear	642034	ADAPTER & CAP REPAIR KIT	4	$86.53
Wear/Tear	N8902138	BRAKE PAD KIT	2	$297.26
Wear/Tear	N8888422	BRAKE ROTOR, FRONT & REAR AXLES	4	$1,213.24
Wear/Tear	642108	SPEED SENSOR, ABS	2	$99.40
Wear/Tear	N43198	AIR BAG	2	$272.49
Wear/Tear	N39730	SHOCK	2	$154.19
Wear/Tear	85143031	SPEED SENSOR, ABS	2	$100.40
Wear/Tear	N35162	AIR BAG	4	$410.00
Wear/Tear	N56226	SHOCK	4	$274.24
Wear/Tear	N49500	LINK, ANTI ROLL	2	$92.11
Wear/Tear	N20922	BUSHING, STABALIZER BAR	4	$103.75
Damage/Loss	N86483-01	WHEEL, FRONT & REAR AXLE	4	$2,272.50
Damage/Loss	N16765	NUT, WHEEL LUG	20	$44.44
Damage/Loss	N17801	STUD, FRONT WHEEL MTG	20	$701.50
Damage/Loss	20434082	NUT, AXLE LUG	20	$46.48
Damage/Loss	N8893366	STUD, REAR WHEEL LUG	20	$179.23
Wear/Tear	N43014	SOLENOID VALVE, RETARDER	1	$127.61
Wear/Tear	N49130	REGULATOR, RETARDER	1	$87.59

Wear/Tear	9220646	CHECK VALVE, RETARDER	1	$26.23
Wear/Tear	N45333	SWITCH, PRESSURE REGULATOR	1	$34.18
Wear/Tear	N45683	SWITCH, PARKING BRAKE	1	$38.28
Wear/Tear	N71032	BRAKE VALVE E-6	1	$187.40
Wear/Tear	15572831	PARKING BREAK VALVE	1	$48.98
Wear/Tear	N17943	VALVE, QR	1	$60.87
Wear/Tear	9220646	CHECK VALVE	1	$26.23
Wear/Tear	N43014	VALVE, PNEUMATIC	1	$127.61
Wear/Tear	N30188	VALVE, LEVELING, FRONT AXLE	1	$82.44
Wear/Tear	N58642	VALVE LEVELING, REAR AXLE	2	$151.96
Wear/Tear	N30292	LINKAGE KIT, L- VALVE REAR AXLE	2	$31.72
Wear/Tear	N8903419	FUSE 450 AMP	1	$1,240.47
Wear/Tear	N8903420	FUSE 250A	1	$320.72
Wear/Tear	N8903423	FUSE 25A	1	$125.50
Wear/Tear	N8903424	FUSE 80A	1	$157.11
PM Item	22843722	FILTER	1	$57.09
Wear/Tear	22372627	VALVE	1	$213.22
Wear/Tear	N8902652	LINK, W/C RAMP	2	$668.57
Wear/Tear	N8902652	PIVOT LINK, W/C RAMP	2	$668.57
Wear/Tear	N8897614	PIVOT RAMP, W/C RAMP	1	$21.92
Wear/Tear	N8900422	BUSHING, W/C RAMP	2	$65.20
Wear/Tear	22722832	I/O MODULE	2	$584.92
Wear/Tear	22722842	I/O B MODULE	4	$975.96
Wear/Tear	N72172	HEADLAMP ASM - LOW BEAM	1	$259.18
Wear/Tear	N72173	HEADLAMP ASM - HIGH BEAM	1	$445.00
Wear/Tear	N45105	LED, AMBER TURN, FRONT	2	$185.93
Wear/Tear	N71054	LED, RED STOP	2	$56.15
Wear/Tear	N71049	LED, AMBER TURN, REAR	2	$119.36
Wear/Tear	N71051	LED, CLEAR BACK-UP	2	$156.18
Wear/Tear	N37780	LED, AMBER MARKER, SIDE	6	$393.90
Wear/Tear	N37781	LED, AMBER MARKER, SIDE	6	$143.63
Wear/Tear	N37783	LED, AMBER MARKER, SIDE	6	$188.75
Wear/Tear	N37779	LED, RED MARKER, REAR	3	$88.21
Wear/Tear	N55203	LAMP, ENTRACE & EXIT	2	$461.10
Wear/Tear	N72571	STROBE, "EMERGENCY"	2	$206.38
Wear/Tear	G5005227	SWITCH, DIMMER	1	$36.05
Wear/Tear	N38403	LAMP, DRIVERS CELING	3	$222.36
Damage/Loss	N71738	MIRROR ASM LH	1	$475.17
Damage/Loss	N77244	MIRROR ASM RH	1	$763.79

Damage/Loss	N8901238	FRONT BUMPER, CENTER MODULE	1	$3,604.08
Damage/Loss	N8901237	FRONT BUMPER, END MODULE RH	1	$3,102.10
Damage/Loss	N8901239	FRONT BUMPER, END MODULE LH	1	$2,687.85
Damage/Loss	N84240	SKIRT PANEL, CS	1	$52.62
Damage/Loss	N84322	SKIRT PANEL, CS	1	$104.08
Damage/Loss	N84259	SKIRT PANEL, CS	1	$85.11
Damage/Loss	N84252	SKIRT PANEL, CS	1	$149.34
Damage/Loss	N84246	SKIRT PANEL, CS & SS	4	$477.09
Damage/Loss	N84253	SKIRT PANEL, CS	1	$53.12
Damage/Loss	N84313	SKIRT PANEL, CS	1	$49.77
Damage/Loss	N84330	SKIRT PANEL, CS	1	$291.12
Damage/Loss	N84311	SKIRT PANEL, CS	1	$232.41
Damage/Loss	N84233	SKIRT PANEL, SS	1	$51.23
Damage/Loss	N84284	SKIRT PANEL, SS	1	$48.31
Damage/Loss	N84302	SKIRT PANEL, SS	1	$49.61
Damage/Loss	N84379	SKIRT PANEL, SS	1	$69.72
Damage/Loss	N84358	SKIRT PANEL, SS	1	$72.68
Damage/Loss	N84278	SKIRT PANEL, SS	1	$186.72
Damage/Loss	N84282	SKIRT PANEL, SS	1	$144.90
Damage/Loss	N78070-01	ACCESS DOOR ASM, RH	1	$887.41
Damage/Loss	N77462-01	SERVICE DOOR ASM	1	$837.64
Damage/Loss	N77396-01	ACCESS DOOR ASM, LH	1	$768.79
Damage/Loss	N56814	FRAME, BATTERY ACCESS	1	$284.93
Damage/Loss	N77395-01	SERVICE DOOR, BATTERY	1	$143.32
Damage/Loss	N60227	FRAME, WASHER RES DOOR	1	$639.03
Damage/Loss	N83249-1	REPAIR SECTION, RH REAR	1	$743.71
Damage/Loss	N83249-2	REPAIR SECTION, LH REAR	1	$743.71
Damage/Loss	910010	REAR BUMPER, CENTER MODULE	1	$389.41
Damage/Loss	N8896657	REAR BUMPER, CS MODULE	1	$346.05
Damage/Loss	N8896658	REAR BUMPER, SS MODULE	1	$337.28
Damage/Loss	N49354	CLIP, SKIRT PANEL	20	$25.47
Damage/Loss	N45830	CLIP, END CORNER	8	$6.84
Damage/Loss	N67209	WINDSHIELD NO HEAT GRID	2	$864.56
Damage/Loss	N32443	DESTINATION GLASS, HEATED	1	$183.14
Damage/Loss	N28908	1/4 WINDOW, SS	1	$108.62
Damage/Loss	N28614-1	1/4 WINDOW, CS	1	$129.22
Damage/Loss	N8901205	GLASS, UPPER ENTRANCE DOOR	2	$890.96

Damage/Loss	N8901206	GLASS, LOWER ENTRANCE DOOR	2	$316.17
Damage/Loss	N8901475	GLASS, UPPER EXIT DOOR	2	$331.10

Schedule 1B - Special Tools List

The contractor shall submit a recommended special tools list with prices for SFMTA's approval. SFMTA reserves the right to add or remove items from the special tools list.

Description	Qty	Unit Price
MaidCom 2, Interface software	1	$-
USB to RS-232 adapter with FTDI Chip	1	$39.84
VBEA - Cable extension DB-9 (Laptop)	1	$70.21
MC43 VECU software (use with KASER Leaf interface as BAE IDS)	1	$-
Nexiq USB Link 2	1	$924.97
Bendix ACOM Software (annual license fees)	1	$457.52
MCC CoolVu, Diagnostic Software	1	$342.85
ECO136e Cable adapter, used with Coolview adapter T35-0735	1	$141.90
USB to RS485 Adapter for CoolVu Software	1	$169.71
Luminator IPS software	1	$364.64
Puller (Wheel/end Hub Services Tool)	1	$606.78
Slotted nut wrench (Wheel/end Hub Services Tool)	1	$357.20
Load carrying fixture (Wheel/end Hub Services Tool)	1	$241.68
Puller (Wheel/end Hub Services Tool)	1	$532.42
Eyebolt (Wheel/end Hub Services Tool)	1	$149
Pry bar. 1 set = 2 units (Wheel/end Hub Services Tool)	1	$236.24
Tool set, caliper	1	$3,054.24
Driver tool (Wheel/end Hub Services Tool)	1	$336.26
Handle (Wheel/end Hub Services Tool)	1	$137.29
Assembly fixture (Wheel/end Hub Services Tool)	1	$401.60
Fixing pin	1	$46.09
Locating Pin. 1 set = 2 units (Wheel/end Hub Services Tool)	1	$92.63
Load Carrying Fixture (Wheel/end Hub Services Tool)	1	$407.03
Mounting Tool (Wheel/end Hub Services Tool)	1	$256.20
Inner installer (Wheel/end Hub Services Tool)	1	$166.28
Handle (Wheel/end Hub Services Tool)	1	$85.60
Guidance	1	$163.81
Needle Bearing Driver	1	$218.25

Mounting Tool	1	$243.13
Mounting Tool	1	$404.53
Mounting Tool	1	$155.19
Tension rod	1	$248.96
Insert (Wheel/end Hub Services Tool)	1	$89.01
Slotted nut wrench	1	$576.40
Offset screw driver	1	$43.16
Slip bushing	1	$205.17
Centering device	1	$276.68
Centering pin	1	$151.89
Assembly fixture, K-B brake tool kit	1	$4,027.64
Pump	1	$2,247.88
Plug-in insert	1	$28.07
Pressure plate	1	$757.62
Handle	1	$114.01
Wheel bolt puller (Wheel/end Hub Services Tool)	1	$410.16
Handle	1	$368.89
Support Arbor (Wheel/end Hub Services Tool)	1	$135.49
Assembly fixture	1	$361.62
Clamping cylinder	1	$522.24
Puller (Wheel/end Hub Services Tool)	1	$606.78
Slotted nut wrench (Wheel/end Hub Services Tool)	1	$357.20
Load carrying fixture (Wheel/end Hub Services Tool)	1	$241.68
Puller (Wheel/end Hub Services Tool)	1	$532.42
Eyebolt (Wheel/end Hub Services Tool)	1	$149
Pry bar. 1 set = 2 units (Wheel/end Hub Services Tool)	1	$236.24
Tool set, caliper	1	$3,054.24
Driver tool (Wheel/end Hub Services Tool)	1	$336.26
Handle (Wheel/end Hub Services Tool)	1	$137.29
Support Arbor (Wheel/end Hub Services Tool)	1	$135.49
Assembly fixture	1	$361.62
Clamping cylinder	1	$522.24
Vapor V300 controller software (Type B USB cable)	1	$-
Class interface software, free from Vapor	1	$-
RJ45 to DB9F modified adapter	1	$57.62

Modine UDS (use with the Nexiq USB Link 2)	1	$-
Vanesco Flash Loader software. Used with Nexiq USB Link.	1	$-
IDS software 4.12 or higher with support files - per license	1	$2,430.93
Cable-Assy- Can diagnostic	1	$182.32
Kvaser leaf light rugged HS	1	$911.60
Fixture, ACTM-PSR lift	1	$2,187.84
Fixture, PSR lift	1	$1,020.99
Fixture, PSR lift	1	$941.99
ACTM speed sensor gap setting tool	1	$1,093.92
Towing Adapter, Hook (2 per kit)	1	$66
Towing Adapter, Fork (2 per kit)	1	$351.27
Towing Adapter RR Curb	1	$246.63
Towing Adapter RR street	1	$260.64
Kit probing tool	1	$1,024.71
Decommissioning Kit	1	$556.57
Multimeter (1000V)	1	$599.21
Kit Glove Inflation	1	$1,127.39
Protective bag 11''	1	$50.84
Leather protective gloves 10'', size 10	1	$56.94
Electrician high voltage gloves class 0, size10	1	$118.14
Wire tightening special tools kit	1	$835.43
Rail protector	1	$1,043.03
Measuring tool (residual voltage measuring)	1	$1,154.07
Kit of red measuring tool interface	1	$314.46
Kit of black measuring tool interface	1	$384.61
Lid protection, recept size 40	1	$61.01
Lid protection, plug size 40	1	$61.64
Dummie protection	1	$94.77
Cable ends voltage protection	1	$87.12
Lifting equipment for canopies, HV batteries, MPCS, MAPS, ECP/MCP. HJB	1	$5,733.33
Special tools for CCTV system	1	8323$

Exhibit B

Project Delivery Schedule

Item	Days after Notice-to-Proceed*
1) Submittal of Baseline Schedule and Management Work Plan	10
2) Submittal of Vehicle drawings, control, Reliability Program Plan and test plans	60
3) Submittal of training plan (including lesson plans)	60
4) Delivery of prototype Coach[1]	355
5) Submittal of draft operations, maintenance, parts manuals, recommended spare parts	210
6) Approval of prototype Coach (estimated)	415

Item	Days after Approval of Prototype
7a) Production starts	100
7b) Beginning of Coach delivery[2]	175
8) Submittal of final operations, maintenance, and parts manual	90
9) Delivery of special tools[3]	100
10) Completion of Coach delivery	180

***Assuming NTP May 3, 2021**

[1] Approval to deliver the prototype will not be granted until after receipt and approval of all Vehicle drawings, controls and test plans.

[2] Approval to deliver production Vehicles will not be granted until after submittal of a satisfactory training plan; draft operations, maintenance, and parts manuals; all computer software, manuals, document and demonstrate their operation and after successful completion of all appropriate tests as described in Section 12.2, TEST REQUIREMENTS of the Technical Specification.

[3] The delivery of the special tools is dependent on the shipping lead times agreed upon with the Suppliers after the SFMTA selects the final tool list.

Exhibit C

Payment Milestones

The City will make progress payments for the Buses upon satisfactory completion of each milestone in accordance with the percentage allocation below.

Item 1- Coach Price

Milestone	Maximum Percent of Bid Item 1 as applicable
(a) Authorization by the SFMTA to ship each Vehicle and authorization by Contractor to release each Vehicle for shipment to the SFMTA, as described in Sections 12.2.3 of the Technical Specifications	25% of Unit Price
(b) Conditional Acceptance of each Vehicle by SFMTA	25% of Unit Price
(c) Full Acceptance of each Vehicle by SFMTA	48% of Unit Price
(d) All Contract Deliverables have been received and Accepted as satisfactory (except for Items 5 and 6)	2%

Item 2 - Spare Parts

The City will make payments for spare parts once they have been delivered and Accepted.

Item 3 – Training

City shall pay for training when 10 mechanics and 20 operators have been fully trained in the operation and maintenance of the vehicle.

Item 4 - Interactive Multimedia Training

City shall make progress payments for Interactive Multimedia Training upon satisfactory completion of each milestone in accordance with the percentage allocation below:

Milestone	Percentage of Bid Item 4
(a) SFMTA approval of design detail documentation	10%
(b) Delivery and approval of one prototype module	20%
(c) Delivery and approval of all pre-production modules	30%
(d) Delivery and approval of all production modules	40%

Item 5 - Operating, Maintenance, and Parts Manuals

When satisfactory draft operating, maintenance and parts manuals have been received, City will pay 30% of this payment item. The balance will be paid when final manuals have been Accepted. Contractor shall deliver to the SFMTA draft operating, maintenance and parts before the start of the first training session.

Item 6 – Special Tools Separate from Coach

City shall pay for special tools and other maintenance equipment upon their Acceptance by the SFMTA.

Exhibit D
Changes to Meet SFMTA Technical Specifications

Item #	Type	Description	Qty	$ Unit Price excluding taxes
1	Base Bus	LFSE+ Electric Base Bus Price	1	$768,256
2	Technical Option	Wheels - Aluminum wheels Durabright brushed finish	1	$4,838
3	Technical Option	Front bumper – Romeo Rim front bumper	1	$708
4	Technical Option	Rear Bumper – Romeo Rim rear bumper	1	$580
5	Technical Option	PAINT - TWO COLOUR SCHEME WITH INTERIOR & EXTERIOR DECALS (RED STRIPES ON SKIRT PANELS IN DECALS)	1	$20,319
6	Technical Option	WINDOWS - FLUSH - TOP TIP-IN / BOTTOM FIXED - MINIMUM 28% LT - TEMPERED - 1/8" CLEAR ANTI-VANDALISM PANEL	1	$22,321
7	Technical Option	USSC Gemini - 34 PAX SEATING - 2 Q'Pods - Includes Docket 90	1	$11,228
8	Technical Option	ADD NEXT STOP REQUEST BUTTONS	1	$11
9	Technical Option	ADD FULL LENGTH GUTTERS	1	$125
10	Technical Option	ADD DOCKET 90	1	$1,543
11	Technical Option	ADD MODESTY PANEL AT FRONT DOOR	1	$191
12	Technical Option	ADD MODESTY PANEL FORE OF REAR DOOR	1	$81
13	Technical Option	ADD CORNERING LIGHT AT REAR DOOR	1	$35
14	Technical Option	LED HEADLIGHTS	1	$320
15	Technical Option	ADD LED LIGHTING ABOVE DOORS	1	$179
16	Technical Option	ADD LIGHTING IN SERVICE COMPARTMENTS	1	$273
17	Technical Option	ADD AIR DRYER Wabtec/GRAHAM WHITE FOR LFSe - DELETE AIR DRYER HALDEX FROM CONFIGURATOR	1	$964
18	Technical Option	Add Teleflex pedals	1	$6,665
19	Technical Option	Add Arow driver's door	1	$5,466
20	Technical Option	Add storage box on curbside wheelhouse	1	$313
21	Technical Option	S-1 guard in front of rear curbside wheel	1	$1,459

22	Technical Option	Horizontal and vertical chime chords	1	$100
23	Technical Option	Cubic - Clipper system installation + commissioning	1	$14,604
24	Technical Option	Full Size ITS W/H storage box	1	$6,138
25	Technical Option	IRIS - IRMA APC System	1	$7,232
26	Technical Option	Conduent - IVU 4000 DVAS/radio communication system	1	$57,450
27	Technical Option	Luminator - Destination Signs - front/side/curb/rear/run number with WiFi update / Compatible with Conduent DVAS (section 3.11). Rear sign to include backup camera integrated with Kratos.	1	$10,038
28	Technical Option	Lytx - customer-supplied DriveCam System + 2 visits at Nova (familiarization and first article inspection) + onsite commissioning at SFMTA	1	$9,327
29	Technical Option	Securitas 10-Cam CCTV System with 2x TOLE cameras	1	$40,293
30	Technical Option	Clever Devices – hands-free stealth microphone	1	$1,998
31	Technical Option	Fleetwatch - bus-mounted data recorder	1	$4,527
32	Technical Option	LCD instrument panel adaptation - State of charge, exit door activity, reverse mode, etc.	1	$2,281
33	Technical Option	Luminator - 18" front and rear INFOtransit system with Cubic integration (separate agreement)	1	$5,209
34	Technical Option	Add Vapor electric front slide-glide wide door and rear wide plug door with Class system	1	$26,296
36	Technical Option	Genfare provisions at Nova + full install at SFMTA	1	$13,451
37	Technical Option	Add upcharge for new Bitzer compressor with the MCC ECO136.2E HVAC unit	1	$415
38	Technical Option	Add USSC 9100 ALX seat based on SFMTA specification - Delete ISRI seat - Includes Docket 90	1	$1,826
39	Technical Option	Add raising feature (Hi-Buoy) to kneeling	1	$4,708

		The over-raise feature shall be activated, sustain its raised height during a predetermined speed range limit, and be de-activated once the speed exceeds the allowable speed limit. The SFMTA prefers that the over-raise feature have the capability to activate while the Vehicle is in motion at low speed operations.		
40	Technical Option	Remove Delco fuel filler neck and fuel tank as the aux heater will be the full electric Valeo Thermo DC 200	1	-$2,913
41	Technical Option	Remove electric foot vent from catalogue configurator	1	-$208
42	Technical Option	2-position Byk Rak with deployment sensor and bumper bracket assembly	1	$1,219
43	Technical Option	Fully automatic fire detection and complete dry chemical fire suppression system (Kidde)	1	$5,594
44	Technical Option	Add scissor-type sun visors for windshield & driver's side windows - Delete roll-down sun visors	1	-$24
45	Technical Option	Remove first aid kit from catalogue configurator	1	-$76
46	Technical Option	Add rear dust pan based on skid resistance requirements from specifications	1	$330
47	Technical Option	Add B&R (Hadley) exterior mirrors with integrated turn signals - Delete Lucerix exterior mirrors from catalogue configurator	1	$1,045
48	Technical Option	Add 22 grabhandles to the configurator (This adds PVC grabhandles)	1	$28
49	Technical Option	Add front license plate	1	$13
50	Technical Option	Add interior advertising frame Two frames shall be provided on the rear of the operator's barrier Three "take-one" boxes	1	$206
51	Technical Option	Delete Lucerix 8x15 convex mirror - Add B&R 8x16 flat mirror	1	$16
52	Technical Option	Add PA foot switch	1	$68
53	Technical Option	Add waste container in driver's area	1	$6
54	Technical Option	Probalyzer for BAE motor	1	$31

55	Technical Option	Add drive shaft guard	1	$27
56	Technical Option	ADD LIFT U LU-18 32in ramp	1	$3,227
57	Technical Option	Add turn signal beeping sound and two toggle switch for maintenance to disable the beeping sound (one for left and one for right turn signals)	1	$2,229
58	Technical Option	Opticom TSP System	1	$3,444
59	Technical Option	Telematic requirements from SFMTA	1	$14,542
60	Technical Option	Provision shall be made to apply shop air to the Coach Air systems through Amflo CP2 female charging port or approved equal.	1	$836
61	Technical Option	Floor covering shall be Altro Transflor TFFG2704F Rocket	1	$13,888
62	Technical Option	Hill holder switch with cover	1	$12,579
63	Technical Option	NEXTBUS (Cubic) - AVAS System integrated with Luminator screens and Conduent	1	$18,608
64	Technical Option	Mirror for bike rack	1	$678
65	Warranty	Extended warranty requirements from SFMTA	1	$159,321
66	delivery	Delivery requirement	1	$19,352
			Total	**$1,305,834**

Exhibit E

CITY AND COUNTY OF SAN FRANCISCO
SAN FRANCISCO MUNICIPAL TRANSPORTATION AGENCY

TECHNICAL SPECIFICATIONS

FOR

THE PROCUREMENT OF
40-FOOT, LOW FLOOR,
BATTERY ELECTRIC COACHES FROM NOVA BUS

CONTRACT NO. SFMTA-2021-06

August 6, 2020

TABLE OF CONTENTS

1 OVERALL REQUIREMENTS

1.1 SCOPE

These specifications detail the technical requirements for the construction of new heavy-duty 40-foot, Low Floor Battery Electric Buses for the San Francisco Municipal Transportation Agency (SFMTA). The new Coaches are intended to provide superior performance in the unique San Francisco operating environment with improved reliability and reduced emissions compared to existing SFMTA equipment. These Coaches are intended for the widest possible spectrum of passengers, including children, adults, seniors, and the ADA community.

The Coach shall be designed to operate in transit service for at least 12 years or 500,000 miles. The average operating range of the coach operating on all of the routes specified in Section 1.4 shall be at least 160 miles on a full charge at the beginning of vehicle life, while operating in 60°F weather and carrying a 52 passenger load.

The Contractor shall be responsible for designing, fabricating, assembling, testing and finishing transit Buses, which are in all respects compliant with the requirements of the Contract Documents. Included with these requirements are specified components, equipment and systems usually accompanied by the phrase “or approved equal.” Such components, equipment and systems, or deviations and substitution items, specifically approved by the SFMTA, shall be provided as part of the completed Coaches by the Contractor.

The Contractor shall ensure that the application and installation of major Bus subcomponents and systems are compliant with all such subcomponent vendors’ requirements and recommendations. Contractor and Agency shall identify subcomponent vendors that shall submit installation/application approval documents with the completion of a pilot or lead Bus. Components used in the vehicle shall be of heavy-duty design and proven in transit service.

The Contractor shall not make any substantive or material changes that would differentiate one Bus from another Bus. If the Contractor identifies a change during the manufacturing process that would materially improve the design, safety and/or performance of the Bus, this change must (a) be discussed with the Agency and (b) be considered as a retrofit (if possible) to any previous Bus(es) manufactured or assembled. Any such changes must be approved by the Agency in accordance with the communication requirements of this Contract.

1.1.1 Background Information

The SFMTA has committed to a zero emissions Bus fleet by the year 2035, and intends to utilize these Technical Specifications in order to run a pilot program for multiple battery electric coach OEMs. The pilot program will consist of revenue service testing for a duration of at least one year. SFMTA intends to use these Technical Specifications in order to pre-qualify the selected battery electric coach OEMs for future procurements of 40’ battery electric coaches. Future procurements are expected to start in 2025, with full implementation of purchasing by 2035.

San Francisco currently operates the largest fleet of zero emission electric trolley Vehicles in North America. The SFMTA plans to transition all routes that are currently served by diesel/hybrid Buses with fully battery electric Buses using the knowledge obtained from this pilot program. The electric Buses from this procurement will be compared to the SFMTA's current fleet of diesel hybrid and trolley Buses on their environmental impact, quality of service, and performance characteristics.

1.1.2 Definitions

The following are definitions of special terms used in the Technical Specifications:

ADA (Americans with Disabilities Act) – A civil rights law that prohibits discrimination against individuals with disabilities in all areas of public life, including jobs, schools, transportation, and all public and private places that are open to the general public. The purpose of the law is to make sure that people with disabilities have the same rights and opportunities as everyone else.

Ambient Temperature – The temperature of the surrounding air. For testing purposes, ambient temperature must be between 16°C (50°F) and 38°C (100°F).

Approach Angle – The angle is measured between a line tangent to the front tire static loaded radius and the initial point of structural interference forward of the front tire to the ground.

Audible Discrete Frequency – An audible discrete frequency is determined to exist if the sound power level in any 1/3-octave band exceeds the average of the sound power levels of the two adjacent 1/3-octave bands by four (4) decibels (dB) or more.

Battery Rated Ampere-hour Capacity – manufacturer-rated capacity of a battery in Ampere-hours obtained from a battery discharged at the manufacturer's recommended discharge rate such that a specified minimum cut-off terminal voltage is reached.

BMS (Battery Management System) – Monitors energy, as well as temperature, individual cell or module voltages, and total pack voltage. The BMS adjusts the control strategy algorithms to maintain the batteries at uniform state of charge and optimal temperatures.

Braking Resistor – Device that converts electrical energy into heat, typically used as a retarder to supplement or replace the regenerative braking.

Break over Angle – The angle is measured between two lines tangent to the front and rear tire static loaded radius and intersecting at a point on the underside of the Vehicle that defines the largest ramp over which the Coach can roll.

Capacity (electrical energy storage device) – Two levels of capacity shall be defined, gross and useable. Gross Capacity shall be the capacity energy (kWh) of the entire battery pack and shall include usable, unusable, and/or reserve capacity energy. Useable Capacity shall be the capacity

energy between the design operating range within the battery management system for normal operation.

Charging Station – Location that houses the charging equipment that is connected to a utility's high voltage service, to provide electricity to a vehicle's battery system through a charging interface.

CL/ID – Clearance/Identification lights for Vehicle not in motion.

Coach – The terms Coach, Bus and Vehicle are used interchangeably.

Controller – See definition of PCS (below).

Curb Weight – Weight of Vehicle, including oil, and coolant, and all equipment required for operation and required by this specification, but without passengers or operator.

dBA – Decibels with reference to 002 microbar as measured on the "A" scale.

DC to DC Converter – A module that converts a source of direct current from one voltage level to another. In a completely battery electric Bus this typically converts High Voltage from the drive train battery system to 28 VDC in lieu of a conventional engine driven alternator.

Defect(s) – Patent or latent malfunctions or failure in manufacture or design of any component or subsystem.

Departure Angle – The angle is measured between a line tangent to the rear tire static loaded radius and the initial point of structural interference rearward of the rear tire to the ground.

DR – Diagnostic Reader

Drive System Controller (DSC) – Regulates energy flow throughout electric drive system components in order to provide motive performance and accessory loads, as applicable, while maintaining critical system parameters (voltages, currents, temperatures, etc.) within specified operating ranges.

Electric Drive System – Electric motor, system controller, generator, and energy storage system.

Electronic Parts Lists – This list shall be associated with an IPC assembly layout drawing and provides all manufacturers part numbers for all the parts identified and shown on the layout drawing.

Electronics Schematic Diagram – This is a detailed drawing of the components and connections at a level detailing to the circuit boards and identifying those individual pieces, functions and connections.

Energy Density - The relationship between the weight of an energy storage device and its power output in units of watt-hours per kilogram (Wh/kg).

Energy Storage System (ESS) - A component or system of components that stores energy and for which its supply of energy is re-chargeable by an Off-Vehicle electric energy source.

Failure Definitions - Classification of failures are described below:

- Bad Order: A failure that does not require removal of the Coach from service during its assignments but does degrade Coach operation. The failure shall be reported by operating personnel.
- MDBF (Mean Distance Between Failure): This measure of failure includes the definition of MDBSF as well as any incident, malfunction, intermittent condition, or failure of equipment or hardware, which prevents the Vehicle from being deployed in revenue service.
- MDBSF (Mean Distance Between Service Failure): Any incident, malfunction, intermittent condition, or failure of equipment or hardware which in either actual or simulated revenue service causes a delay in excess of five (5) minutes and under normal operating conditions would cause passengers to be transferred to another Vehicle.
- Physical Safety: A failure that could lead directly to passenger, operator or maintainer injury

Fireproof - Materials that will not burn or melt at temperatures less than 2,000°F.

Fire-Resistant - Materials that have a flame spread index less than 150 as measured in a radiant panel flame test per ASTM-E 162-75.

Free Floor Space - Floor area available to standees, excluding stepwells, area under seats, area occupied by feet of seated passengers, and the vestibule area forward of the standee line. Floor area of 1.5 square feet shall be allocated to be occupied by the feet of each standee.

GAWR (Gross Axle Weight Rated) – The maximum total weight as determined by the axle manufacturer, at which the axle can be safely and reliably operated for its intended purpose.

Gross Load - 150 pounds for every designed passenger seating position, for the operator, and for each 1.5 square feet of free floor space.

GVW (Gross Vehicle Weight) - Curb weight plus gross load.

GVWR (Gross Vehicle Weight Rated) - The maximum total weight, as determined by the Vehicle manufacturer, at which the Vehicle can be safely and reliably operated for its intended purpose. The GVWR shall be greater than or equal to GVW.

High Voltage - 50-800 volts (AC and DC).

Human Dimensions - The human dimensions used in the Technical Specifications are defined in SAE Recommended practice J833.

HVAC (Heating, Ventilation, and Air Conditioning) – The on-board system which provide the operator and passengers temperature comfort within the Coach.

IPC (Illustrated Parts Catalog) – Layout drawings containing essential parts and part numbers which make up an assembly. These documents include the original manufacturers name part numbers, part quality, quantity, and sub-part and vendor information.

J1708 & J1939 – A SAE standard defining a bi-directional, serial communication link among control modules containing microcomputers in heavy-duty Vehicle applications.

Low Floor - Vehicle configuration primarily identified by the lack of steps at the front and rear doors.

Low Voltage - 50 volts or less.

Maintenance Personnel Skill Levels - Definitions of maintenance personnel skill levels are listed below:

a) 5M: Specialist Mechanic or Class A Mechanic Leader
b) 4M: Journeyman or Class A Mechanic
c) 3M: Service Mechanic or Class B Service
d) 2M: Mechanic Helper or Coach Servicer
e) 1M: Cleaner, Fueler, Oiler, Hostler, or Shifter
f) 3E: Assistant Supervising Electronics Maintenance Technician
g) 2E: Electronics Maintenance Technician
h) 1E: Assistant Electronics Maintenance Technician

Major Component - A complete system that is an essential part of the vehicle. Major Components include the Vehicle chassis, propulsion unit, energy storage system, suspension, power steering system, braking system, axles, computer-aided dispatch and voice annunciation system, door system, wheelchair ramp, fire suppression system, HVAC system, fare collection system, and video surveillance system.

Maximum Standard Operating State of Charge – The maximum design operating state of charge as recommended by the propulsion system integrator and battery manufacturer.

Minimum Standard Operating State of Charge – The minimum design operating state of charge as specified by the propulsion system integrator and battery manufacturer.

Operator's Eye Range - The 95th percentile ellipse defined in the SAE recommended Practice J941, except that the height of the ellipse shall be determined from the seat at its reference height.

PCB (Printed Circuit Board Assembly) - A PCB includes the printed circuit board and all of the individual electronic components and interconnections that make up the assembly.

PCS (Propulsion Control System) - The electronic controller regulates the amount of energy, (DC power in the case of batteries and capacitors), that is transferred (or converted to AC power by the inverter in AC motors) for acceleration. It also ensures that voltage is maintained within the specifications required for operating the motor(s). An electronic controller can also recover electrical energy by switching the motor(s) to a generator in order to capture the Vehicle's kinetic energy through regenerative braking. The controller also ensures that the regenerative current does not overcharge the energy storage system and that regenerative energy is otherwise safely dissipated when not captured.

Power Density - The power of a battery cell in terms of its ability to discharge and accept energy at a given rate.

Propulsion System - System that provides propulsion for the Vehicle in an amount proportional to what the driver commands. Includes the ESS and system controllers; including all wiring and any converter or inverter.

Regenerative Braking - Deceleration of the Coach caused by operating an electric motor-generator system. This act returns energy to the Vehicle propulsion system and provides charge to the Energy Storage System.

Related Defect(s) - Damages inflicted on any component or subsystem as a direct result of a Defect.

RFI - Radio Frequency Interference

Seated Load - 150 pounds for every designed passenger seating position and for the operator.

SHOPS (Shop History and On-Line Parts System) – SFMTA's computerized maintenance system utilized for tracking Vehicle history including but not limited to labor, parts, warranty, vendor activity, in addition to inventory of parts and supplies.

SLW (Seated Load Weight) - Curb weight plus seated load.

Standee Line - A line marked across the Coach aisle in line with the front curbside modesty panel to designate the forward area, which passengers may not occupy when the Coach is moving.

SOC (State of charge) - Quantity of electric energy remaining in the battery relative to the maximum rated Amp hour (Ah) capacity of the battery expressed in percent. This is a dynamic measurement used for the energy storage system. A full SOC indicates that the energy storage system cannot accept further charging from the regenerative braking system or external sources. An absolute SOC is based on total battery capacity at the beginning of useful life. A

relative SOC is based on total degraded capacity at the time of measurement. The actual relationship between the SOC and energy stored expressed as a percentage shall be linear.

Structure – The basic body, including floor deck material and installation, load-bearing external panels, structural components, axle mounting provisions and suspension beams and attachment points.

ViriCiti – Vehicle monitoring system for electric vehicles and charging stations. Provides tools for energy management, route operations, diagnostics, and smart charging.

Warrantable End of Life (WEOL) – WEOL is a measure of battery degradation determined as the point at which the batteries can no longer provide the energy or power required to meet the design operating profile. It is expressed as a percentage of remaining battery capacity as compared to gross capacity at the beginning of useful life. For purposes of this specification, WEOL shall be a measure of the useful and intended life of the energy storage device. This measure shall be a percentage of remaining useful capacity based on degradation from the beginning capacity, i.e. kWhr and is used in the overall calculation of mileage range. WEOL shall be used as a condition for battery replacement and to potentially initiate warranty claims.

Wheelchair - Mobility aid belonging to any class of three or four-wheel devices, usable indoors, designed for and used by individuals with mobility impairments, whether operated manually or powered. A “common wheelchair” is such a device, which does not exceed 30 inches in width and 48 inches in length measured two inches above the ground, and does not weigh more than 600 pounds when occupied.

Working Day - All 24-hour periods beginning and ending at midnight, Monday through Friday inclusive.

1.1.3 Abbreviation

The following is a list of abbreviations used in the Technical Specifications:

A/C	Air Conditioning
ABS	Anti-Lock Braking System
AC	Alternating Current
ADA	Americans with Disabilities Act
Ah	Amp hour
ANSI	American National Standards Institute
APC	Automatic Passenger Counter
APTA	American Public Transportation Association
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers

ASTM	American Society for Testing and Materials
AVL	Automatic Vehicle Location
AWS	American Welding Society
BMS	Battery Management System
CCR	California Code of Regulations
CCTV	Closed-Circuit Television
CFR	Code of Federal Regulations
dB	Decibel
DC	Direct Current
DDU	Driver Display Unit
DVD	Digital Versatile Disc
DTE	Diagnostic Test Equipment
DVAS	Digital Voice Annunciation System
EMC	Electromagnetic Compatibility
EMF	Electromagnetic Force
EMI	Electromagnetic Interference
EPA	Environmental Protection Agency
EPU	Emergency Propulsion Unit
FCC	Federal Communications Commission
FEA	Finite Element Analysis
FEMA	Failure Mode Effects Analysis
FSRP	Field Service Repair Procedure
FMCSR	Federal Motor Carrier Safety Regulations
FMVSS	Federal Motor Vehicle Safety Standards
FTA	Federal Transit Administration
GAWR	Gross Axle Weight Rated
GPS	Global Positioning System
GVW	Gross Vehicle Weight
GVWR	Gross Vehicle Weight Rating
HVAC	Heating, Ventilation and Air Conditioning
IEEE	Institute of Electrical and Electronics Engineers
IPC	Illustrated Parts Catalog

IP	Internet Protocol
ISO	International Organization for Standardization
JIC	Joint Industrial Council
LED	Light Emitting Diode
MIL-STD	Military Standard
NEC	National Electrical Code
NFPA	National Fire Protection Association
NHTSA	National Highway Traffic Safety Administration
NTSC	National Television System Committee
OCU	Operator Control Unit
OEM	Original Equipment Manufacturer
PA	Public Address
PCB	Printed Circuit Board
PLC	Programmable Logic Controller
PPU	Primary Propulsion Unit
psi	Pounds per Square Inch
RFI	Radio Frequency Interference
SAE	Society of Automotive Engineers
SOC	State of Charge
SPI	Society of the Plastics Industry
SDTS	Self Diagnostic Testing Software
SHOPS	Shop History and On-Line Parts System
SLW	Seated Load Weight
UL	Underwriters Laboratories
USDOT	United States Department of Transportation
VDC	Volts of Direct Current
Wh	Watt-Hours

1.1.4 Legal Requirements

A. The Coach shall meet all applicable FMVSS in effect at the date of manufacture. The Coaches and equipment must comply with all applicable federal, state, and local regulations. Local regulations are defined as those below the state level. In the event of any conflict between

the requirements of these specifications and any applicable legal requirement, the legal requirement shall prevail.

B. Manufacturer shall certify to SFMTA that the Vehicle complies with 49 U.S.C. § 5323(c) and FTA implementing regulations at 49 CFR Part 665 concerning Coach testing.
C. Manufacturer shall test the prototype Coach at the Altoona, PA Testing Facility and shall provide copies of all testing. If the Coach proposed by the manufacturer has already been tested successfully at the Altoona, PA Testing Facility, then re-test of the prototype will not be necessary, subject to the SFMTA's approval of the test results. The Contractor shall provide results from all Altoona testing.
D. Manufacturer shall certify that the proposed Coach meets the specifications set forth in the ADA.

1.2 DIMENSIONS

With the exceptions of exterior mirrors, marker and signal lights, flexible portions of the bumpers, and fender skirts, the Coach shall have the following overall general dimensions:

TABLE 1.2 – Coach Requirements

Length, excluding bumpers	41' +/- 2'
Width - exterior, excluding mirrors	102" max
Height Overall, without roof-mounted HVAC system	134" max
Height Overall, with roof-mounted HVAC system	140" max
Seating Capacity:	32 min
Width of Seat (one passenger)	18" min
Width of Seat (two passenger)	35" min
General Aisle Width	22" min
Headroom along Center Aisle, at Front Axle Wheelhouse	79" min
Headroom along Center Aisle, at Rear Axle Wheelhouse	73" min
Front Door Height From Ground (normal)	15.5" max
Front Door Height From Ground (kneeled)	13" max
Rear Door Height From Ground (normal)	17.5" max
Body Ground Clearance	8" min
Approach Angle with/without Over-raise Feature	9 degrees min
Break over Angle with/without Over-raise Feature	8.9 degrees min
Departure Angle with/without Over-raise Feature	9 degrees min
Turning Radius (Outside Body Corners)	45 feet max.
Axle Zone Clearance	5" min

1.2.1 Turning Radius

The outside body corner turning radius shall not exceed 45 feet with the Coach at GVWR.

1.2.2 Underbody Clearance

The Coach shall maintain the minimum clearance dimensions as shown in Table 1.2 and defined in SAE Standard J689, regardless of load, up to the GVWR. All components under the Coach, including traction motor shall be protected from impacts.

Ramp Clearances: Approach and departure angles shall be no less than nine egrees. Break over angle shall be no less than 8.9 degrees. Any encroachment into the approach or departure angle area shall encounter a structural member before any component. A wedge supplied by the Contractor shall verify the approach and departure angles.

Ground Clearance: Ground clearance shall be no less than eight inches except within the axle zone and wheel area.

Axle Zone Clearance: Axle zone clearance (the axle zone is the projected area between tires and wheel on the same axial centerline) shall be no less than five inches.

1.3 PROPULSION SYSTEM PERFORMANCE

All electric Coaches shall be road-tested and shall meet the following criteria with respect to GVWR. Acceleration times begin when the accelerator pedal is depressed; lag time between depression of the accelerator pedal and movement of the Coach should be minimized. The SFMTA will fully accept the pilot Bus only if all performance criteria outlined below are met. Any Buses that fail the below-mentioned performance criteria will be allowed no more than 90 working days to rectify the failures or obtain a waiver for that requirement. Any Bus that fails to meet the criteria after the 90-working-day period or obtain a valid waiver from the SFMTA will result in the elimination of the Bus from further testing, and the OEM will be required to remove the Bus and associated equipment from the SFMTA's property as soon as possible. Minimum actual Vehicle speed and acceleration requirements are:

TABLE 1.3.1 – Performance Requirements

Speed on Grade

Grade	Speed Requirement
0% Grade	63 mph (max)
2% Grade	55 mph
5% Grade	25 mph
10% Grade	15 mph
16% Grade	10 mph
23% Grade	7 mph

Acceleration on Grade

Grade	mph	Time (seconds)
0% Grade	0-10	5
0% Grade	0-20	10
0% Grade	0-40	26
2% Grade	0-15	8
5% Grade	0-18	10
10% Grade	0-14	10
16% Grade	0-10	12

Locations of Grades for Speed and Acceleration Tests:

Interstate 280 at 25th St	--	0% grade heading southbound toward San Jose.
California & 28th Ave	--	5% grade heading westbound for three blocks.
Jackson & Steiner	--	10% grade heading westbound.
Castro & 24th Ave	--	16% grade heading northbound.
Noe & 26th Ave	--	23% grade heading southbound.

1.4 DUTY CYCLE

Coaches shall be designed to be compatible with the terrain and environment found in the SFMTA's service area. Also, Coaches shall be capable of running continuously with GVWR in the environmental conditions found in SFMTA's service area. These conditions include high humidity, rain, and occasional temperature extremes.

The propulsion and braking systems shall meet the performance requirements specified below in this section. Braking application and performance shall remain consistent regardless of ESS State of Charge (SOC) or other variances related to regenerative braking.

The system shall be programmable to allow optimization of acceleration and deceleration rate. Performance may be affected when reprogramming. The manufacturer shall supply the new performance data.

Manufacturer to provide a complete list of programmable acceleration and deceleration settings with performance for each setting. Performance data to include acceleration data as shown in Table 1.3.1 and an estimate of effect on energy consumption per mile on a standard drive cycle.

Jerk, the rate of change of acceleration, shall be minimized throughout acceleration and deceleration and shall average no greater than 4 mph/s, per second over any half-second interval. This requirement shall be achieved regardless of operator actions.

Coaches shall be capable of continuous operation at freeway speeds with GVWR and an ambient temperature of 115°F without overheating or degradation of any operating component. They shall operate in stop and go downtown traffic with no adverse effects. Coaches shall also be able to safely and efficiently negotiate the hilly conditions found in San Francisco. The SFMTA's service area includes grades of up to 23 percent.

The Coach shall achieve normal operation in the environmental conditions of San Francisco with temperature ranges of 0 degree Fahrenheit (°F) to 115°F, at relative humidity between 5 percent and 100 percent, and at essentially sea level altitudes. Any exception to the above requirement must be approved by the SFMTA.

The Vehicle shall be capable of traveling along the paths specified below with adequate clearance such that the Vehicle chassis does not make contact with the road or sidewalk.

Paths for Clearance Testing:

24 Divisadero Line	--	Travel beginning at 30th and Mission, along 30th, right on Noe, left on 26th, right on Castro, Divisadero to Geary (both directions) without chassis scraping
Market and Clayton	--	Operate around left turn from Clayton onto Market and also right turn from Market onto Clayton
DeHaro	--	Travel on De Haro from Mariposa to 23rd St. without chassis scraping (note: this is a 21% grade)
23rd Street	--	Travel on 23rd St. from Indiana to Pennsylvania in both directions without contacting road with chassis. This determines straight-on approach, break over, and departure clearances.
Mansell Street	--	Travel on Mansell St at San Bruno to determine if Bus meets departure angle clearance.
Rhode Island & 26th St	--	Travel on Rhode Island and turn southbound onto 26th without contacting road with chassis. This determines front-left side chassis clearance through left-hand turn.
2nd Street at Folsom	--	Travel on 2nd St. and turn westbound onto Folsom without contacting road with chassis. This determines rear-right side chassis clearance through right-hand turn.

1.5 AUDIBLE NOISE LEVEL CONTROL

The SFMTA strongly prefers that each Coach have a low level of exterior/interior noise and, as a design goal, that each Coach be significantly quieter than the specification allows. Instrumentation and other requirements shall conform to SAE Standard J366, except that the two-dBA tolerance is not allowed. The contractor shall develop a test plan for validating the noise levels based on the following criteria. This plan shall be presented to the SFMTA for review and approval. The tests shall be configured to be conducted with the Coach loaded to SLW.

1.5.1 Interior Noise

The Contractor shall use testing procedures in accordance with the Altoona interior noise test to measure the noise levels under the following conditions: a) when Bus is stationary with 80 dBA white noise on the left side exterior of the Bus; b) Bus accelerating at full throttle from 0-35 mph; and c) observe vibrations/rattles with Bus operating at various speeds from 0-55mph.

TABLE 1.5.1

OPERATING MODE	Maximum Allowable At Any Seat Location in Passenger Area	Maximum Allowable at Operator Seat
Stationary w/80dBA	65 dBA	75 dBA
(0-35 mph)	80 dBA	75 dBA with AC OFF 78 dBA with AC ON
Vibration/Rattles	none	none

1.5.2 Exterior Noise

The Contractor shall use exterior noise testing procedures in accordance with the Altoona noise test to measure the exterior noise levels when a Bus is operating at all three conditions.

TABLE 1.5.2

OPERATING MODE (Curb Side)	MAXIMUM ALLOWABLE
Pull-away test	83 dBA
Curb idle test w/AC ON	65 dBA
Full Throttle from 35 mph	80 dBA

1.6 ELECTRONIC NOISE CONTROL

Electrical and electronic subsystems and components on the Coaches shall not emit electromagnetic radiation that will interfere with on-board equipment, fare collection, telephone, radio, TV reception or be susceptible to R.F.I./E.M.I., and shall not be affected by external sources of R.F.I./E.M.I. (Reference Section 7.12, Electrical and Electronic Noise).

1.7 COMPONENT PROTECTION AND OVER-RIDE

All major components of the propulsion system shall be monitored for proper operation, and shall be provided with automatic shut-down features that will protect the components from damage in the event of conditions such as over-speed, over-temperature, overload, or short circuit. Such shutdown features shall be tied to warning lights and alarms in the driver's area, and to fault codes logged in the diagnostic system. The vehicle may continue to drive until the operator moves to a safe location and parks the vehicle at which point the vehicle will automatically shut down. The components that must be protected in this way include, but may not be limited to: traction motor(s), power electronics, and energy storage units. Such automatic shut-down features shall be capable of being overridden in order to allow the Vehicle to be

safely moved a short distance (for example: out of the flow of traffic). The over-ride feature shall be activated by a guarded momentary contact switch located at the driver's position.

The control system shall be designed so that components that are mechanically connected to the rear wheels shall be prevented from over-speeding. This shall be accomplished automatically, without operator intervention, through a Vehicle speed limiting control system. As an example, accelerator application shall be progressively reduced and/or regenerative braking shall be progressively applied to prevent the drive motor system from over-speeding.

1.8 SHOCK HAZARDS

Casual contact with components that have a sufficient voltage potential (EMF) to cause bodily injury shall not be possible. No passenger, driver, or passerby shall be able to contact such equipment.

Electrical systems and equipment shall conform to the applicable SAE standards and/or recommended practices for electric Vehicles (including, J1673, J1742, J1766, J1797, J1798, J2344, J2293). The electrical system shall also conform to SAE standards for wiring (J1654 and J1673) and connectors (J1742).

There should be no high voltage areas within the passenger compartment. For maintenance purposes, all devices that contain high-voltage circuits (maximum circuit operating voltages above 50V) shall be contained within protective enclosures or enclosed Coach body compartments that are either non-conductive or have been coated with SFMTA approved non-conductive insulation.

All access covers for such enclosures and compartments shall be permanently labeled with a warning and the voltage, for example "**DANGER-> 600 VOLTS DC**". All high voltage wiring and equipment shall be shielded by access covers, requiring the removal of at least one bolt, screw, or latch. It shall not be possible to contact high voltage devices with the access covers closed.

Appropriate warning signs and labels shall be used to alert maintenance personnel and/or emergency crews to the presence of high voltage batteries and cabling within the Coach. All visible high voltage equipment or conductors shall be identified with a "HIGH VOLTAGE" marking. The electric Coach should be clearly marked "ELECTRIC VEHICLE" on the exterior.

Energy storage box enclosures shall be properly grounded and considered part of the chassis ground. Ground fault protection circuits shall be provided to ensure insulation integrity between the high voltage circuit components and the Coach chassis. Circuit breakers and/or fuses (or approved equal) shall be provided to effect electrical isolation of components and systems (including the energy storage unit) in the case of a short circuit and/or excessive current draw. In the case of battery isolation, the disconnecting contactors shall be located as close as possible to the positive and negative output of the energy storage unit. A means for informing the operator of the loss of high voltage ground isolation shall be provided by proper

annunciation on the dashboard with visual and audible signals in a phased warning and shutdown.

High voltage cables and wires shall be installed in the dedicated harnesses, wire conduits, or raceways. High voltage wires and harnesses shall be permanently identified with the use of orange color per SAE specifications.

Low voltage systems should be independent of high voltage systems, so that emergency lighting, cameras, and all other accessories remain operable in the event of a high voltage system failure.

The Contractor shall provide specific safety precautions and procedures in the service manuals to enable maintenance personnel to safely access doors and covers on inverters, converters and other energy storing devices. Doors and covers shall utilize square Coach "door key" latches allowing for commonality among other doors on the Coach.

The energy storage system enclosure, inverter(s), converter(s), main switch group, Propulsion Control System (PCS) and traction motor terminal covers shall all be labeled with "HIGH VOLTAGE WARNING" labels.

The energy storage system, inverter(s), converter(s), main switch group, PCS, traction motor and propulsion system generator shall be enclosed or covered to prevent casual contact. The PCS enclosure shall have a mechanical interlock to ensure that the high voltage connections are disconnected before the enclosure is opened. The energy storage unit shall be stored in a sealed container(s).

If the traction battery storage box cover is removable, the traction (energy storage) batteries will remain a live power source if the cover is removed. The distance between main terminals shall be beyond the mechanics reach to minimize potential problems. Energy storage modules shall be properly secured to withstand road vibrations and designed to ensure that their terminals do not come in contact with any part of the Coach body or storage box and are not ejected, or leak, even under severe crash conditions. Module terminals shall under no circumstances be able to come into contact with the storage box lid.

The storage box must be sealed to the extent practical while being well ventilated and kept within acceptable operating temperatures by a thermal management system. If the low voltage battery is removed from the Coach, all high voltage should be isolated within the battery boxes, regardless of the position of the master switch.

1.9 MASTER DISCONNECT

Coaches shall be equipped with a master disconnect switch that interrupts all high voltage power. If the master disconnect switch is in the "Off" position, there will be no high voltages originating from the ESS. The master disconnect switch shall be capable of being locked in the "OFF' position. The purpose and function of the switch shall be clearly and permanently marked

so as to be easily understood by an individual unfamiliar with electric Vehicles. The switch shall be readily accessible to maintenance and emergency service personnel but shall not be located in areas that can be readily accessed by passengers. The design of this switch shall provide for hand operation and include physical lock-out/tag-out features for maintenance.

1.10 ELECTRO-MAGNETIC INTERFERENCE (EMI)

EMI requirements evaluation shall be performed to identify the following criteria:

1. Acceptable levels of radiated emissions from the Coach both in low frequency (30Hz-30kHz) and RF frequency (30kHz-100mHz) ranges shall be identified. A report shall be submitted to SFMTA utilizing the guidelines of CISPR12 and ICES-002, or equivalent (such as MIL-STD-461 and/or SAE-J551) that identifies known properties of existing SFMTA-approved devices, such as: portable/mobile radios, PA systems, fare collection, multiplex and door control systems have been tested and approved.

2. RF susceptibility levels. Latest guidelines of MILSTD-461 and/or SAE-J551, as well as known properties of existing SFMTA devices, such as: radios, PA systems, fare collection, door control shall be included

3. Electromagnetic compatibility between the various electrical and electronic devices mounted on the electric Coach shall be ensured by utilizing established EMC containment techniques, such as proper shielding, grounding, filtering, signal wiring separation, switching frequency management.

4. Adequate EMI/EMC testing shall be conducted by analysis only on the individual components and on the finished Coach to prove that design goals for EMI/EMC are met.

5. A summary report shall be delivered to SFMTA covering items 1-4 with problem areas identified.

1.11 PROTOTYPE

The Contractor shall produce and deliver to the SFMTA a prototype Coach that is entirely representative of a production unit. The prototype shall undergo qualification testing in order to verify that the requirements of these specifications have been met. The format for qualification testing shall be determined by the SFMTA.

The testing shall include the utilization of worn SFMTA tires so as to simulate worst-case maneuverability conditions. The SFMTA shall notify the Contractor in writing of change orders and the specific areas in which the prototype does not comply with the specification no later than 90 working days after the prototype has successfully completed its evaluation period.

Any failure by the SFMTA to detect any Defects or omissions in this review shall in no way relieve the Contractor from fully complying with the Contract.

The prototype Coach shall be brought up to the final production Coach configuration in all respects at no additional cost to the SFMTA, except as may be agreed by change orders. An emphasis will be placed on testing and evaluating new technologies, which may present challenges to the manufacturer and the SFMTA.

1.12 ALTOONA TESTING

Prior to Acceptance of the first Coach, the structure of the Coach shall have undergone appropriate structural testing and/or analysis, including FTA-required Altoona testing, to ensure adequacy of design for the urban transit service. Any items that required repeated repairs or replacement must undergo the corrective action with supporting test and analysis. A report clearly describing and explaining the failures and corrective actions taken to ensure any and all such failures will not occur shall be submitted to the SFMTA.

A manufacturer whose Coach is involved in a structurally related fleet failure in any transit property in the U.S. or Canada in the last ten years must have completed the detailed investigation of the failure and the detailed structural analysis of the complete Coach structure to rule out any effect on any part of the structure. All failures involving basic body, structure, axles, and suspension are included as structural related failures for purposes of this specification. If the apparent responsive manufacturer's Coach has been involved in a structurally related fleet failure, that manufacturer shall submit the report to the SFMTA project manager for review with the initial proposal.

The investigation of failure and structural analysis must be carried out by a reputable, independent Transit Industry Consultant and shall not only be limited to Finite Element Analysis (FEA) but be confirmed by actual track test with suitable time concentration, to prove ability of modified structure to perform for the specified 500,000 miles in the SFMTA’s operating conditions. The report shall include all models and access to the software used to solve the model. Clear comparisons of the design, and improvements must be shown both in the report and the provided model. The SFMTA reserves the right to approve the consultant prior to work performance. The report submitted to the SFMTA must be detailed and must include proof of accuracy of the SFMTA’s operating conditions.

A copy of the Altoona test shall be provided.

1.13 MATERIALS

All materials used in construction of the Coach and all its parts shall conform in all respects to American Society of Testing Materials (ASTM), Society of Automotive Engineers (SAE), and industry recognized standards. Materials used shall be duplicated in manufacture, design, and construction on each Coach. Reference Section 8.1 (Materials).

1.14 CORROSION RESISTANCE

The Coach shall resist corrosion from atmospheric conditions, road chemicals, salt and other commonly encountered corrosive substances. It shall maintain structural integrity and maintain nearly original appearance throughout its service life, provided it is maintained by the SFMTA in accordance with the procedures specified in the service manual (Reference Section 2.1.8, Resistance to Corrosion).

1.14.1 Electrolyte Spills

Battery boxes shall be designed to prevent all battery fluids from entering the passenger compartment during a Vehicle crash.

1.15 WORKMANSHIP

Workmanship shall be of the best grade and shall conform in all respects to the best practice in the industry. Welding procedures, welding materials, and qualifications of welding operators shall be in accordance with the standards of the ASTM and the AWS. Work performed outside the U.S. must conform to U.S. welding standards as approved by the SFMTA (Reference Section 8.2, OVERALL WORK QUALITY).

All lines, cables, hoses shall be properly routed, supported and secured with adequate clearance to mitigate any potential rubbing, ruptures, shorts, etc.

1.15.1 Cable/Lines/Hoses/Wire Securement

The clamps shall maintain a constant tension at all times, expanding and contracting with the hose in response to temperature changes and aging of the hose material. Cables, lines, hoses, and wires shall not foul or rub. All cables, lines, hoses, and wires shall be secured at a minimum of 30-inch intervals unless otherwise approved by the SFMTA.

1.16 MAINTAINABILITY

As a goal, relative accessibility of components, measured in time required to gain access, shall be inversely proportional to frequency of maintenance and repair of the components (Reference Section 11.5, MAINTAINABILITY).

1.16.1 Maintenance and Inspection

Scheduled maintenance or inspection tasks as specified by the Contractor shall be within the prevailing industry practices and subject to SFMTA approval (Reference Section 11.5.4, Maintenance and Inspection).

1.16.2 Electronic Components

Electrical subsystems shall consist of replaceable units so that each major component, apparatus panel, or wiring harness is easily repairable or replaceable with standard hand tools or by means of connectors. Reference Section 7.5 (Electrical Components). Contractors shall provide general configuration layout, arrangements, schematics (with or without dimensions), angles and, when applicable, specification sheets. Contractors shall provide electrical drawings, which shall include a master wiring schematic (complete bus electrical system), and individual sub-system schematics and wiring diagrams. The Contractor shall provide software information required by the SFMTA to perform maintenance.

The Coach shall have a self-diagnostic system for the purpose of self-testing and fault isolation such that a 4M mechanic in the field should be able to isolate a failure to a single removable component in less than 30 minutes. Contractor shall identify during design review those systems that cannot be diagnosed in less than 30 minutes. The number of pieces of equipment required to locate a fault shall be minimized. All special test equipment required to locate a fault or test equipment function shall be supplied by the Contractor.

Shop test equipment shall be supplied for the purpose of testing, trouble-shooting, and calibrating individual electrical assemblies. Test equipment shall be compatible with the SFMTA's maintenance facilities. Testers shall be able to isolate a failure to a component or component grouping.

All the supplied testers described above will be accompanied by documentation to allow SFMTA personnel to operate and repair them. This should include but not be limited to schematics, operation and maintenance manuals.

1.16.3 Interchangeability

Components with identical functions shall be fully interchangeable where possible. These components shall include, but not be limited to, passenger window hardware, interior trim, step treads, lamps, lenses, and seat assemblies. Components with non-identical functions shall not be, or appear to be, interchangeable.

1.17 FIRE SAFETY

The Coach shall be designed and manufactured in accordance with all applicable fire safety and smoke emission regulations. These provisions shall include the use of fire-retardant/low-smoke materials, fire detection systems, firewalls, and facilitation of passenger evacuation.

All materials used in the construction of the Passenger Compartment of the Coach shall be in accordance with the Recommended Fire Safety Practices defined in FTA Docket 90, latest version or document superseding Docket 90. Materials entirely enclosed from the passenger compartment, such as insulation within the sidewalls, need not comply. In addition, smaller

components and items, such as seat grab rails, switch knobs and small light lenses, shall be exempt from this requirement.

A fire retardant barrier or coating between the energy storage unit and storage box and the Coach itself should be used to prevent, or at the very least delay, the spread of fire. A fire suppression system shall be installed. This system shall be a dry chemical suppression system.

Battery box materials that are compatible and non-reactive with the battery electrolytes shall be used. The use of non-conductive storage boxes for the house batteries, or ones coated with non-conductive materials, is preferred.

Battery overheat, fire or smoke conditions in the battery compartment shall actuate a visual and audible alarm at the operator's control panel. The specific type of alert shall be indicated to the operator. The alarm shall have a distinguishing audible level and configuration. The visual and audible alarm must be approved by the SFMTA.

A warning notice will be provided within the battery compartment and on the outside of the Coach NOT to pour water on the battery equipment in case of fire. Appropriate instructions will be posted.

Fire suppression systems shall be provided, including inside the house battery box and traction motor compartment, to reduce the risk of the fire from spreading to other parts of the Vehicle (Reference Section 5.10, FIRE DETECTION / SUPPRESSION). Fire detection systems shall be provided for the house battery compartment, all ESS modules, traction motor compartment, and for all other power conversion hardware and electronics on the vehicle.

1.18 NEW COMPONENTS

All components not manufactured by the Contractor and required or selected by SFMTA that are not standard equipment on the Coach shall have the design, installation, and integration certified by the component/subcomponent manufacturer to ensure proper installation of the unit. Contractor shall assume primary responsibility for systems integration. The SFMTA requires that a representative from the component/subcomponent manufacturer certify the design and installation. Certifications shall be provided to the SFMTA prior to delivery of the prototype Coach. Certifications shall clearly indicate that the installation and application of the component/subcomponent meets the installation and operational guidelines of the manufacturer and has been approved by the manufacturer's representative. The component manufacturers shall certify the following Major Component installations:

- Electric Motor
- Steering and Hydraulic System
- Brakes and Air System
- Traction Motor
- Electric Drive System Generator
- Propulsion Control System

- Energy Storage and Management System
- Destination Sign and Voice Annunciation System
- Heating and Ventilation System
- Fire Detection / Suppression System
- Video Surveillance System
- Cooling System
- Paint
- Axles
- Passenger Doors
- Suspensions
- Wheelchair Ramp
- Wheelchair Securement System
- Charging station(s) (if applicable)
- Bus Chassis

2 BODY

2.1 BODY STRUCTURE

The Coach shall have a clean, simple design, primarily derived from Coach performance requirements and passenger service criteria established in these specifications. The body and under-structure shall be built as an integral unit reinforced at points of stress and concentration. The exterior and body features, including grilles and louvers, shall be shaped to allow complete and easy cleaning by SFMTA's automatic Coach washers without snagging washer brushes or retaining water and dirt. The body and windows shall be sealed to prevent leaking of air, dust, or water under normal operating conditions and during cleaning in automatic Coach washers for the service life of the Coach. The windows, hatches, and doors shall be able to be sealed. Accumulation on any window of spray and splash generated by the Coach wheels on a wet road shall be minimized.

The entire Coach shall negotiate through all established SFMTA motor Coach infrastructure (including but not limited to: charging areas, Coach maintenance and storage areas, body shop areas, and tire shop areas) without coming in contact with any part of the facilities or its attachments, or having any clearance issues.

Body materials shall be selected and the body fabricated for easy replacement and repair, to reduce maintenance, extend durability, and provide consistency of appearance throughout the service life of the Coach.

The passenger compartment shall be separated by fire-resistant bulkheads. This bulkhead shall preclude or retard propagation of a traction motor or an electric storage system compartment fire into the passenger compartment and shall be in accordance with the Recommended Fire Safety Practices defined in FTA Docket 90A, dated October 20, 1993. Only necessary openings shall be allowed in the bulkhead, and these shall be fire-resistant. In the event that the Supplier's overall design contains no bulkheads, the Suppliers may use the floor and roof as a barrier between the high voltage batteries and the cabin. Any passageways for the climate control system air shall be separated from the electric drive system by fire- resistant material. Piping through the bulkhead shall have fire-resistant fittings or caulking sealed at the bulkhead. Wiring may pass through the bulkhead only if connectors or other means are provided to prevent or retard fire propagation through the bulkhead. Service access panels in the bulkhead shall be fabricated of fire-resistant material and secured with fire-resistant fasteners. These panels, their fasteners and the bulkhead shall be constructed and reinforced to minimize warping of the panels during a fire that will compromise the integrity of the bulkhead.

Detailing shall be kept simple. Add-on devices and trim shall be minimized and, where necessary, integrated into the basic design.

2.1.1 Strength and Fatigue Life

The basic structure shall be designed so that fatigue damage will not occur during the service life of the Coach. The structure shall also withstand, without permanent deformation or damage, impact and inertial loads due to street travel during normal SFMTA service throughout the Coach's service life. Contractor shall test the proposed coach chassis at GVWR utilizing strain

gauges to determine the weak points and fatigue life analysis of the basic structure. The strain gauges shall be placed in accordance with the indicated high stress areas predicted by the computerized FEA. The FEA testing procedure must be approved by the SFMTA on a case-by-case basis. Copies of all analysis and testing shall be submitted to the SFMTA for review and Acceptance.

The Contractor may submit relevant test reports or previous FEA data, with similar Coach structure, to the SFMTA for review and approval. Based on the sufficiency of the FEA, the SFMTA, in its discretion, may relieve the Contractor from its responsibility to perform the strain gauge testing.

2.1.2 Distortion

The Coach, at GVWR and under static or dynamic conditions, shall not exhibit deformation or deflection that will damage panels or structural members or impair operation of doors, windows, or other mechanical elements. Static conditions include the Vehicle at rest with any one wheel or dual set of wheels on a six inch curb or in a six inch deep hole. Dynamic conditions include operation on a variety of road surfaces at prudent speeds up to the maximum for each type of Coach and road irregularities such as chuckholes and railroad level crossing.

2.1.3 Crashworthiness

The Coach body and roof structure shall withstand a static load equal to 150 percent of the curb weight evenly distributed on the roof with no more than a six-inch reduction in any interior dimension. Windows shall remain in place and shall not open under such a load, but shall be easily opened when used as emergency exits.

Exterior panels below three feet from the ground and their supporting structural members shall withstand a static load of 2,000 pounds applied perpendicular to the Coach anywhere below the three foot height by a pad no larger than five inches square. This load shall not result in deformation that prevents installation of new exterior panels to restore the original appearance of the Coach. Components located behind these panels cannot be damaged by this test method.

The Coach structure shall withstand a 25 mph impact by a 4,000 pound automobile at any point with no more than three inches of permanent structural deformation at seated passenger hip height. This impact shall not result in sharp edges or protrusions into the Coach interior.

The Contractor shall demonstrate compliance by relevant test results or by dynamic FEA, per the requirements in Section 2.1.1 Strength and Fatigue Life.

2.1.4 Resonance

Structure, body, and panel bending mode frequencies, including vertical, lateral, and torsional modes, shall be sufficiently removed from all primary excitation, and major harmonic frequencies to minimize audible, visible, or sensible resonant vibrations during service.

2.1.5 Towing

Fixed towing devices shall be provided on each end of the Coach. The towing devices shall withstand, without permanent deformation, tension loads up to 1.2 times the curb weight of the

Coach within 20 degrees of the longitudinal axis of the Coach. The rear towing device(s) are only for extracting the vehicles from a ditch or pulling them to position in order to be towed from the front, and shall not provide a toehold for unauthorized riders. The front towing devices shall allow attachment of a rigid tow bar and shall permit lifting of the Coach, at curb weight, by the towing devices and the tow bar until the front wheels are clear of the ground. The method of attaching the tow bar must be approved by the SFMTA.

Each towing device shall accommodate a crane hook with a one-inch throat. Any specialized towing adapters for emergency road service and quick Coach recovery by contracted towing companies must be approved by the SFMTA and the contracted towing company.

2.1.6 Jacking and Hoisting

Jacking pads, located on the axle or suspension near the wheels, shall permit easy and safe jacking of the Coach, at curb weight, with a common ten-inch-high jack or a ten-ton floor jack. Such jacking shall occur, when the Coach is on a level, hard surface, without the mechanic having to crawl under any portion of the Coach. Jacking from a single point shall permit raising the Coach sufficiently to remove and reinstall a wheel and tire assembly. Jacking and changing any one tire shall be completed by a 4M mechanic in less than 30 minutes. The Coach shall withstand such jacking at any one or any combination of wheel locations without permanent deformation or damage.

The Coach axles and/or jacking plates shall accommodate the lifting pads of the SFMTA's hoist system. Jacking plates, if used as hoisting pads, shall be approximately 4 by 4 inches or a 4-inch diameter circle, with a turned-down flange, or approved alternate, not less than 1/2-inch-deep on each side. The "turned-down" flange can be of welded, bent or cast construction. Other pads, or the Coach structure, shall support the Coach on jack stands independent of the hoist. Hoist adapters, if required, shall be supplied by the Contractor for each in-ground hoist.

2.1.7 Exclusion of Water

The Coach shall be designed to assure that the underside, wheel houses, floor, exterior body, windows, passenger doors, roof ventilators, lamps, access doors, and other openings do not admit water into the interior of the Coach or into any compartments covered by exterior doors during operation. Any equipment compartment located inside the Coach shall be sealed to prevent water entry.

The SFMTA requires that each Coach be wate- tested in the Contractor's manufacturing facility before shipment to San Francisco. The Contractor shall propose a water test method for SFMTA approval that includes a 15-minute water test.

The proposed water test shall include duration of test, rate of water flow, amount and placement of nozzles, and nozzle pressure/pattern. Each Coach shall be water-tested. Coaches, which fail any part of the test shall be repaired and fully re-tested until they pass. Use of sealers, externally applied to already attached components to meet the water test requirement, is prohibited. All exterior hardware must be installed. No temporary sealing methods can be used.

Any leaks found during this test shall be repaired by the Contractor, who will also make appropriate corrections in the assembly line and factory water test.

2.1.8 Resistance to Corrosion

The Coach shall resist corrosion from atmospheric conditions, road chemicals, salt, graffiti removal chemicals, commercial cleaning solutions, and other commonly encountered corrosive substance. It shall maintain structural integrity and maintain nearly original appearance throughout its service life, provided it is maintained by the SFMTA in accordance with the procedures specified in the service manual. Materials exposed to the elements and all joints and connections of dissimilar metals shall be either corrosion proof or protected from galvanic corrosion. The corrosion inhibitor shall be non-flammable and the application must be approved by the SFMTA.

All interior and exterior stainless steel hardware shall be of approved grades. Representative samples shall withstand a two-week salt spray test in accordance with ASTM Procedure B-117 with no visual or structural detrimental effects and no significant structural degradation or weight loss over one percent for other members or components.

2.1.9 Skid Resistance

The Coach shall be designed to resist damage from impact and skidding against asphalt roads when the road conditions exceed the vehicle's rated breakover, approach, and departure angles. Metal skid plates shall be provided on the underside of the front and rear overhangs of the Coach to protect sensitive components or any parts of the chassis that would be significantly damaged by skidding on the surface of a road. Vulnerable composite chassis components on the underside of the front and rear overhangs shall be protected by metal skid plates.

2.2 EXTERIOR

Exterior protrusions greater than 1/2 inch and within 80 inches of the ground shall have a radius no less than the amount of the protrusion. The right side and left side mirrors, required lights and reflectors are exempt from this requirement. Grilles, doors, bumpers, and other features on the sides and rear of the Coach shall be designed to minimize the ability of unauthorized riders to secure toeholds or handholds.

2.2.1 Strength and Installation

Exterior panels that are three feet above the road may be structural components. Exterior panels below three feet shall be easily repairable and may be replaced. Composite structural components shall be repairable using common composite repair techniques or be easily replaceable.

2.2.2 Rain Gutters

Gutters shall be provided or designed as an integral part of the Bus body to prevent water flowing from the roof onto side windows and doors. When the Coach decelerates, accelerates, coasts, or stops, the gutters shall not drain onto the windshield or operator's side window, or into the door boarding area. Cross sections of the gutters shall be no less than 1/4 square inch. Contractor shall demonstrate compliance with this section during prototype review.

2.2.3 License Plate Holders

Provisions shall be made to mount standard U.S. license plates on the front and rear of the Coach. License plates shall be mounted so that they can be cleaned by the SFMTA's automatic Coach washing equipment without being caught by the brushes. License plates and mountings shall not provide toeholds or handholds for unauthorized riders. The rear license plate shall be illuminated.

2.2.4 Bicycle Rack

The Contractor shall install a Byk-Rak three-bicycle rack with non-glare finish, or approved equal, on the front bumper of the Coach. These shall be of the front-loading type. The mounting of the bicycle rack to the Coach shall be designed in a manner that the rack can be easily removed in the event the Vehicle needs to be towed. The Contractor shall submit details of installation to the SFMTA for approval during design review.

A dash mounted bike rack deployment indicator light, clearly visible to the operator at all times shall be installed.

2.2.5 Finish and Color

Coach exterior shall be painted or wrapped with decals (Colors and Paint Specifications are given in 8 MATERIALS AND OVERALL WORK QUALITY). Proposer shall provide one or more proposed paint schemes for the Coach that align with the SFMTA's latest brand guide (see ATTACHMENT 2: DECAL LISTING); SFMTA reserves the right to provide its own paint scheme, or to select a proposed paint scheme from one OEM to be used on all Buses purchased through this RFP. The Contractor shall furnish anti-graffiti/vandalism treatment for SFMTA approval; this treatment includes Axalta 8430S Clearcoat or approved equals.

All exterior surfaces shall be smooth and free of visible fasteners, wrinkles and dents. Exterior surfaces shall be properly prepared as required by the paint system supplier prior to application of paint to assure a proper bond between the basic surface and successive coats of original paint for the service life of the Coach. Body filler materials may be used for surface dressing, but not for repair of damaged or improperly fitted panels. Exterior shall be finished with lead-free Axalta Imron Elite, PPG Delta DBHS 2.7 VOC, Gelcoat, or approved equal in accordance with the paint manufacturer's recommendations. All paint used shall be lead free.

2.2.6 Fender Skirts

Fender skirts of flexible rubber shall be included in wheel housing. Fender skirts shall be unbreakable and easily replaceable. Wheels and tires shall be removable with the fender skirts in place.

2.2.7 Splash Aprons

Splash aprons composed of composition or rubberized fabric at least 1/4 inch thick shall be installed behind each wheel and shall extend downward to within four inches of the road surface. Apron widths shall be no less than tire widths. Splash aprons shall be bolted to the Coach under structure. Splash aprons and their attachments shall be inherently weaker than the structure to which they are attached. Splash aprons and their attachments shall not be included in the road clearance measurements. Additional splash aprons shall be installed

where necessary to protect Coach equipment, including but not limited to the full width of the Coach immediately fore or aft of the front and rear axles.

2.2.8 Windshield Wipers and Washers

The Coach shall be equipped with Sprague, Comotech, DOGA, or approved equal, electric powered, continuously variable speed windshield wipers for the windshield. At 50 mph, no more than ten percent of the wiped area shall be lost due to windshield wiper lift. Windshield wiper motors and mechanisms shall be easily accessible for repairs or service, mounted with mechanical fasteners, and removable as individual units from the interior or exterior of the Coach. The information supplied for service and repair shall encompass the individual sub-assemblies to the lowest point of detail including the printed circuit boards of the sub-assemblies.

The windshield washer system shall deposit washing fluid on the windshield and, when used with the wipers, shall evenly and completely wet the entire wiped area.

The windshield washer system shall have not less than a two gallon reservoir located for easy refilling. A location inside the Coach near the front step is permissible. Access shall be provided through a spring-loaded paddle door. Reservoir pumps, lines, and fittings shall be corrosion resistant, and the reservoir itself shall be translucent for easy determination of fluid level. No equipment shall be located beneath the reservoir.

2.2.9 Service Compartments and Access Doors

SFMTA prefers conventional doors with stainless steel piano hinges for access to the rear service compartment and all auxiliary equipment compartments. Access openings shall be sized for easy performance of tasks within the compartment, including tool-operating space. All handles shall be flush with, or recessed into, the body contour and shall be sized to provide an adequate grip for opening. Springs and hinges shall be corrosion resistant and shall last for the Coach's service life. Keys for all exterior service access shall have a square male end which matches the door locking mechanism.

2.2.9.1 Access Doors

Access doors shall be of rugged, corrosion-resistant metal or composite construction and shall maintain mechanical integrity and function under normal operations throughout the service life of the Coach. They shall close flush with the body surface, and be prevented from coming loose or opening during transit service or Coach washing operations. Access doors when open, shall not restrict access for servicing other components or systems.

Access doors requiring more than 25 lbs. of force to lift into place shall be retained in the open and close positions with over-center gas-filled springs. Doors smaller than 36 square inches shall be retained in the open and close positions by over-center springs. A thumbhole or handhold shall be provided on such doors to facilitate opening and closing.

2.2.9.2 Rear Equipment Compartment

The rear maintenance door, and both rear side maintenance doors shall be easily opened by one person. Traction motor fluid shall be checked and added through the maintenance compartment doors. Traction motor coolant shall be checked and added through a paddle door

located on the roadside of the Coach. The location of these systems is the discretions of the Contractor but shall seek approval from the SFMTA on the final location. All maintenance access doors shall be locked with 5/16-inch square tool.

2.2.9.3 Low Voltage Battery Compartment

The low voltage or auxiliary battery compartments shall be constructed of 304 stainless, polyethylene or approved equal. The battery shall be located under the floor of the Coach, vented and self-drained, and prevent accumulation of debris on top of the batteries. It shall be accessible only from the outside of the Coach. All components within the battery compartment, and the compartment itself, shall be protected from damage or corrosion from the electrolyte. The inside surface of the battery compartment's access door shall be electrically insulated. Battery terminals shall under no circumstances be able to come into contact with the storage box lid. Batteries shall be properly secured to withstand road vibrations and designed to ensure that their terminals do not come in contact with any part of the Coach body or storage box and are not ejected, or leak, even under severe crash conditions. Batteries shall be mounted in trays that are constructed of 304 stainless, polyethylene with a 304 stainless sub-frame, or approved corrosion resistant materials to resist corrosion. The SFMTA prefers that the trays easily slide out of the body for service or replacement. Battery trays may be e-coated or powder coated to assist with corrosion or abrasion resistance. Low voltage systems should be independent of high voltage systems, so that emergency lighting, cameras, and all other accessories remain operable in the event of a high voltage system failure. If the low voltage battery is removed from the Coach, all high voltage should be isolated within the battery boxes, regardless of the position of the master switch.

2.2.9.4 Electronic Equipment Compartment

The Contractor shall provide a secured enclosure for the equipment. Location and design must be approved by SFMTA.

2.2.10 Bumper System

Bumpers shall be Romeo Rim High Energy Level Polymer (HELP) bumpers or approved equal, adapted to the Coach provided, and installed to meet the performance requirements of these Technical Specifications. Bumpers shall provide impact protection for the front and rear of the Coach up to 26 inches above the ground. The bumpers may wrap around the Coach but shall not exceed the allowable Coach width. Bumper material shall be corrosion resistant. Visible surfaces shall be black. These qualities shall be sustained throughout the service life of the Coach. Support and backing of the resilient portion of the bumper shall be made from materials and mounted in a manner, which protects the Coach in the event of an accident. A steel or reinforced aluminum sub-frame shall be used.

2.2.10.1 Front Bumper

No part of the Coach, including the bumper, shall be significantly damaged as a result of a five mph impact of the Coach at curb weight with a fixed, flat barrier perpendicular to the Coach's longitudinal centerline. The bumper shall return to its pre-impact shape within 10 minutes of the impact. The energy absorption system of the bumper shall be independent of every power system of the Coach and shall not require service or maintenance in normal operation during

the service life of the Coach. The flexible portion of the bumper may increase the overall Coach length specified in (Section 1.2, DIMENSIONS) by no more than seven inches.

2.2.10.2 Rear Bumper

No part of the Coach, including the bumper shall be damaged as a result of a two mph impact with a fixed, flat barrier perpendicular to the longitudinal centerline of the Coach. The bumper shall return to its pre-impact shape within ten minutes of the impact. When using a yard tug with a smooth, flat plate bumper two feet wide contacting the horizontal centerline of the rear bumper, the bumper shall provide protection at speeds up to five mph, over pavement discontinuities up to two inches high, and at accelerations up to two mph/sec.

The rear bumper or bumper extensions shall not offer footholds to unauthorized riders. The bumper extensions shall not hinder service and shall be faired into the Coach body with no protrusions or sharp edges. The bumper shall be independent of all power systems of the Coach and shall not require service or maintenance in normal operation during the service life of the Coach. Any flexible portion of the bumper may increase the overall Coach length specified in Section 1.2, DIMENSIONS, by no more than six inches.

2.3 INTERIOR TRIM, PANELING AND ACCESS

Materials shall be selected on the basis of ease of maintenance, durability, appearance, safety, flammability, and tactile qualities. Trim and attachment details shall be kept simple. Trim shall be secured to avoid resonant vibrations under normal operational conditions. Panels shall be reinforced to resist buckling, flexing, drumming, vandalism, and other rigors of SFMTA Coach service. They shall permit easy removal of paint, greasy fingerprints, and ink from felt-tip pens, resistant to scratches and markings, and easily replaceable and tamper resistant.

All interior surfaces below the lower edge of the windows or windshield shall be shaped so that objects placed on them fall to the floor when the Coach is parked on a level surface. The entire interior, with the exception of the driver's area, electric equipment box, and any other sensitive electrical equipment, shall be cleanable with a hose, using a liquid soap attachment. Interior mullion trim, moldings, and trim strips shall be textured stainless steel, PVC, or anodized aluminum. Individual trim panels and parts shall be interchangeable. Untrimmed areas shall be painted and finished to the quality described in Section 2.2.5 (Finish and Color).

2.3.1 Divider and Side Trim Panel

Divider panels of 1/4-inch melamine, Lustran, ABS, lexan or approved equal material that matches the sidewalls shall be provided as required at the rear of the entry stepwell and at the front and rear of the exit stepwell(s). Surfaces of the divider panels shall be per Attachment 3, Materials, Colors and Finishes.

These dividers may be mounted on the sidewall or floor, and shall project toward the aisle no farther than passenger knee projection in longitudinal seats, the aisle side of the transverse seats, or the edge of a stepwell. Divider panels shall not extend more than 10 inches higher than the daylight opening of the side windows. Panels forward of longitudinal seats shall extend to below the level of the seat surface. Dividers positioned at the doorways shall provide no less than 2-1/4 inches of clearance between the divider panel and the opened door. The divider

panel and its mounting shall withstand normal kicking, pushing, and pulling loads from 200 pound passengers without permanent visible deformation.

Interior side wall panels shall be premium grade melamine-type paneling, backed with a durable, moisture-resistant material no less than 1/10 inch thick. The material shall permit easy removal of paint, greasy fingerprints, and ink from felt-tip pens. Panels shall be easily replaceable without removing the window(s) and tamper resistant. They shall be reinforced, as necessary, to resist buckling, flexing, drumming, vandalism, and other rigors of transit Coach service.

2.3.2 Rear Bulkhead

The rear bulkhead shall be paneled with premium grade melamine-type material, Kydex material, or approved equal, at least 1/16-inch-thick, and trimmed with aluminum or stainless steel. The panels above the seat shall be contoured to fit the ceiling, sidewalls, and seatbacks. Any air vents in this area shall be designed to reduce trash or litter being thrown or drawn through the grille and shall be reinforced to prevent bending by passengers. The air vents shall meet the requirements of Section 2.3.6, Access Doors, if components requiring service are located behind the grille.

2.3.3 Headlining

Ceiling panels and the trim between the passenger windows and in the front end down to the level of the lower daylight opening shall be premium grade 1/16-inch melamine, Lustran, ABS plastic or approved equal. For ease of graffiti removal, the surface shall be smooth and matte. The Contractor shall provide a proposal of graffiti-resistant materials and also the graffiti removal solution. The specific color and surface type must be approved by SFMTA prior to production.

Headlining shall be supported to prevent buckling, drumming, or flexing, and shall be mechanically secured without loose edges. Headlining materials shall be treated or insulated to prevent marks due to condensation where panels are in contact with metal members. Moldings and trim strips, as required to make the edges tamper-proof, shall be aluminum, stainless steel, or a durable polymer material.

2.3.4 Front End

The entire front end of the Coach shall be sealed to prevent debris accumulation behind the dash and to prevent the operator's feet from kicking or fouling wiring and other equipment. The front end shall be free of hazardous protrusions. Paneling across the front of the Coach and any trim around the operator's area shall be made of formed metal or a durable polymer or composite material.

Formed metal dash panels shall be vinyl coated or painted and finished to the quality described in Section 2.2.5 (Finish and Color). Plastic dash panels shall be reinforced as necessary, resistant to age discoloration and cracking, vandal resistant, and easily replaceable. All colored, painted, and plated parts forward of the operator's barrier and below the upper daylight opening shall be finished with a smooth, dull matte surface in a flat black or gray color that matches or coordinates with the Coach interior.

The dash will be constructed with metal support so components designated for dash mounting are securely mounted to an underside panel. Mounting areas shall be pre-drilled and tapped. The components shall be mounted to the underside panel using machine screws, or threaded nutserts. The components are radio head, speaker, and sign programming controller.

2.3.5 Fastening

Interior panels shall be attached so that there are no exposed edges or rough surfaces. Panels and fasteners shall not be easily removed by passengers but shall be easily replaceable when necessary Self-tapping screws are not permissible for attachment of interior panels.

2.3.6 Access Doors

Access for maintenance and replacement of equipment, shall be provided by panels and doors that appear to be an integral part of the interior. Removal of fixtures or equipment that is unrelated to the repair task to gain access should not be allowed. All door hinges shall be of steel or stainless steel piano-style type. All interior access doors, panels and on the door actuator compartments shall be retained securely with latches with self-contained tamper-proof fasteners approved by the SFMTA.

2.4 FLOOR

The floor deck shall be mounted securely on the structure to prevent chafing or horizontal movement. The floor shall be retained by adhesives with or without the assistance of stainless steel fasteners. The joints should be filled with adhesive and rough surface areas faired with an appropriate bonding material and sanded smooth where required. Tapping plates used for the floor fasteners shall be of a sufficient thickness, preferably no less than the thickness of a standard nut, and all floor fasteners shall be secured and protected from corrosion for the service life of the Coach. The floor deck shall be reinforced as needed to support passenger loads. At GVWR, the floor should have an elastic deflection of no more than 0.60 inch from the normal plane. The floor shall withstand the application of 2.5 times gross load weight without permanent detrimental deformation. The floor and treads, with coverings applied, shall withstand a static load of at least 150 pounds, applied through the flat end of a 1/2-inch diameter rod with 1/32-inch radius, without permanent visible deformation.

The floor, as assembled, including the sealer, attachments, and coverings, shall be waterproof, non-hygroscopic, resistant to wet and dry rot, resistant to mold growth, and impervious to insects. All edges shall be sealed with an SFMTA-approved sealer.

All gaps filled and ground flush with the floor. Sheets shall run the full width of the Coach. Structural members shall support all joints. Use of parallel joints shall be minimized to the extent practicable. Floor irregularities and joints shall not be visible after installation of floor covering.

Plywood is not considered acceptable flooring for this procurement. The flooring shall be composite material flooring, Coosa, Milwaukee, SpaceAge Synthetics, René Composite, or an approved equal. Any de-laminations or bubbles formed between the floor covering and the subfloor is not acceptable and reference Section 10.1.2, FIGURE 10-1 for the flooring warranty requirement.

2.4.1 Height

Height of the floor above the street shall be no more than 15 inches measured at the centerline of the doors when the doors are open. The floor shall be essentially level from the front door to the rear door. If the floor is raised at the rear axle, it shall have steps with risers no greater than 10-¾ inches. The step method is preferred however a ramp with a slope may be acceptable to the SFMTA. The Coach may adjust the floor height while the vehicle is in motion if the operator commands the doors to open; however, the doors shall not open before the 15 inch floor height is achieved and the vehicle is stationary.

2.4.2 Edges

Where the floor meets the walls of the Coach, the edges shall be blended with a fillet or be otherwise bonded to prevent water infiltration. The design of the Vehicle shall prevent debris accumulation between the floor and wheel housings or provide a transition between the floor and any walls that do not have cove moldings.

2.4.3 Floor Covering

Floor covering shall be Altro Transflor TFFG2704F “Rocket”, Coosa Composites, or approved equal. Floor covering shall be nonskid, material that remains effective in all weather conditions and complies with all ADA requirements. The floor covering, as well as transition of flooring material to the center aisle and to the stepwell area, shall be smooth and present no tripping hazards.

The standee line shall be at least two inches wide and shall extend across the Coach aisle 18 inches behind the turn of the corner at the forward edge of the wheel well; and at the exit door area in line with the inward edge of the opened door. This line shall be the same yellow color as the edge of the door area. Color shall be consistent throughout the floor covering.

The floor covering shall closely fit the sidewall cove or extend to the top of the cove. The color of the floor covering in the passenger compartment shall be the same as that in the vestibule. Warning decals or flooring inlays indicating that passengers should not stand in the doorways should be inlay at each exit vestibules. The design shall be submitted for approval by the SFMTA.

2.5 STEPS AND STEPWELLS

2.5.1 Steps

Interior step risers shall be no more than 10-3/4 inches.

2.5.1.1 Step Treads

The plane of the step treads shall be essentially parallel to the plane of the floor, sloped only sufficiently to prevent water accumulation on the floor. All step treads shall be covered with the same nonskid floor covering material and shall remain effective in all weather conditions. The edge of the vestibule floor shall conform to ADA requirements and shall have a maximum of 5/16-inch overhang at the step riser. The outer edge of the step, just below the step nosing, at the rear door shall be covered with a stainless steel strip. The edge of the vestibule floor tread shall have a bright, contrasting yellow band no less than two inches wide on the full width of the

opening. The color shall be permanently blended into the floor covering material. Yellow / black caution stripe decal is required at each vertical face of the step.

2.6 WHEEL HOUSINGS

Wheel housings shall be constructed of 18-gauge stainless steel or heavier, equivalent strength fiberglass, composite monocoque structure or approved equal. Sufficient clearance and air circulation shall be provided around the tires, wheels, and brakes to prevent overheating when the Coach is operating. Wheels and tires shall be removable when the Coach is jacked by the axle or suspension, even with the air bags depleted. Interference between the tires and any portion of the Coach shall not be possible in maneuvers up to the limit of tire adhesion with Coach weights from curb to GVWR.

2.7 INSULATION

The Contractor shall ensure that the Coach is properly insulated thermally and acoustically in order to meet the SFMTA's performance requirements. Any insulation material used between the inner and outer panels shall be fire resistant and installed to minimize entry and retention of moisture. Insulation properties shall not be impaired by vibration compacting or settling during the service life of the Coach. The insulation material shall be non-hygroscopic and resistant to fungus and the breeding of insects. The material shall be physically retained to prevent tearing.

2.7.1 Thermal Insulation

The combination of inner and outer panels on the sides, roof, and ends of the Coach, and any material used between these panels shall provide a thermal insulation sufficient to meet the interior temperature requirements of Section 3.4, INTERIOR CLIMATE CONTROL. The Coach body shall be thoroughly sealed so that the operator or passengers during normal operations cannot feel drafts with the passenger doors closed.

2.7.2 Sound Insulation

The combination of inner and outer panels and any material used between them shall provide sufficient sound insulation so that a sound source with a level of 80 dBA measured at the outside skin of the Coach shall have a sound level of as specified in Section 1.5.1. These conditions shall prevail with all openings, including doors and windows, closed and with accessories switched off.

3 FURNISHINGS

3.1 WINDSHIELD, DRIVER, AND PASSENGER WINDOWS

Opening shall be provided in the body structure to accommodate a windshield, driver's window, and passenger windows. All windows shall be supported by metal sub-structure. Tint shall be applied in the inter-layer. All designs and dimensions of windshield and windows must be approved by the SFMTA.

3.1.1 Windshield

The windshield requirements are given in Section 4.4.1 (Windshield).

3.1.2 Driver's Side Window

The driver's side window requirements are given in Section 4.4.2 (Side Window).

3.1.3 Passenger Windows

Windows shall be required on each side of the Coach. All passenger windows shall be of the smooth flush mount "BRT" style, also referred to as "seamless windows.". Contractor shall provide dimensions, specifications, and drawings for all windows.

Passenger windows shall have Thermoguard Bluespruce laminated glazing, Thermoguard Bluespruce tempered glazing, or approved equal.

3.1.3.1 Dimensions

At minimum, all passenger windows shall extend from the shoulder height of a 5th-percentile seated female passenger to the eye level of a 95th-percentile standing male passenger. Windows shall be divided horizontally. The bottom portions of the windows shall be fixed. The upper portion over the side destination sign shall be fixed. The upper portions of all other windows shall be 9 to 15 inches high and shall open by tip in or tip out. All windows shall be easily replaceable without disturbing adjacent windows and shall be mounted so that flexing or vibration from electric motor operation or normal road excitation is not apparent. All windows shall be the same size to the extent practicable. The replacement of the window should be done by two persons within one hour.

3.1.3.2 Materials

All passenger windows and door windows shall be safety glass of minimum 1/4-inch-thick and conform to the requirements of ANSI Z26.1 Standard for Type AS-3. All passenger windows and door windows shall be no less than 28 percent luminous transmittance. Windows over the side destination signs shall not be tinted. Window sash shall be weather-protected and

corrosion-resistant. The tracks and seals shall be designed to be vandal resistant and to last the service life of the Coach.

3.1.3.3 Anti-Vandalism Provision

The contractor shall apply 1/8-inch thick, scratch resistant, clear panels to all of the interior passenger windows and sliders. These panels shall protect the Coach windows from etching and other forms of vandalism. The protective panels shall be undetectable and capable of being applied to any size or shape window, including sliding windows. The protective panels shall be resistant to detergents and graffiti removers. No accumulation of moisture shall be allowed between the surfaces of the original windows and the protective panels. Each protective panel shall be capable of being removed and installed by a single 4M mechanic within three minutes. This anti-vandalism provision must be approved by the SFMTA.

3.1.3.4 Emergency Exits

All Coaches shall be provided with adequate exits for quick passenger escape during emergency conditions. All emergency exits shall comply with applicable codes and requirements and the best industry practice.

All passenger side windows shall open outward to provide an emergency exit except for the two rear most windows and the destination sign windows on each side of the Bus. The upper window mounting hinge shall be stainless steel. A simple red latch shall be provided on all passenger side windows that take no more than 20 pounds of force to manipulate. This latch shall not pinch a person's fingers or hands when operating, and shall be designed so that it returns to its normally closed position. It shall not be possible for passengers to use the latch as an accessory hook. Latch design must be approved by S the FMTA. Each emergency exit window location shall be labeled with an instruction plate (preferably close to the latch). Contractor shall provide emergency exit provision for SFMTA approval.

3.2 DOORS

Doors shall be Vapor plug sliding style provided on curb side of the Coach. The front entrance door shall be forward of the front wheels and located so that the operator is able to collect or monitor the collection of fares. The rear exit doors shall be located in front of the drive (rear) axle. Passenger entrance and exit doors and doorways shall comply with all requirements of the ADA.

The passenger exit (rear) doors shall have Vapor CLASS (Contact-Less Acoustic Sensing System). This allows the passenger to signal through the movement of their hand or body, the opening of the door after operator actuation. Operator actuation shall result in the illumination of a green light above the doors notifying the passenger the exit door can be opened. The door system will recognize the presence of passenger in the exit area or within 24 inches of the outside opening of the Coach, and not close until the area is cleared of people. On the outside of the vehicle on the exit doors, there shall be pushbutton-style door request buttons to allow for

onboarding passengers to open the exit door when the Bus is stopped and the operator has enabled the doors to open. The system shall have a positive mechanical locking feature when the door control is in the “OFF” position. A door annunciator shall make digitally recorded messages (such as warnings, greetings, or service announcements) in the exit door area. The contractor shall present details of their methodology for entrance and exit door operation for SFMTA review. The task of the final commissioning shall be included in the Contract price.

3.2.1 Materials

Structure of the doors, their attachments, inside and outside trim panels, and any mechanism exposed to the elements shall be durable and corrosion resistant. Doors shall be constructed of aluminum. Top and bottom door seals shall be brush-type, flap-type, or an approved equal. The doors, when fully opened, shall provide a firm support and shall not be damaged if used as an assist by passengers.

3.2.2 Dimensions

Door openings shall be no less than 74 inches high. Front door free clear opening shall be able to accommodate a 32-inch wheelchair ramp as minimum. The rear door shall have a free clear opening of 43 inches wide for the entire vertical height. The rear door clear opening width may be reduced to 41 inches wide in the areas of the passenger assists and the passenger head and foot areas, if these projections do not present hazards.

3.2.3 Door Glazing

The front doors shall be glazed as a one-piece panel at full length. The doors may be split into two sections with a rubber divider between the sections as approved by the SFMTA. The edge of a six (6) inches high curb shall be visible to the seated operator through the closed front door when the Coach is more than 12 inches from the curb. The rear doors shall be upper portion glazed and aluminum lower panel for exit doors. Door glazing materials shall be the same as Section 3.1.3.2 (Materials).

3.2.4 Door Projection

Exterior projection of the doors shall be minimized and shall not exceed 6-1/2 inches during the opening or closing cycles or when doors are fully opened. The closing edge of each door panel shall have no less than two inches of soft weather-stripping. The doors when closed shall be effectively sealed and the hard edges of the doors shall be at least four inches apart.

Inside the Coach, the door mechanisms shall be recessed into the ceiling or paneled over so that no ledges are created.

3.2.5 Door Height above Pavement

It shall be possible to open and close the passenger doors when the Coach is loaded to GVWR and not knelt and parked with the tires touching an eight inches high curb on a street sloping toward the curb so that the street side wheels are five inches higher than the curb side wheels.

3.2.6 Actuator

Door opening and closing speeds shall be independently adjustable. Both door panels shall be operated by a single actuator for each door opening to guarantee synchronization of panels during opening and closing cycles. Actuators and the door mechanism shall be concealed from passengers but shall be easily accessible for servicing.

3.2.7 Emergency Operations

In the event of an emergency, it shall be possible to open each door manually from inside the Coach using a force of no more than 25 pounds after actuating an emergency door-unlocking device directly adjacent to each door. The unlocking devices shall be clearly marked as an emergency-only device and shall require punching in a small plastic window and activating a control. Concise instructions for emergency exits shall be posted near the device. Door emergency unlocking devices shall be accessible from the door areas. When any of the door emergency unlocking devices is actuated, the door interlock throttle system shall inhibit traction, and the door interlock brake system shall apply regardless of the position of the override switch described in Section 4.1.4.3 (Interlock Override Switch). The interlock system may be overridden is the Coach is required to be moved.

Locked doors shall require a force of more than 300 pounds to open manually. When the locked doors are manually forced to open, damage shall be limited to the bending of minor door linkages with no resulting structural damage to the doors, motors, and complex mechanisms.

3.2.8 Sensitive Edges

The rear exit door shall be equipped with air-wave-type, electric sensitive edge or sensitive edge sensor system in the meeting edge of the rubber weather stripping of the doors. Closing door edge speed shall not exceed 19 inches per second. The doors shall release when the doors close on an object as small as a 1/2-inch diameter smooth cylinder held perpendicular to the plane of the door opening at any point where the door halves meet, or if a single piece door, where the door edge meets the door frame. For Buses equipped with a 4-inch or larger gap between the power-closed doors, the doors shall react when closing on a 1-inch diameter smooth cylinder. These specifications shall not apply to the top two inches or the bottom two inches of the sensitive edge.

The sensitive edge system shall alert the Coach operator by a visual and audible alarm if the doors completely close on any part of a person's body or any object. The system shall react to this obstruction within no more than a second.

3.2.9 Front Door Timing (Entrance Door)

Doors shall open or close completely within 2 - 4 seconds from the time of actuation.

3.2.10 Rear Door Timing (Exit Door)

Doors shall open or close completely within 2 - 4 seconds from the time of actuation.

3.3 LIGHTING

3.3.1 Exterior Lighting & Back-up Alarm

All exterior lights shall be sealed to prevent entry and accumulation of moisture or dust, and each lamp shall be replaceable in less than five minutes. LED (Light Emitting Diode)-type with anti-scratch coating lamps shall be used wherever possible. Lights mounted on any compartment doors or adjacent panels shall be protected from the impact shock of door opening and closing. Lamps, lenses and fixtures shall be interchangeable to the extent practicable.

Turn signal lights shall be provided on both sides of the Coach. All side turn signal lights shall be mounted above or forward of each wheel well, except for the front curbside turn signal which may be aft of the wheel well. In addition to the amber lights, a right turn cornering lamp shall be installed between the wheel well and the exit door(s). The right turn cornering lamp shall be activated by the right turn signal switch during night runs only.

LED's shall have a minimum expected life of 50,000 hours of operation at 25^{o} C.

LED Lights

LED lights shall be Truck Lite, Dialight, Hella, Luminator, Simcona, E-Corp, or approved equal. Wheelchair ramp and kneeling indicator lights shall be illuminated with LED light. The Contractor may utilize a single LED warning light to be used for wheelchair ramp deployment and the kneeling indicator. Stop, turn, tail lights, and marker lights shall be flush mounted or low profile without guards.

3.3.1.1 Courtesy Lights

An ADA compliant door header light, 1.0" x 18.5" LED strip light [shall be provided at both entrance and exit doors. The LED lights will illuminate the door opening to the ground. The LED light shall provide 1.37 ft-candles for a distance of 36 inches from the front step edge.

3.3.1.2 Back-up Alarm

Visible and audible warning shall inform following Vehicles or pedestrians of reverse operation. Visible reverse operation warning shall conform to SAE Standard J593. Audible reverse operation warning shall conform to SAE Recommended Practice J994-Type C or D.

3.3.2 Interior Lighting

The LED passenger interior lighting system shall be DINEX, Hadley, TCB, Pretoria, or approved equal. The interior lighting system shall provide a minimum 14.5 foot-candle illumination on a 1 square foot plane at an angle of 45 degrees from horizontal, centered 33 inches above the floor and 24 inches in front of the seat back at each seat position. Allowable average light level for the rear bench seats shall be 7 foot-candles. Floor surface in the aisles shall be a minimum of ten foot-candles, vestibule area a minimum of 4 foot-candles with the front doors open. The front entrance area shall provide enough illumination to meet ADA requirements. The rear exit area shall illuminate when rear door is unlocked.

The light source shall be located to minimize windshield glare with distribution of the light focused primarily on the passengers' reading plane while casting sufficient light onto the advertising display. The brightness of the interior light system shall be adjustable to minimize glare.

Lens material shall be non-flammable polycarbonate in compliance with Doc 90A. Lens shall be designed to effectively "mask" all individual LED's to make them invisible and there shall be no visible "hot spot" or "dark spot". Lens shall be sealed to inhibit incursion of dust and insects yet are easily removable for service. If threaded fasteners are used they must be held captive in the lens. Access panels shall be provided to allow servicing of components located behind light panels.

When the master switch is in the RUN mode, the first light module on each side of the Coach shall turn off when the front door is in the closed position and illuminate to maximum light level when the door is opened. The light system may be designed to form part of the entire air distribution duct.

3.3.3 Service Area Lighting

Lights shall be provided in the motor compartments to generally illuminate the area for night emergency repairs or adjustments. The lights shall be LED and be controlled by a conveniently located toggle switch near the rear start controls in the compartment. Lights located in other service compartments shall be provided with toggle switches on the light fixture or conveniently near the light fixture. Adequacy of lighting must be approved by the SFMTA during prototype review.

3.4 INTERIOR CLIMATE CONTROL

The interior climate control system shall provide heating, ventilation and air conditioning (HVAC). The HVAC system shall be provided by Thermo King, MCC, Ebershpacher Electric HVAC, or approved equal. The Contractor shall provide to the SFMTA all the essential information needed to test and troubleshoot the interior climate control electronic controllers. The task of the final commissioning shall be included in the Contract price. The HVAC system

may use R134a or R407c as refrigerant; the Proposer shall clearly indicate which refrigerant is being used on the Coaches.

3.4.1 Controls

The control of the Interior Climate Control shall be hard-wired switches or display panel with AUTO, A/C, HEAT, and VENT modes located in a place that is convenient to the operator. Reference Section 4.1.12 (Climate Control).

3.4.2 Air Flow

The ventilation mode of the interior climate control system shall introduce outside air into the Coach at or near the ceiling height at a minimum rate required to maintain 68-72 degrees F. Airflow shall be evenly distributed throughout the Coach.

3.4.3 Air Intakes

Outside openings for air intake shall be at least seven feet above ground level, in a location to ensure cleanliness of air entering the climate control system, from the Coach, adjacent traffic, and airborne dust generated by the rear wheels. All intake openings shall be baffled to prevent entry of water.

Except for roof-mounted ventilators, outside air shall be filtered before discharge into the passenger compartment. The filter shall meet the ASHRAE requirement for five percent or better atmospheric dust spot efficiency, 50 percent weight arrestance, and a minimum dust holding capacity of 120 gram per 1000-cfm cell. More efficient air filtration may be provided to maintain efficient heater operation. Air filters shall be easily cleaned or removed for service. Moisture drains from air intake openings shall be located to prevent clogging from road dirt.

3.5 ROOF VENTILATORS

At least one roof ventilator shall be provided in the roof of the Coach approximately over each axle or equally spaced at a location approved by the SFMTA. Each ventilator shall be easily opened and closed manually by one person and shall also function as an emergency exit. When open, with the Coach in motion, these ventilators shall provide fresh air inside the Coach. Each ventilator shall cover an opening area no less than 425 square inches. Each ventilator shall be capable of being positioned as a scoop with either the leading or trailing edge open no less than 4 inches, or with all four edges raised simultaneously to a height no less than 3-1/2 inches.

3.6 WHEELCHAIR LOADING SYSTEM

An automatically-controlled, electrically-power operated loading system shall accommodate passengers on wheelchairs or using crutches, canes, walkers or persons with difficulty using steps ingress and egress from or to the street level or curb quickly, safely, and comfortably. The

wheelchair loading system shall conform to all applicable ADA requirements. The task of the final commissioning shall be included in the Contract price.

3.6.1 Wheelchair Ramp

The wheelchair ramp shall be a Lift-U LU-18 or approved equal with a flip-out type design and shall be self-contained, electrically-powered, fully compliant with ADA and FTA requirements, and shall be provided at the front door of the Coach. The driver shall be able to deploy the ramp from a seated position. In case of a power failure, driver shall be able to deploy the ramp manually. When the system is not in use, the passageway shall appear normal. In the stored position of the ramp, no tripping hazards shall be present and any resulting gaps shall be minimized. The ramp shall be capable of reaching a 1:6 maximum slope when deployed to the ground. All components of the ramp shall be accessible and serviceable through an interior access panel in the ramp. All drive chains shall be a minimum size #40 and constructed of corrosion resistant material. Ramp shall use only inductive proximity switches when required, the use of mechanical limit switches shall not be allowed. The loading platform shall be covered with replaceable or renewable, nonskid material and shall be fitted with devices to prevent the wheelchair from rolling off the sides during loading or unloading. During deployment or stowage, the ramp floor plate shall remain stationary at all times and shall not have any moving parts. Deployment or stowage of the ramp shall require no more than 15 seconds. The device shall function without failure or adjustment for 500 cycles or 5,000 miles in all weather conditions on the design operating profile when activated once during the idle phase. A manual override system shall permit unloading a wheelchair and storing the device in the event of a primary power failure, requiring no more than 20 lbs. to manually stow or deploy. The ramp assembly shall be replaceable within 30 minutes by a 4M mechanic without the need of any special tools or fixtures.

3.6.2 Wheelchair Ramp Controls

The controls shall be simple to operate and conveniently located so the driver can operate and monitor the loading operation without leaving the driver’s station. Control switches shall be of the momentary type, so that release of the control switch will stop the ramp immediately. All controls, and switch locations must be approved by the SFMTA.

The Coach shall be prevented from moving during the loading or unloading cycle by an accelerator and brake interlock system. The loading system shall be inhibited from retracting or folding when a passenger is on the ramp/platform and shall be equipped with an electronic current limiting feature to minimize damage if the ramp hits an obstruction during the stow/deploy functions. Whenever the ramp system is activated, an audible alarm shall sound and a visual signal shall illuminate with LED. One International Symbol of Accessibility, in blue and white, shall be provided near the ramp signal at the front door opening of the Coach, curbside visible to patrons in front of the oncoming Coach. All wheelchair ramp maintenance controllers shall be supplied by the Contractor.

3.7 PASSENGER SEATS

A minimum of 32 passenger seats shall be provided in each Coach. The seatbacks shall be contoured to increase passenger knee room and Coach capacity. The aisle between the transverse seats shall be no less than 23.6 inches wide at seated passenger hip height. Contractor shall be required to present to the SFMTA for consideration seating layouts, which maximize the space in the passenger area while meeting clearances required for accessible ingress and egress. Seating layout shall be optimized to meet GVWR Capacity and must be approved by SFMTA.

All priority seating area seats, accommodating for wheelchair securement, passengers using crutches, canes, walkers or with difficulties in walking, shall be installed with blue color seat inserts with the Priority Seating stencil, referred in SFMTA Vehicle Decal Package V 1-4.

The SFMTA will require Contractor to provide seating layouts for review and approval that utilize the available space efficiently while meeting ADA requirements for clearances and wheelchair maneuverability.

3.7.1 Dimensions

Seats shall have hip-to-knee room measured from the front of one seatback horizontally across the highest part of the seat surface to the seat or panel immediately in front. Wherever possible, the hip-to-knee room shall be no less than 27 inches at all seating positions, with the exception of the two double transverse seats in front of the rear bench which may have a hip to knee dimension of 26 inches. Floor room, measured at the floor forward from a point vertically below the front of the seat surface, shall be no less than 14 inches. Seats immediately behind the wheel housings may have foot room reduced, provided the wheelhouse is shaped so that it may be used as a footrest. Foot room measuring down to 10 inches at the first seat on the curbside aft of the exit door is acceptable. Transverse seats accommodating two passengers shall have a minimum width of 35 inches, and seats accommodating one passenger shall have a minimum width of 18 inches.

3.7.2 Design

Passenger seats shall be baseline seats, USSC 4One Gemini seats, or approved equal, integrally molded with drain holes. The seat frame structure shall be a cantilever design that is mounted to the Coach wall structure at three points and of the strength necessary to meet the energy-absorbing requirements. The rearmost bench seat may be a molded design without individual frames. The passenger seat frame and its supporting structure shall be constructed and mounted so that space under the seat is maximized to increase wheelchair maneuvering room and is completely free of obstructions to facilitate cleaning. The lowest part of the seat assembly that is within 12 inches of the aisle shall be at least 10 inches above the floor. The underside of the seat and the sidewall shall be configured to prevent debris accumulation, and the transition from the seat underside to the Coach sidewall to the floor cove radius shall be smooth. The seatback shall be contoured to maximize knee room. All transverse objects in

front of forward facing seats, including seatbacks, modesty panels, and longitudinal seats, shall not introduce a laceration hazard as a result of structural failure. ADA seats shall be secure and not rattle while the Bus is in motion.

3.7.2.1 Transverse Seat

The back of each transverse seat shall incorporate a stainless steel handhold. The handhold shall extend above the seatback near the aisle so that standees shall have a convenient vertical assist, no less than four inches long that may be grasped with the full hand. This handhold shall not cause a standee using this assist to interfere with a seated 40th-percentile male passenger. The handhold shall also be usable by a 5th-percentile female, as well as by larger passengers, to assist with seat access and egress for either transverse seating position. The seatback handhold may be deleted from seats that do not have another seat directly behind them and where vertical assist is provided in accordance with Section 3.9 (Passenger Assists). Armrests shall not be included in the design of transverse seats. Transverse seats shall not rattle while the Bus is in motion.

3.7.2.2 Longitudinal Seat

Longitudinal seats shall be the same general design as transverse seats but without seatback handholds. Longitudinal seats may be mounted on the wheelhouses. Armrests shall be included on the ends of each set of longitudinal seats except on the forward end of a seat set that is immediately to the rear of a transverse seat, the operator's barrier, or a modesty panel where these fixtures perform the function of restraining passengers from sliding forward off the seat. Armrests are not required on longitudinal seats that fold up in the wheelchair parking area when the armrest on the adjacent fixed longitudinal seat is within 1-1/2 to 3-1/2 inches of the end of the seat surface. Armrests shall be located from seven to nine inches above the seat surface. The area between the armrest and the seat surface shall be open. The top and sides of the armrests shall have a minimum width of two inches and shall be free from sharp protrusions. Longitudinal seats shall not rattle while the Bus is in motion.

3.7.2.3 Handholds and Armrest Strength

Seat back handholds and armrests shall withstand static horizontal and vertical forces of 250 pounds applied anywhere along their length with less than 1/4-inch permanent deformation. Seatback handholds and armrests shall withstand 25,000 impacts in each direction of a horizontal force of 125 pounds with less than 1/4-inch permanent deformation and without visible deterioration.

3.7.3 Structure

The seat assembly shall withstand static vertical forces of 500 pounds applied to the seat surface in each seating position with less than 1/4-inch permanent deformation in the seat or its mountings. The seat assembly shall withstand static horizontal forces of 500 pounds evenly distributed along the top of the seatback with less than 1/4-inch permanent deformation in the

seat or its mountings. (Seatbacks shall withstand repeated impact of two 40-pound sandbags without visible deterioration. One sandbag shall strike the front 40,000 times and the other sandbag shall strike the rear 40,000 times. Each sandbag shall be suspended on a 36-inch pendulum and shall strike the seatback 10,000 times from distances of 6, 8, 10, and 12 inches respectively. Seat surfaces shall withstand 100,000 randomly positioned 3-1/2 inches drops of a squirming, 150 pounds, smooth-surfaced, buttocks-shaped striker with only minimal wear on the seat surface.)

3.7.4 Construction and Materials

The seat shall be stainless steel or plastic with replaceable inserts for maximum vandal resistance and minimal maintenance. Seat must be modular allowing each component to be easily replaced if necessary. Seat surface and back "inserts" shall be granite blue, with color number E-512 for non-priority seats and stroller seat(s) and blue color number E-989 for priority seats consistent with existing SFMTA equipment, or an alternative color as approved by the SFMTA. Priority seats and stroller seat(s) required white stencil on the seat inserts according to SFMTA Vehicle Decal Standard. Complete seat assemblies shall be interchangeable to the extent practicable. All materials and workmanship shall conform to SPI standards and specifications in testing for plastic materials.

3.7.5 Wheelchair Accommodation

Two forward wheelchair securement positions, at 60 inches in length as close to the front door as practical, shall be provided for each Coach in a staggered configuration. Each wheelchair accommodation shall provide parking space and secure tie down for one passenger in a wheelchair. No portion of the wheelchair or its occupant shall protrude into the normal aisle when parked in the designated wheelchair parking space. Contractor shall submit wheelchair accommodation options for SFMTA review and approval as part of the general seating arrangement.

The design and construction of the Bus shall be in accordance with all requirements defined in 49 CFR Part 38, Subpart B: ADA Accessibility Specifications for Transportation Vehicles - Buses, Vans and Systems, the latest approved ADAG Board guidelines and California Title 13 standards. Space and body structural provisions shall be provided at the front door of the Bus to accommodate a wheelchair ramp that meets these requirements.

3.7.5.1 Maneuvering room

Maneuvering room inside the Coach shall accommodate easy travel for a passenger in a wheelchair from the loading device through the Coach to the designated parking area and back out. SFMTA prefers the maneuvering room of each Coach to closely resemble the drawing shown in Attachment 5 (Wheelchair Maneuvering Room). No width dimensions shall be less than 34 inches; area requiring 90 degree turns of wheelchair shall have a clearance arc dimensions of no less than 35 inches; and in the parking area, where 180-degree turns are

expected, space shall be clear in a full 60-inch diameter circle. Wheelchair footrest clearance of 12 inches above the floor surface shall be provided on the outside turning radius.

3.7.5.2 Wheelchair Securing Devices

A wheelchair-securing device, QPod three-point securement or approved equal, shall be provided at each wheelchair position. A hand or foot operated release lever shall be conveniently located to release the latching mechanism. The wheelchair latching mechanism shall not interfere with battery-operated wheelchairs. A bumper shall be provided at each wheelchair location. The wheelchair securing devices configuration and installation must be approved by the SFMTA. Vendor shall provide two staggered wheelchair securing devices.

3.7.5.3 Seat Belts

Three-point securement system shall be provided in the wheelchair parking area. Seatbelts shall be easily accessible for wheelchair users A belt-type securement system and shoulder strap seat belt shall be included. The latching mechanism and retracted belts shall be readily visible when seats are folded down. Wheelchair area accommodations shall comply with the latest ADA laws and federal safety requirements and have a retractable shoulder belt.

3.8 PASSENGER EXIT SIGNAL

A passenger chime and stop requested signal system that complies with applicable ADA requirements defined in 49 CFR Section 38.37 or latest shall be provided. It shall be integrated with the Digital Voice Announcement System in Section 3.11. “Stop Requested” signs shall be illuminated with LEDs. One stop request sign shall be located adjacent to the operator or at a position the operator can clearly see. The location must be approved by the SFMTA.

The sign shall remain illuminated until any of the passenger doors is opened, at which point the chime and illumination systems shall reset. Whenever the sign is illuminated, the chime signal shall be muted, and it shall not disable the “STOP” pushbutton for a wheelchair passenger to request to disembark.

3.8.1 Exit Signal

This system shall consist of a vandal resistant pull cable, chime, and interior sign message. The pull cable shall be located the full length of the Coach on the sidewall and no higher than the division bar between the upper and lower window sections. Vertical pull cable shall be provided at each window mullion and at each wheelchair user area. Eyelets shall be provided as necessary to prevent the cords from rubbing against the Coach interior. In addition, "STOP" pushbuttons shall be provided on vertical stanchions. Contractor shall submit STOP pushbuttons location for SFMTA review and approval.

A digital “{CHIME} Stop Requested” and an analog CHIME shall announce when the system is activated from any pull cord or any “Stop” button on the vertical stanchion. Simultaneously, a

"STOP REQUESTED" sign shall illuminate. Reference Section 3.11.3 (Sign Requirement). The digital Chime shall announce no later than 0.5 second after the cord is pulled. In the event the digital system fails, the analog chime system will remain functional.

3.8.2 Mobility Aid Passenger Exit Signal

This system shall consist of a vandal resistant push button, chime, and interior sign message. The “Stop” push button shall be mounted underneath the folding seat or in a position easily accessible to the patron in each of the wheelchair parking areas, and shall be no higher than 48 inches and no lower than 15 inches from the floor. The chime shall be distinct and distinguishable from the mobile passenger exit signal defined in Section 3.8.1 (Exit Signal).

When this system is activated, a light on the dashboard shall be illuminated to alert the driver that a mobility aid passenger wishes to disembark. This shall also illuminate the “STOP REQUESTED” sign with a message that displays “RAMP REQUESTED”. Configuring the system so that Coach stop, Coach ID #, and time are announced upon activation is strongly encouraged.

Location of the “Stop” push button and the material shall be submitted to the SFMTA for review and approval.

3.9 PASSENGER ASSISTS

Passenger assists in the form of full-grip vertical stanchions or handholds shall be provided for the safety of standees and for Coach ingress and egress. Passenger assists shall be convenient in location, shape, and size for both the 95th-percentile male and 5th-percentile female standees. Starting from the entrance doorway and moving anywhere in the Coach, full-length vertical assists shall be provided so that a 5th-percentile female passenger may easily move from one assist to another without losing support. Vertical assists shall be mounted on the aisle side of the seatback of every transverse seat. These assists shall be functionally continuous with the overhead assist. Stanchions and other assists shall be bolted or pinned at each end.

Excluding the seatback and doorway assists, the assists shall be between 1-1/4 and 1-1/2 inches in diameter or width with a radius no less than 1/4 inch. All passenger assists, including those along edges of modesty panels, shall permit a full handgrip with no less than 1-1/2 inches of knuckle clearance around the assist. In addition, flexible grey PVC straps in yellow metal mounting bracket shall be secured to the overhead assists, allowing passengers a grab handle when not gaining the opportunity for a seat (see Section 3.9.3: Overhead). Each hand strap location shall be stationary by using clamp shell compression parts and SFMTA prefers not to drill through the assists.

A crash resulting in a 1-foot intrusion shall not produce sharp edges, loose rails, or other potentially dangerous conditions associated with a lack of structural integrity of the assist. Any joints in the assist structure shall be underneath supporting brackets and securely clamped to

prevent passengers from moving or twisting the assist. All areas of the passenger assists that are handled by passengers, including functional components used as passenger assists, shall be of stainless steel with yellow powder coated. Assists shall withstand a force of 300 pounds applied over a 12-inch linear dimension in any direction normal to the assist without permanent visible deformation. Brackets, clamps, screw heads, and other fasteners used on the passenger assists shall be free of rough edges.

3.9.1 Doorways

Assists shall be mounted in the doorway and on the doors to aid passengers in boarding and alighting. A 5th-percentile female shall be provided functionally continuous assists from the curb to the assists within the Coach. For design purposes, use a six inche curb height. These assists shall begin with a vertical element not less than 12 inches long and no more than 4 inches from the outside edge of the exit area tread and continue inward no less than the first inboard stanchion. Assists in the doorways shall be no less than 3/4 inch in width and shall provide at least 1-1/2 inches of knuckle clearance between the assists and their mountings. A full-size vertical assist that is functionally continuous with the overhead assist shall be provided on the aisle side of the modesty panels at the entrance and exit areas. A full-size assist no less than 36 inches above the floor tread surface shall be provided in the middle of the rear door area extending from the aisle to the outside edge of the exit area.

The SFMTA will review door opening passenger assists and provide a final approval during the prototype Coach development in an effort to maximize this aid to seniors, persons with disabilities, and wheelchair users boarding the Coach.

3.9.2 Vestibule

A horizontal passenger assist shall be located across the front of the Coach to prevent passengers from sustaining injuries on the fare collection device or windshield in the event of a sudden deceleration. Without restricting the vestibule space, the assist shall provide continuous support for a boarding passenger from the front door through the fare collection procedure. Passengers shall be able to lean against the assist for security while paying fares. The assist shall be no less than 36 inches above the floor. The assists at the front of the Coach shall be arranged to permit a 5th-percentile female passenger to reach easily from the door assist to the front assist and then to vertical assists on the operator's barrier or front modesty panel.

3.9.3 Overhead

Except forward of the standee line and at the rear door, a continuous full-closed-grip, overhead assist shall be provided along both sides of the Coach. This assist shall be located at a height convenient to standees, directly over the aisle-side edge of the seats. The assists shall be located no less than 67 inches above the floor and equally spaced no less than 33 inches apart. Overhead assists shall be Bentech Grabstraps P/N SH-21-TP. Contractor shall provide 22 to 24 overhead assists. No more than five percent of the full-grip feature shall be lost due to assist supports.

3.9.4 Longitudinal Seats

Longitudinal seats shall have vertical assists located between each pair of seating positions, except for seats that fold up to accommodate wheelchair securement. Assists shall extend from near the leading edge of the seat and shall be functionally continuous with the overhead assist. Assists shall be staggered across the aisle from each other where practicable and shall be no more than 52 inches apart longitudinally. Vertical assists shall be attached either by plastic receiver cups or stainless steel receiver cups with isolators welded to the seat grabrail on one end, and "T" bracket attachments to the overhead horizontal assist at the other end.

3.9.5 Divider Panel

A horizontal passenger assist shall be mounted on the top of every divider panel forward of a transverse seat.

3.10 DESTINATION SIGNS

Contractor shall provide and install on each Bus an automatic electronic sign system by Luminator or approved equal. The system shall conform to all applicable ADA requirements and shall function seamlessly with the DVAS specified in Section 3.11. All locations and mounting of equipment must be approved by the SFMTA.

The proposed electronic signs and equipment to be installed and integrated by the Contractor are:

Item	Part Location	Part Description	Part Number	Qty.
1	Front	24x200 Spectrum	511305-001	1
2	Curbside	8x96 Amber	511288-A0x	1
3	Streetside	8x96 Amber	511288-A0x	1
4	Rear w/camera	16x48 Amber	511291-A01	1
5	Dash	12x40 amber	511240-A01	1
6	Operator Area	MCU Controller	510632-C44	1

The Master Run Switch shall control power to the sign system. The signs shall operate in all positions of this switch except in “OFF” position. The signs shall be internally protected against voltage transients and RFI interference to ensure proper operation in the SFMTA operating environment.

The system shall be capable of communicating with additional information devices, such as interior information signs, Voice Annunciation devices, and fareboxes. The system shall provide for destination and/or Public Relations (P/R) message entry.

The system shall have the ability to sequentially display multi-line destination messages, with the route number portion remaining in a constant “on” mode at all times. It shall also be capable of accepting manual entry of Route Alpha/Numeric on any/all signs.

The system shall be capable of storing and displaying up to 10,000 message lines. Message memory shall be changeable and sized according to the message listing noted herein. Download via a PCMCIA card or Memory Transfer Unit will not be accepted.

The route profile shall be capable of being uploaded wirelessly.

All sign programming tools shall be supplied by the Contractor. The task of the final commissioning onsite at the SFMTA shall be included in the Contract price.

3.10.1 Display

The displays shall consist of pixels utilizing High Intensity Light Emitting Diode (LED). The LEDs shall be the only means of illumination of the displays. Each pixel shall have a dedicated LED for illumination of that pixel in any lighting conditions. The displays shall adjust intensity level automatically as a function of the ambient light conditions. No fan or special cooling shall be required for the displays. The LEDs will have a life expectancy of 100,000 hours and each LED shall consume no more than 0.02 watts. The LED’s power circuit shall be protected against normal Bus power surges. The LEDs shall be mounted such as to be visible directly to the observer positioned in the viewing cone, allowing for full readability 65 degrees either side of the destination sign centerline. Destination readings shall be furnished by the SFMTA. The characters formed by the displays shall meet the requirements of the ADA. Reference 49 CFR Section 38.39.

The sign enclosure shall inhibit dirt, dust, moisture, water, and insects during normal operation or cleaning with a cyclone cleaner. Access shall be provided to clean the inside of destination sign windows and to remove or replace the sign mechanism. The Vehicle manufacturer shall comply with the destination sign manufacturers recommended mounting configuration and installation procedures to assure optimum visibility of the sign display.

3.10.2 Front Destination Sign

The front destination sign shall be in full color. The front destination sign shall have no less than 24 rows by 200 columns of LEDs. All service performed on this sign must be done through the sign access door.

3.10.3 Curb Side Designation

The curbside destination sign shall be amber display and have no less than 14 x 96 columns of LEDs. The display must be easily read from the sidewalk level.

3.10.4 Street Side Destination Sign

The street side destination sign shall be amber display and have no less than 14 x 96 columns of LEDs.

3.10.5 Rear Destination Sign

The rear destination sign shall be amber color display and have no less than 14 x 48 columns of LEDs. The rear destination sign shall include an integrated backup camera, which will display a view on a color LCD display located in the driver's dash display with a latency of 100 milliseconds or less. The rear designation sign will also integrate with the Kratos DVR for the purposes of recording video.

3.10.6 Run Number Sign-Dash Mounted

The integrated run number sign shall be amber display and have no less than 12 rows by 40 columns of LEDs. The display area shall be able to display a minimum of 4 characters and each of the 4 characters shall be capable of displaying all 26 upper case letters as well as numbers 0 - 9. Run numbers to be displayed shall be input directly into the destination sign system's MCU (see Section 3.10.7 below) and the MDT of the SFMTA radio system, and shall be independent of any destination sign message code. The sign shall be mounted as low as possible on the dash on the right hand side of the Bus.

3.10.7 Multi-System Control Unit (MCU)

The MCU shall be used to view and update display messages. It shall be recessed mounted in an area that is easily accessed by the Vehicle operator. The location must be approved by the SFMTA.

The MCU shall also control the operation of the DVAS referenced in Section 3.11. The MCU shall utilize a water resistant multi-key conductive rubber pad keyboard and be designed for transit operating conditions and a maximum depth of 1.25". The MCU keypad shall have a minimum of 28 keys within a sealed, elastomeric membrane.

The system control console shall contain a 4.3" color LCD touchscreen display. Programmable multifunction keys shall be used for basic operation while the touchscreen can be used for more advanced operations. The system control console shall provide audible feedback to alert the operator to view the display for a message, or beeps indicating that a key is depressed. The system control console shall continuously display the complete message associated with the selected destination code.

The MCU shall be capable of accepting single point logon information by interfacing to other on board systems via RS232, J-1708 or J-1939 for automated destination code and public relations code selection.

The sign system shall be reprogrammable through the system control console by a standard USB Thumb Drive. The system shall also be capable of wireless message listing updates using 'store and forward' through an on board computer. An Ethernet connection shall be used to minimize the file transfer time from the on-board computer to the sign system.

3.10.8 Emergency Message Display

An emergency button, in a location approved by the SFMTA, shall activate an emergency message. The emergency message shall be displayed only on the front and rear signs facing outside the Vehicle, while signs inside the Vehicle, including the MCU display, remain unchanged. The emergency message shall be canceled by entering a new destination code, or by removing the emergency signal.

3.10.9 Message Memory Transfer and Wireless Upload/Download

The sign system shall be reprogrammable wirelessly and on the Bus with the use of a USB Key. A key slot shall be provided on the MCU face for this purpose. The maximum reprogramming time for a 10,000 line listing shall be no more than 30 seconds.

The wireless Upload/Download Automated system shall transfer the new data from a local computer to the on-board memory or vice versa. After transfer is initiated, the system shall trigger an automated data update followed by "Signs Update Completed" type message on the Signs and the OCU Display. The system shall provide a software application to manage the fleet data deployment update and also the update completion status.

3.10.10 Passenger Information System

The OEM shall work with the SFMTA and Conduent to provide a real-time information system with hardware and software integrated with the CAD/AVL and radio system as specified in Section 3.15. The Contractor shall submit the complete system specifications and plans for SFMTA approval. All components of the passenger information system aside from the front and rear displays shall be provided by Cubic. The front and rear displays shall be from INFOtransit and shall feature screen panels measuring at least 18" diagonally. The Cubic system shall integrate with the INFOtransit displays. Any associated costs to integrate the Cubic system with INFOtransit displays shall not be included as part of this Contract; the SFMTA shall cover the costs of integration as part of a separate agreement with Cubic.

Based on the Bus location provided by the Conduent CAD/AVL system, the passenger information system shall generate information such as (a) the next stop, (b) predicted arrivals for connecting routes at the next stop, (c) detours, switchbacks and other real-time service changes, (d) predicted arrival times at upcoming stops, (e) a map showing the current Bus location, (f) a programmable display of live interior camera feeds, (g) stop request and wheelchair request notifications, and (h) ads or other system notifications based on vehicle GPS location as requested by the SFMTA.

The passenger information system shall include at least 2 display screens visible to customers throughout the vehicle. The location of the screens shall be submitted to the SFMTA for approval. The screens shall meet the following minimum characteristics:

- Are ADA-compliant
- Can display both text and graphics
- Are compliant with the Real Time Streaming protocol.
- Can receive and transmit data to the SFMTA's back-end system in real-time
- Can annunciate text sent to the Passenger Information System. The voice announcement on the screen shall not override the DVAS announcements. The DVAS announcements shall not be interrupted by the voice annunciations from display screens.
- Are vandalism-resistant

At the direction of the SFMTA, the Contractor's real-time information system shall either:

- Display text and graphical content produced by the Next Generation Customer Information System in its entirety, or
- Receive a text feed from the Next Generation Customer Information System and format this information graphically for display onto screens

To this end the Contractor must provide an open architecture platform that allows for integration, acceptance of date from other systems, primarily a content management system and be able to receive and appropriately display real time data. Preferred format is GTFS-RealTime API format.

The proposed equipment to be installed and integrated by the Contractor are:

NB Part #	Description	Quantity
10018384	Antaira POE Ethernet Switch	1
10018243	MuxLab HDMI POE Extender TX	1
10018355	MuxLab HDMI POE Extender RX	1
5NKM4-200-9303	DCU-4 NB Basic	1
5NKM4-100-980051	RAM Mounting plate	1
5NKM4-100-961283	Charge Guard	1
10018851	4K HDMI Splitter Pigtail Type	1
10018680	HDMI 3 ft cable	1
10018683	HDMI 6 ft cable	2
10006483	Ethernet 1000 mm STP CAT6 Cable	2
TBD	Ethernet X ft Cable	1
TBD	Ethernet Y ft Cable	1
10025224	Fuse Holder with 15 A Fuse	1
5NKM4-100-980051	Plate, RAM 2.5" Round base mount	1

10011318	Microcircuit, Converter, DC-DC, Stepdown Buck	1
10025639	CABLE ASSY, USB TYPE-A TO 3.5MM, 3.0-FT	1
10025772	Cable High-Speed HDMI, 20ft	1

3.11 DIGITAL VOICE ANNOUNCEMENT SYSTEM

The Bus manufacturer shall provide all equipment and full installation for the Digital Voice Announcement System (DVAS) by Conduent and approved by the SFMTA. The Contractor shall work with Conduent to obtain a full bill of materials or the proposed DVAS and shall submit this bill of materials to the SFMTA for approval. The DVAS shall be incorporated into the current SFMTA radio system specified in Section 3.15.

The system shall meet or exceed all ADA requirements found in 49 CFR Sections 37.167 and 38.35 and shall provide different, simultaneous audio announcements to riders onboard and waiting curbside. The system shall also provide a control capability for integrating present and future electronics on the Bus. In order to maximize the system's useful life and to ensure ease of integration with third party electronics on transit Vehicles, the system shall provide a robust, open software and hardware architecture. The system shall have the capability of hardware and software extension to include new or additional features. The system shall also incorporate ease of programming and updates of all operating information.

The DVAS system shall coordinate with the Passenger Information System to ensure that the announcements from the Passenger Information System do not play while the DVAS system is announcing.

The DVAS shall include IVU 4000 capable of providing a single log-on for other in-Vehicle electronics systems (e.g., destination / head signs systems, fare collection systems, automatic passenger counters, etc.). The communications protocol to accomplish system integration shall be SAE J1708 and J1939 communication protocols. The vendor shall also broadcast driver identification information, APC data, and route information on the J1939 network to be used by the ViriCiti data monitoring system. The system shall include an easy-to-use means of specifying whether log-on and/or passwords are required, and what Vehicle operator ID's and passwords are acceptable for each subsystem. The DVAS shall be capable of playing audio diagnostics for all integrated electronics and provide audio messages describing any failures.

The DVAS shall allow the operator to select the route via the MCU or the MDT for the radio system and shall display the route and the next stop to be announced on the operator control unit. The operator shall have the ability to scroll forward or backward within the selected route's list of announcements. Internal announcements are intended for on-board riders and shall play either by manual activation by the operator or in response to signals received by an on-board Automatic Message Trigger (AMT). The AMT function shall incorporate a GPS receiver and dead-reckoning. External announcements shall play automatically when the door is opened for a stop.

The DVAS shall have dual channel audio capable of playing simultaneous internal and external announcements. Vendor shall provide all database programming and route mapping services necessary for the system to be fully functional.

The system shall include a noise-sensing device, an Automatic Gain Control (AGC) Microphone, for each audio channel and shall automatically and independently adjust each channel's audio volume as appropriate in response to ambient noise detected.

3.11.1 Programming

Each Bus shall be delivered with a fully programmed, fully functioning voice annunciation system. The programming for the voice annunciation system shall include no less than sixty Bus lines and four thousand unique Bus stops. The trigger points for all voice announcements shall be user programmable. The supplier shall provide the SFMTA with all of the necessary hardware and software to maintain this DVAS and to collect data (including GPS coordinates & distances between stops), record announcements, program signs, and program routes for this DVAs.

This shall include, at a minimum, the following:

- Two current Tough Book Laptop PCs using Windows 7 or newer for the Programmer's field use. Each in portable cases installed with ISCU and GPS systems hardware and software needed to perform/test field route mapping. Destination Sign programming software installed as well.
- Audio development system software package.
- Sign messages programming software package.
- Full Training documentation for the programming and development of Route Mapping, Sign Messages, and Audio Messages.
- On-Site training and support to fully train two SFMTA personnel on programming and use of the above equipment and software.
- Five years no cost software and firmware upgrades on all software and equipment.

All hardware and software shall be uniquely identified as SFMTA property with serial numbers.

3.11.2 Audio Announcement Subsystem

Audio announcements shall be initiated automatically at points along SFMTA motor Coach routes. Each announcement shall be designated interior and/or exterior. The volume for each announcement shall be automatically set based upon analysis of the ambient noise level (this automatic volume adjustment needs to react in a range of 0.100 of a second to 10 second.) All volume settings shall be digitally set to ensure consistent volume throughout the fleet. At least 8 Exterior and 8 Interior Preset default settings, each with different volume and ambient AGC choices to be provided, as well as enough memory for saving at least 10 of our own volume settings.

An Integrated Public Address (IPA) Subsystem shall use the Vehicle's interior and exterior public address speakers. This system shall also provide the driver the capability to make his own interior and exterior announcements. The IPA shall include a driver's volume control (This should be a temporary volume setting {10db in range} that will go back to the default setting when the Vehicle is shut off.) and speaker select, which shall only affect PA operation when the PTT (Push-to-Talk) button is depressed. The IPA Subsystem shall use the existing Bus interior speakers. The exterior speaker and bracket shall be supplied. The design, location and position of speakers shall be consistent from Coach to Coach and approved by the SFMTA.

3.11.3 Sign Requirements

The internal display sign shall display coordinating text for next stop and other audio announcements. The sign shall meet all ADA requirements for internal signage. The sign shall be a Light Emitting Diode (LED) type sign with 16 characters per line with bright amber LEDs. Sign shall be no larger than 27" x 2 1/8" x 4 1/8" (single line) or 6 1/8" (double line). Messages can be shown streaming or by any of 3 single frame modes with automatic centering. Speed, delays, and looping shall be programmable. Busy/ready status shall be poll-able. Forced reset capability shall exist.

The internal LED display sign shall be used to display the words "Stop Requested" and shall be visible to passengers. When the passenger chime is activated and shall remain on until the front or rear door is opened. The internal LED display sign shall also be used to display "Ramp Requested" when the wheelchair passenger stop request is activated.

Enclosure shall be aluminum with welded and sanded seams, black powder paint finish and acrylic fascia with matte finish for reduction of reflected glare. Sign shall be constructed to withstand the harsh environmental conditions found in transit applications.

The interior information sign shall also function as a Stop Requested sign. This stop requested sign message should be automatically mixed with other active messages when applicable. The stop requested message shall be cleared when one or both of the passenger doors are opened.

The Contractor shall also install an independent analog passenger stop request display located on the front sign compartment door and shall function simultaneously with the electronic sign when a stop is requested by passengers.

3.11.4 GPS Vehicle Location Message Trigger

The GPS shall be capable of providing its positioning information to other onboard equipment. Such GPS information shall be made available for AVM and AVL applications. The system shall automatically determine adherence to the Bus route and trigger the announcement of the next Bus stop as it is approached. The system shall utilize GPS satellites signals, WAAS satellites, a heading sensor, and an odometer sensor to provide continuous location information and automatic correction.

Once initialized, the automatic announcement system shall not require Operator intervention or action in the event of off-route excursions. The system shall detect off-route excursions and remain silent when off route. The system shall detect reacquisition of the route, at any point along the route, and automatically determine and announce the next valid Bus stop.

3.11.5 Data Transfer and Wireless Data Transfer

The DVAS shall be reprogrammable on the Bus. On-Vehicle reprogramming shall also be accomplished in a single-step process using a 802.11g or faster protocol.

The wireless Upload/Download Automated system shall transfer the new data from a local computer to the on-board memory or vice versa. After the transfer is initiated, the system shall trigger an automated data update followed by “Voice Update Completed” type message on the Signs and the MCU Display. The system shall provide a software application to manage the fleet data deployment update and also the update completion status.

The Contractor shall demonstrate to the SFMTA the wireless uploading/downloading and provide necessary training to SFMTA designated personnel.

3.12 PUBLIC ADDRESS SYSTEM

A public address system that complies with the ADA requirements of 49 CFR Section 38.35 and enables the operator to address passengers either inside or outside the Coach shall be provided in a location approved by SFMTA engineering.

The public address system shall be activated by a floor-mounted momentary switch to permit driver to make internal announcement only or external announcement only - switching from inside to outside speakers shall not require volume adjustment. Switch shall be easily accessible to the operator. Six inside speakers and one outside speaker shall be installed. All speakers shall broadcast in a clear tone so that all announcements are clearly heard in all passenger locations. Interior speaker grills shall be metallic material and shall be secured by tamper-proof screws or rivets. The PA system shall be muted when not in use. A Stealth Mic hands-free digital microphone system, Digital Recorders Inc., REI, or approved equal shall be provided. The SFMTA must approve all locations and installation for the public address system.

3.13 DIGITAL VIDEO RECORDING AND SURVEILLANCE CAMERA SYSTEM

The Contractor shall provide equipment and installation for a digital video recording and surveillance system (DVRS system) by Kratos or approved equal, and shall demonstrate successful operation of the system on each Vehicle. The DVRS system shall provide full coverage of the interior and exterior of the Vehicle and will also support two Transit-Only Lane Enforcement (TOLE) cameras. The system design be reviewed and approved by the SFMTA during detailed design and prototype review.

The DVRS shall be programmable to automatically tag events, or pre-programmed activities. Tagged and programmed events shall be stored, and when a recording is retrieved, the tagged events shall be easily identifiable. The DVRS shall include a 3-axis accelerometer with an adjustable alarm export feature to flag video recordings for review by SFMTA.

The system shall be able to retain time, date and any user programmable data (e.g., Coach number, route, run) without connection to the power source. The system shall have its own power supply connected to the 12 volt or 24 volt power of the Coach, and shall include an uninterruptible power source that provides for 30 minutes of system run-time without vehicle power. The system must be able to withstand all transients, surges, and dips in power from the Vehicle's electrical system without any deterioration of system performance. The system shall not be affected by electro-magnetic interference (EMI) or radio frequency interference (RFI). The system shall meet all applicable rules and regulations of the Federal Communications Commission (including FCC Part 15 Rules and Regulations) and the Department of Transportation.

The Contractor shall include in the Vehicle maintenance manuals wiring diagrams clearly showing the interfacing Coach wiring for the system as well as individual maintenance manuals for each piece of supplied equipment. These manuals shall include schematic diagrams and maintenance procedures including but not limited to operation, preventive maintenance, and troubleshooting. The task of the final commissioning onsite at the SFMTA shall be included in the Contract price.

The below Bill of Materials does not include all components required to be installed and integrated by the Contractor. The Contractor shall obtain a final Bill of Materials from RCM Security Inc.

Vendor P/N #	PN#	Description
CBL-HAR-NFSFM-40-MDR6-1	TBD	ASSY-CABLES,CAMERA SYSTEM
RCM-MDR-6	TBD	DVR-MDR6,2TB
RCM-PPC0710T.IDB	TBD	7 Inch Monitor
RCM-NSW1024	TBD	POE SWITCH
IP-SW1-USW	TBD	ETHERNET RELAY
PST-DC-UPS-1212-10A with 12v LION BAT	TBD	UPS MODULE
RCM-FB-PWR-CBL	TBD	FUSE BLOCK W/ PIGTAILS
RCM-CBL-NF-SF-DVR-PWR	TBD	CABLE-DVR PWR/IGN INTERFACE
RCM-CABLEDVR4B	TBD	CABLE-ETHERNET,CAT6E,18",BLUE
RCM-CABLEDVR4RG	TBD	CABLE-ETHERNET,CAT6E,18",90DEG,GREY
RCM-XNV6012-FF 2.8MM	TBD	CAMERA-IP,2.8MM (CAM #1), W/ AUDIO
RCM-CAM.M1380C-TOLE 8.0MM	TBD	CAMERA-IP,8.0MM (CAM #2), W/ AUDIO
RCM-XNV6012-FD 2.8MM	TBD	CAMERA-IP,2.8MM (CAM #3), W/ AUDIO
RCM-XNV6012-FS 2.8MM	TBD	CAMERA-IP,2.8MM (CAM #4), W/ AUDIO
RCM-XNV6012-MS 2.8MM	TBD	CAMERA-IP,2.8MM (CAM #5), W/ AUDIO

RCM-XNV6012-RS 2.8MM	TBD	CAMERA-IP,2.8MM (CAM #6), W/ AUDIO
RCM-XNV6012-RD 2.8MM	TBD	CAMERA-IP,2.8MM (CAM #7), W/ AUDIO
RCM-XNV6013-SS 2.8MM	TBD	CAMERA-IP,2.8MM (CAM #9), W/ AUDIO
RCM-XNV6013-CS 2.8MM	TBD	CAMERA-IP,2.8MM (CAM #10), W/ AUDIO
RCM-XNV6013-RV 2.8MM	TBD	CAMERA-IP,2.8MM (CAM #11), W/ AUDIO
RCM-ANA-CAMRD 2.8MM	TBD	CAMERA-ANALOG,REAR DOOR (CAM #8, #12)
RCM-CMB-SF-FF-3S	593846	BRACKET-FORWARD FACING CAMERA
RCM-ADI2000.BCA	TBD	MODULE-EVENT SWITCH
RCM-R232DB9GPS-CBL	TBD	GPS Interface cable
Panroma Antenna	TBD	Panorama 9-1 Antenna - **Customer Provided**
Cradlepoint IBR-1700 Router	TBD	Cradlepoint Router - **Customer Provided**

3.13.1 Camera

Contractor shall provide all camera system equipment and installation required for full coverage of the vehicle, and two TOLE cameras located as specified by the SFMTA. The cameras shall be Hanwha Techwin Wisenet XNV-6013 models or an approved equal. The camera system must be compliant with the Real Time Streaming protocol.

Exterior cameras shall not make any audio recordings outside of the transit Vehicle including in the front of the Vehicle or on the side of the Vehicle.

A rear exterior surveillance backup camera integrated with the Luminator rear run sign shall be provided and shall be integrated with the LCD dash display for the purpose of displaying live video to the dash display when the Coach is in reverse.. In addition, a rear exterior IP camera shall be provided and shall be integrated with the Kratos DVR for the purpose of recording video.

An interior rear door analog camera overlooking the exit door shall be provided and shall integrate with the LCD dash display for the purpose of displaying live video to the dash display when the doors are open. The rear door interior IP camera overlooking the exit door shall be integrated with the Kratos DVR for the purpose of recording video.

The TOLE cameras shall be positioned to capture an identifiable image of the Vehicles in front of the transit Vehicle, including the license plate, color, and other identifying characteristics of the Vehicles. The TOLE cameras shall be positioned to capture the location of the Vehicles illegally occupying the transit-only lanes in front of the transit Vehicle. The operator shall be able to manually trigger the export of one minute of TOLE camera video recording of a transit lane violation (spanning from 30 seconds before to 30 seconds after triggering the signal) with a pushbutton located on the dash or driver's side console. The video recording shall be catalogued for SFMTA review into folders titled by each day, such as "dd.mm.yyyy."

The exterior camera outside the transit Vehicle shall be pointed towards the rear and at the doors. It shall prevent damage to the lens from the transit Vehicles washers or tree branches on the Vehicle's route.

All cameras supplied shall have a standard IP color signal output. The NTSC cameras shall be capable of producing undistorted 150db or better wide dynamic image, i.e., capable of capturing face images with bright backgrounds within the transit vehicle. The cameras shall have M12 connectors, be power over Ethernet (PoE) and of 1920 x 1080 or greater resolution. A Day/Night shall work in all lighting conditions (Day & Night (ICR) without the need for manual adjustment to any equipment capability shall provide display images from 0.04Lux@F2.0 (Color)day mode and 0Lux (B/W : IR LED On) in night mode.

3.13.2 Digital Video Recorder

The digital video recorder (DVR) shall be a DTI MDR-6 Mobile Data Recorder, or approved equal, capable of recording the outputs of the TOLE cameras and video surveillance cameras on internal separately removal hard drives. The video surveillance camera hard drive shall provide a minimum of one month video retention with H.264 compression algorithm, and shall be a minimum two terabyte capacity SATA hard drive or an approved equal. The TOLE camera hard drive shall provide a minimum of three days storage capacity, and shall be a minimum two terabyte capacity solid state drive, or an approved equal. All hard drives shall be "Hot Swappable" (i.e., the hard drives shall be removable without corrupting the data even with the DVR ON). The DVR shall record simultaneously at a speed of not less than five frames per second each , along with synchronous audio tracks and be identified with time, date, Vehicle number, GPS location information, and time sync. The GPS information shall be able to relate to an address on a map.

The DVR shall be capable of recording IP audio signal from the interior IP surveillance cameras. The SFMTA shall have the ability to approve which IP cameras' audio feed will be recorded. (See *ATTACHMENT 6: CAMERA LAYOUT*)

The DVR shall have the ability to automatically download selected video events in user selectable increments via a wireless connection to the satisfaction of the SFMTA.

Specific transit Vehicle and specific times shall be selectable.

The DVR shall have the capability to be pre-programmed to download recorded incidents that have not been "tagged" by the operator up to one hour in length from all cameras recorded in the transit Vehicle when the Vehicle returns to the yard to the satisfaction of the SFMTA.

The download shall continue until complete even if the transit Vehicle is powered down.

The DVR shall have the capability to transmit live video, from inside the Vehicle, upon demand to a laptop or PDA while the Vehicle is still in revenue service to the satisfaction of the SFMTA.

The DVR shall have a shutdown feature where the DVR is powered down after a specified period of time following the ignition of the vehicle being turned off. The time interval before DVR shutdown shall be adjustable from zero to 30 minutes.

The live video feed shall be transmitted up to a distance from the transit Vehicle to be determined by the SFMTA.

3.13.3 Silent Alarm Requirements

Upon activation of the silent alarm switch, the recording system must protect a window of recorded data that extends to a point, up to 30 minutes, prior to the activation of the silent alarm and to a point, up to 30 minutes, after activation and will not allow the recording to be erased. The software system shall allow the SFMTA to adjust the extent of the data to be saved through software without the need for contractor's support. The activation of the silent alarm switch must be recorded on the video medium. Additional requirements for the silent alarm are given in Section 4.1.13, (Silent Alarm and Event Marker).

3.13.4 Health Monitor Tool (HMT)

The Contractor shall provide Health Monitor Tool (HMT) application software for continuous monitoring of the health of remote DVRs. The DVR shall be capable of sending real-time health checks and notification through e-mail or text of any Defect noted during transit Vehicle operation.

A. The HMT software shall perform the following functions:

- Automatically monitor multiple remote connected DVRs at set intervals.
- Manually poll all DVRs for system health variables.
- Provide an on-line report of all results.
- Export reporting capability in 3 formats (Excel, HTML, and CSV).
- Email notification of events to multiple recipients.

B. Monitored Events:

- Connection: Network connectivity test.
- Failed Drive Access: Each drive shall be verified.
- Camera Failures during Defined Intervals: Cameras shall be continuously tested to ensure connectivity.
- Reboots anytime a DVR is restarted or shutdown.
- Time Since Recording: Verification that recording is continuing up to current time.
- Protected Capacity Used %: System shall monitor the space remaining for protected video and display the percentage used.
- Days of Storage shall display the number of days currently retained on the DVR for unprotected recorded video.

3.13.5 Downloading Software

The downloading software shall have the capability to be programmed by a maintenance technician at the server to be able to download recently recorded video for QA checks of equipment functionality of each transit Vehicle on a daily, weekly, and monthly basis. The downloading software shall have the ability to download the error/status log from the DVR every time the transit Vehicle is back in the depot yard. It shall include a "GPS Search" feature that will allow SFMTA staff to video search the entire fleet based on specific or range of times and at or near specific locations of any incident. The use of Graphic User Interface (GUI) will be the preferred method of interface with the program.

The downloading software shall have fleet-wide software for viewing DVR and camera "health status" that are continuously updated and recorded in a log file accessible to the SFMTA Video Technicians and shall include real time health checks and notification that can send notifications to SFMTA staff via e-mail/text of any Defect noted during operation.

The system shall have the capability to be pre-programmed to download recorded incidents that have not been "tagged" by the operator, up to one hour in length from all cameras recorded on the transit Vehicle when the Vehicle returns to depot yard. The Contractor shall provide all support equipment needed to facilitate this (i.e., antenna, transmitter, receiver, and server).

3.13.6 Wireless System

The wireless system on the transit Vehicle shall be the latest wireless bridge, currently the Firetide 8020 wireless radioor approved equal. The Contractor shall supply or use an existing antenna mounted on the roof of the transit Vehicle of at least three dbm gain, and if needed per the Contractor's power configuration, an external power supply to power the bridge may be installed. The wireless bridge shall have the capability to turn on and off the DVR via a wireless switch or IP relay.

3.13.7 Security Enclosure

The mobile DVR shall be encased in a vented, rugged metal chassis with shock absorbers to withstand exposure to extreme shocks, vibrations, and temperatures. A system status and event button indicator shall be provided on the outside of the enclosure. A pick resistant ACE-type lock or better shall be used. The lock shall be quarter turn lock and unlock. The internal and external assembly of the security enclosure shall be designed for ease of removal and repair of an internal subassembly and of the entire assembly. Ease of and convenience of maintenance, changing user parameters and media removal and replacement are also important functional requirements for the system. Design of the security enclosure must be approved by the SFMTA during prototype review.

3.13.8 Viewing Stations

The contractor shall provide complete viewing stations which will allow SFMTA personnel to review recorded video and audio data, transfer data to long term storage media, or transfer to compact disk (CD) or DVD for court room viewing. The viewable and audible data shall meet all applicable requirements for admissibility set forth in the California Evidence Code and the Federal Rules of Evidence. The video shall be playable off the CD/DVD without the need of installing viewing software. The viewing station shall permit the SFMTA to view the GPS location of the vehicle for each recorded event, and shall allow for the SFMTA to search for recorded events at a specified location.

3.13.9 Documentation and Training

Documentation and Training are referenced in Section 9.2.7 (Surveillance Camera System Manuals) and Section 9.1.7 (Surveillance Camera System Training), respectively.

3.14 DRIVECAM

The Contractor shall provide a continuous battery powered DriveCam system on all Vehicles. The DriveCam system (DriveCam System) shall include the DC3 Cellular Event Recorder (Event Recorder) with audio front and rear video views and internal IR, DriveCam GPS system with GPS antenna (internal or external), wiring bundle, electrical connects, securing tie down straps, mounting brackets, miscellaneous hardware and all associated equipment to provide an operational event recorder system that meets the written software and hardware related specifications DriveCam provided to the SFMTA. The system design and installation must be approved by SFMTA. The task of the final commissioning onsite at the SFMTA shall be included in the Contract price.

3.14.1 Hardware

A. DriveCam 3 Video Event Recorder – Cell – part number VER-DC3-0004 including:

- GPS Antenna – part number PER-GPS-0001 (not applicable for internal GPS)
- VER 6 Port Hub Installation Doc – part number DRC-302 (not applicable for 5-port hub)
- Instructions for Mounting Pushbutton Collar – part number DRC-929

B. Torx Wrench DC3 – part number 1130-00101-0000

C. Mounting hardware, accessories and power harness

3.14.2 Software

A. The Contractor shall provide the following software including any updates or patches:

- Initial Year Hindsight License – part number 3235-000HS -INIT
- ASP Hosting – part number 4230-00ASP-INIT

3.14.3 Services

A. The Contractor shall provide the following services:

- Cellular Transport Plan (Tier 3) – part number 4230-0CELL-INIT
- Managed Service (Tier 3) – part number 4230-000MS-INIT

3.14.4 Wires and Cables

A. All wire sizes and insulation shall be based on the current carrying capability, voltage drop, mechanical strength, temperature and flexibility requirements, as well as fire resistance requirements for Vehicle applications in accordance with DriveCam specifications.
B. Wiring shall be uniformly color coded and tagged.
C. Wiring shall be prefabricated into standardized harnesses, wrapped and tied with “all weather UV type” nylon ties.
D. The power source wires must be sized appropriately to meet specified requirements for unit. Wherever there is a possibility of interference, wiring and interconnecting cables shall be properly shielded.
E. A protective plastic or rubber grommet must be installed in every hole that provides passage for conduit or wiring to avoid chaffing or cutting of the conduit or wiring.
F. Start up and normal operation should prevent unacceptable voltage drops

3.15 MOBILE RADIO SYSTEM

The Contractor shall provide all equipment for, and fully install, the IVU 4000 radio/CAD/AVL system by Harris/Conduent, subject to approval by the SFMTA. The Contractor shall work with Harris and Conduent to verify the full bill of materials listed below for the proposed radio system and shall submit this bill of materials to the SFMTA for approval. The IVU 4000 system shall be integrated with the passenger information system to provide necessary information for the display screens.

The location of all radio and public address equipment shall be in an electronic compartment box at an accessible location inside the Vehicle and subject to SFMTA review and approval.

The operator handset shall be located on the inside of the operator barrier door.

The task of the final commissioning of the radio/CAD/AVL system shall be included in the Contract price.

The proposed bill of materials to be installed and integrated by the Contractor:

Item	PN#	Description	QTY
1	TMS-006298	Mounting Base with Ball Ram Vesa Base 3.625 sq.	1
2	TMS-006299	Mounting Base Square, 4.57 Sq.	1
3	TMS-006300	Socket Arm Assy, DBL Ball, RAM	1
4	120041-3	AGC Microphone, Internal	1
5	420000-1	AGC Microphone, External	1
6	131623-1	Gasket, External AGC Microphone	1
7	120004-5	Handset	1
8	130627-1	Bracket, Mount, Handset	1
9	110444-2	Sign, LED, Interior, 14 Characters, Amber, w/Conn	2
10	TMS-006276	Cisco Router 829 Router, Wireless WWAN	1
11	LNX800AG-T	Switch, Ethernet, 8 Port	1
12	410006-1	TRAY-IVU-4000, EQUIPMENT w/TIB	1
13	410001-1	MDT-1000, Display	1
14	440080C-240	Cable Assy, MDT Display to IVU 4000	1
15	440057-39	Cable Assy, Vehicle Interface, CAN to IVU 4000	1
16	440007-60	Cable Assy, IVU 4000 Ethernet to LNX 800 Switch	1
17	440071A-240	Cable Assy, Handset to IVU 4000 TIB	1
18	440068A-300	Cable Assy, IVU-4000 TIB to Farebox	1
19	440048A-300	Cable Assy, External AGC Pre-Amp to Audio Interface, IVU4000 TIB	1
20	440110A-36	Cable Assy, IVU to Harris M7300 Radio, Control and Serial	1
21	440093A-180	Cable Assy, AVA LED Sign to IVU4000 TIB, J1708_TR	1
22	440093A-240	Cable Assy, AVA LED Sign to IVU4000 TIB, J1708_TR	1
23	440055-300	Cable Assy, Internal AGC Microphone to IVU4000 TIB	1
24	141580A-12	Cable Assy, J1708 Splitter, TIB	1
25	440112B-36	Cable Assy, Discrete Alarm Connections, TIB to Bus	1
26	440046-24	Cable Assy, Audio Interface, TIB to Bus	1
27	440099A-192	Cable Assy, Destination Sign, Luminator, MCU, w/Loom	1
28	440062-70	Cable Assy, TIB to DVR, Serial RS-232	1
29	141579A-100	Cable Assy, Power, Cisco 829 Router	1
30	141581A-18	Cable Assy, Cisco 829, Router Power Pigtail	1
31	141577-192	Cable Assy, Destination Sign,MCU to IVU 4000, Ethernet	1
32	141578A-36	Cable Assy, Power LNX 800 Switch	1
33	TMS-006134	ANTENNA, GPS	1
34	141352-340	CABLE ASSY, GPS ANTENNA, 28'	1
35	TMS-006260	ANTENNA-802.11P, CISCO ROUTER (12" pigtail/TNC male)	2
36	14044-0107-340	CABLE ASSY, 802.11P ANTENNA (TNC female TO RPTNC male)	2
37	AN-225001-004	ANTENNA-HARRIS RADIO (700/800 MHz, NMO)	1
38	141335-180	CABLE ASSY, HARRIS RADIO ANTENNA, 15' (NMO TO MALE TNC)	1
	Supplied by others:		
39		RADIO-HARRIS, M7300	1
40		RADIO MOUNTING BRACKET KIT TRAY, SHORT, REMOVE MOUNT	1
41		SAMLEX MODULE-POWER FILTER	1

42		CABLE-DC POWER, M7300 RADIO	1
43		CAN TERMINATOR, STRAIGHT, RADIO	2
44		SENSORS, APC, MATRIX, FRONT & REAR	2
45		CABLES, MATRIX SENSOR, ETHERNET, M12 CONN to IVU	2
46		CABLES, MATRIX SENSOR, PWR	2

3.15.1 Electronic Equipment Compartment and MDT

An electronic equipment compartment shall be provided to accommodate all the radio system equipment. The compartment shall have a locked door. A location convenient to the operator shall be provided for the radio control head, speaker, MDT and handset. The electronic equipment compartment shall be supplied with a nominal 12-volt, 30-amp direct current with positive and negative leads. This service shall be protected by a 30-amp circuit breaker located at the circuit breaker panel.

The design, location and installation of the radio compartment and MDT must be approved by the SFMTA.

3.15.2 Radio Antenna

Contractor shall provide and install all antennae for the SFMTA radio system specified in Section 3.15. Contractor shall provide and install type RG 58 coaxial from the under-floor radio compartment to each antenna location.

Contractor shall provide a concealed 3/4-inch conduit and pull wire from each reinforcement plate to the radio compartment. The conduit shall have no sharp or right angle bends.

3.16 FARE COLLECTION

A Genfare Odyssey fare box with transfer ticket printed technology shall be provided as far forward and as deep into the floor as practicable. Location of the fare box shall not restrict traffic, including wheelchairs, in the vestibule and shall allow the operator to easily reach the fare box operational buttons and to view the deposited fares. The fare box shall not restrict access to the operator's area and shall not restrict operation of operator controls. The passenger side of the fare box will face the front door of the Coach, so there shall be sufficient clearance for easy access to the cash box/receiver system. The fare box must have sufficient clearance for easy removal of the coin and bill modules, as well as the Master Controller Card. Meters and counters on the fare box shall be easily readable on a daily basis. The location of the fare box shall comply with ADA requirements. Wiring and mounting shall meet all clearance and access requirements, and shall accommodate installation of Genfare electronic fare boxes. The task of the final commissioning shall be included in the Contract price.

3.16.1 Electrical

A 10-amp maximum, 24-volt, direct current protected circuit shall be available to power the fare box and will have the ability to communicate using J1708 protocol. This circuit shall be composed of three wires, +24VDC wire, 24VDC return, and a ground lead all enclosed in a protective flexible conduit. All wires are 14 AWG, stranded, oil/grease/abrasion resistant where applicable, the Contractor shall install circuit breakers. A power-disconnect switch shall be provided inside the fare box for maintenance purposes.

3.16.2 Fare Box Mounting

The SFMTA requires a reinforcing mounting support plate with nuts welded onto it. The support plate shall be mounted to the top surface of the farebox pedestal. The Contractor shall place emphasis on the proposed placement of the fare box in order to meet space and maneuverability requirements for wheelchairs in addition to entrance and egress for the operator in an effort to minimize the possibility of industrial injury. The location of the fare box and installation procedures must be approved by the SFMTA.

3.17 CLIPPER®

Each Coach shall be provided with a fully programmed, fully functioning Clipper® system. The Clipper® system shall consist of one DC (Driver Console) at the Operator Area and one Customer Interface Device (CID) for each door. The DC shall not obstruct the view of the Operators and shall not interfere with Operator's Vent and Heater/Defroster in Section 4.3. Cables shall not be exposed and accessibility to wiring shall be a primary design consideration for ease of maintenance. The mounting locations of the DC and PD must be approved by the SFMTA. The task of the final commissioning onsite at the SFMTA shall be included in the Contract price.

The Clipper on-board equipment requires either 12VDC or 24VDC power from protected sources with voltage variations from 9VDC to 32VDC. The protection shall be a 5A manual resetting circuit breaker that visibly identifies an open circuit in the tripped state.

3.18 AUTOMATIC PASSENGER COUNTING (APC)

Contractor shall furnish, install, and demonstrate successful operation of the APC systems with the IRMA sensor installed on each door. The APC system shall be working with the Radio System. The APC system shall utilize optical image or optical thermosensors and process the collected data. The system shall be capable to generate reports on the passengers load with Bus stops information at the discretion of the user. Cables shall be mounted so as not to interfere with the operation and maintenance of the wheelchair ramp, or other Vehicle systems. The installation will be heavy duty and able to withstand the stresses of urban transit operation in the SFMTA environment. Accessibility of wiring and ease of maintenance shall be primary design considerations. Automatic Passenger Counting shall be able to count bicycle and

wheelchair users, as well as ambulatory passengers. The APC design and location must be approved by the SFMTA.

All specialized tools for the APC system shall be supplied by the Contractor. The task of the final commissioning onsite at the SFMTA shall be included in the Contract price.

3.18.1 Electrical

The Master Run Switch shall control activation of the APC system. The APC system shall operate in all Run positions of this switch. Power to the APC system shall be on at all times, except when the battery has been shut off (this is to enable the Wireless download to operate at all times, as explained in Section 3.13.2 (Digital Video Recorder).

The APC system shall have a very small current draw; it shall not drain Vehicle battery below vehicle starting level (as applicable) or to provide auxiliary electrical power for at least four full days.

The APC system shall have its own circuit breaker, and it shall be internally protected against voltage transients and RF interference to ensure proper operation in the SFMTA operating environment.

3.18.2 System Enclosure

The APC system shall be housed in a sturdy vandal-resistant enclosure that includes a tamper- and pick-resistant lock. The unit shall be installed in an area determined by the SFMTA. This area must be easily and safely accessible to authorized personnel.

3.18.3 Passenger Counting Sensors

The Passenger Counting Sensor features shall be proven devices from a well-established APC company specializing in APC systems. They should include, but not be limited to, the following:

A. Acquisition of passenger counts by means of sensing devices at each Vehicle door opening.
B. Fully adjustable detection zones that meet the requirements of the Vehicle design.
C. Bicycle rack and wheelchair ramp switches that tabulate bicycle rack and wheelchair ramp users.
D. 95% counting accuracy that is not affected by normal variables, including but not limited to:

- The reasonable speed at which someone passes by sensors.
- Passengers carrying items such as backpacks, boxes, briefcases, etc.
- Obstructions to the sensors, such as passengers remaining immobile within the sensor field.
- The difference between passengers boarding and exiting the Vehicle.

- Variations in light and temperature.

3.18.4 GPS (Global Positioning System)

The Global Positioning System (GPS) shall provide accurate location of the Vehicle while passengers board and exit. Location information will include but not be limited to route and Bus stop/car stop identification. The GPS shall include a Dead Reckoning system so that Stop ID's can be accurately recorded in poor GPS reception areas, and self-diagnostics with status lights for easy troubleshooting. These will include indications such as: "Power," "Boot Up Mode," "3-D Fix," and "Dead Reckoning in Use." The GPS system shall be provided with hardware and software to access status information and configuration settings in real time for the Electronics Shop Technicians to use as a troubleshooting and configuration tool.

3.18.5 Computer Data Logging System

The Computer Data Logging System shall be a proven device supplied by a well-established company specializing in APC. It shall include, but not be limited to:

A. The GPS described in Section 3.18.4 GPS (Global Positioning System).
B. An onboard microcomputer that gathers and stores at least an average of 10 Days of Vehicle/route data that can be wirelessly downloaded to a local server via a RF Wireless System. Data shall also be stored on a non-volatile medium for onboard retrieval.
C. A RF Wireless Receiver System, stationed at each facility where the APC Vehicles reside. Each RF Wireless Receiving Unit shall be installed in a secure area, determined by SFMTA.
D. An IBM PC server used for the wireless system. It shall be installed in a secure area determined by the SFMTA. The Server shall connect to the SFMTA's existing LAN for remote data retrieval.
E. Ability of the RF Wireless System and APC Server to run 24 hours a day, 365 days a year in order to provide authorized access to all APC data at any time.
F. Self-diagnostic capability of individual System units.

Microcomputer gathered data should consist of but not be limited to:

A. Route ID
B. Vehicle ID
C. Time and date stamp
D. Stop ID
E. GPS stop coordinates
F. Direction of travel
G. Minimum and maximum passenger numbers
H. Number of passengers boarding and exiting at each stop ID/GPS location
I. Passenger load count at any time
J. Bicycle rack user and wheelchair lift user data.

The above data and other variants shall be used with software described in Section 3.18.6 (Computer Data Analysis Software).

3.18.6 Computer Data Analysis Software

The APC Vendor shall provide complete data analysis (PC Windows) software for use with downloaded APC computer-logged data, to generate summaries, reports, analyses, plots, and graphs, such as, but not limited to, the following:

A. Route Summary Report
B. Route Productivity Plot
C. Trip Summary Report
D. Trip Report; Bus/Car Stop Summary
E. APC Mapping
F. Schedule Adherence Summaries and Reports

The software shall have the ability to adjust the parameters of the Reports and Summaries, such as dates, routes, addition of external data, etc. The Vendor shall provide three desktop PCs, all installed with a full version of APC software for converting the compiled data into useful information as outlined above**.**

The Data Analysis Software will be part of the proven APC system supplied by a well-established APC company specializing in APC systems. The APC data/software shall be fully compatible with the Plan module of the Trapeze scheduling system.

3.19 PASSENGER INFORMATION HOLDER

Two frames shall be provided on the rear of the operator's barrier to retain information sized 17 inches wide and 11 inches high posted by the SFMTA, such as routes and schedules.

Three "take-one" boxes shall be mounted inside the Coach. Two boxes on the street side shall be mounted on the window pillars: one half-way between the operator's area and the space across from the rear door and one half-way between the rear door and the rear of the Coach. One box shall be mounted on the rear door pillar. The "take-one" boxes shall be aluminum or stainless steel and shall retain a 1-1/4 inches stack of 4-1/4 inches-wide media. The boxes shall be four nches deep.

Locations and placement of the passenger information holders are subject to SFMTA review and approval.

3.20 NUMBERING AND SIGNING

Coaches shall have four-digit fleet numbers counting upward in sequence with Coach serial numbers. The SFMTA will inform the Contractor of the fleet numbers. The SFMTA logo and serial numbers shall be decals. The SFMTA common carrier number "CA 49819" shall be on decals in three-inch high numbers on both the curbside and the road side of the Coach. The Contractor shall provide the Vehicle number on a decal on the roof of the Vehicle. The Contractor shall submit the decal design to the SFMTA for approval. A Bus fleet number plate shall be installed on the panel behind the operator seat. Fleet number style and locations shall be subject to approval by the SFMTA.

The interior of the Coaches shall have the four-digit fleet number in three-inch block style decal located on the panel or access door above the operator's head and centered vertically from the windshield to the ceiling and horizontally between the Coach interior walls. In addition, on the panel behind the operator's station, a Braille Vehicle number sign will be placed in accordance with ADA height and size requirements listed below.

Signing shall be applied to the inside and outside of the Coach in compliance with the ADA requirements defined in 49 CFR Section 38.27. Signs shall be durable and resistant to fading, chipping, and peeling; they may be painted signs, decals, or pressure-sensitive appliqués. All decals shall be sealed with clear, waterproof sealant around all exposed edges if required by the decal supplier. Appliqués shall be 3M Scotchcal, 3M Controltac or approved equal. Signing listings are included in ATTACHMENT 2 Decal Listing. Contractor will be supplied with a sample of all decals and decal drawings at design review. Sign materials, location and placement shall be subject to approval by the SFMTA.

3.21 TRAFFIC SIGNAL PRIORITY EQUIPMENT

Contractor shall supply and install fully functional signal priority equipment, the Opticom model 2101, Opticom Model 4010 Universal Computer, 2800 Vehicle-ASM-SF Software, Model 288-5 J1708 or J1939 Interface Cable, the traffic signal priority equipment shall utilize standalone GPS antenna. The design and location of the equipment must be approved by SFMTA during design review. The task of the final commissioning onsite at S the FMTA shall be included in the Contract price.

3.22 CHASSIS MOUNTED PEDESTRIAN BARRIER (S1 GUARD)

Contractor shall provide a chassis mounted pedestrian barrier on the curbside in front of the rear axle wheel. The pedestrian barrier shall be adequate enough to push pedestrian away from the right rear wheel.

3.23 Telematics

The Contractor shall provide a data monitoring system by ViriCiti, making use of the ViriCiti DataHub onboard vehicle telematics device. The service shall be capable of collecting

information on energy management, smart charging, route data, and vehicle data (including fault codes). The monitoring system shall be fully compliant with version 1.6 or later of the Open Charge Point Protocol (OCPP) standard. In addition to complying with OCPP, the vendor shall also provide driver information, APC data, and route information through the vehicle J1939 connection to the ViriCiti data monitoring system.

The Contractor shall provide a two-year subscription for ViriCiti, which includes the core vehicle and charging station packages as well as the optional driver behavior, maintenance, and smart charging packages.

4 OPERATOR'S AREA

The objective of designing the operator's area is to provide an environment for the driver to operate the Coach safely and efficiently for long periods of time without injury and with minimal fatigue. The operator's area shall also be designed to minimize glare to the extent possible. The use of polished metal and light-colored surfaces within and adjacent to the operator's area shall be avoided. To the extent practicable, areas that are visible from outside the Coach in the vicinity of the dash panel and cowl shall be configured to preclude use for storage of items. The Contractor shall present the complete detailed layout of the operator's area at the design review for approval by the SFMTA.

The Contractor shall construct a mock-up of the operator's area or provide an electronic mockup for approval of the operator's area by the SFMTA prior to the manufacture of each prototype Coach.

The operator's area shall comply with the following SAE recommended practices (or with an approved alternative set of recommended practices):

TABLE 4.0

SAE J287	Driver Hand Control Reach
SAE J941	Motor Vehicle Driver Eye Range
SAE J1050	Driver's Field of View
SAE J1052	Motor Vehicle Driver and Passenger Head Position
SAE J1516	Accommodation Tool Reference Point
SAE J1522	Truck Driver Stomach Position
SAE J1834	Seat Belt Comfort, Fit and Convenience

4.1 CONTROLS

All switches and controls shall be in convenient operator locations and shall either be marked with easily read backlit identifiers or shall be easily legible at night. All panel-mounted switches and controls shall be replaceable, and the wiring at these controls shall be serviceable from the vestibule or the operator's seat. Switches, controls, and instruments shall be dust and water resistant, consistent with the Coach washing practice described in Section 2.3, INTERIOR TRIM, PANELING AND ACCESS unless otherwise approved by the SFMTA. All operator controls shall be located in positions where the operator can activate and deactivate them without reaching below the dash level and shall be located in a position that the operators body cannot contact them while entering / existing the control station, or while operating the Coach.

4.1.1 Operator Control

SFMTA Operations personnel will be heavily involved with the final approval and Acceptance of the operator's area. All switches shall be water and dust resistant, unless otherwise approved by the SFMTA. All control panels installed on to the Operator's area shall be sealed properly to prevent water intrusion. All switches and controls necessary for the operation of the Coach shall be conveniently located in the operator's area and shall provide for ease of operation. They shall be identifiable by shape, touch, and permanent non-wear or fading identification markings Specific requirements for operator controls are summarized in Figure 4-1 (Operator Control Requirements). All required switches and controls are included in Figure 4-2 (Operator Switches and Controls) and shall be constructed and specified as heavy-duty automotive/industrial quality.

No wiring, equipment or housings shall interfere with the operation of foot-controlled switches or pedals. Controls and all dash features shall be designed so that the operator or passengers may not easily tamper with them. Layout of controls must be approved by the SFMTA.

4.1.2 Instruments

The speedometer, certain indicator lights, and air pressure gauge(s) with single needle and a minimum of 2-1/2 inches in diameter, shall be located on the front cowl immediately ahead of the steering wheel. The Coach may also use digital air system pressure indicators on the LCD dash display. Illumination of the instruments shall be simultaneous with the marker lamps. Glare or reflection in the windshield, side window, or front door windows from the instruments, indicators, or other controls shall be minimized. All instruments and indicators (including those shown on the LCD screen) shall be easily readable in direct sunlight. Instrument and indicator light readability in all conditions will be approved by the SFMTA during prototype evaluation.

The instrument panel shall include an electric analog-speedometer with a maximum possible indicating speed of no less than 75 mph and calibrated in maximum increments of five (5) mph. The speedometer shall be a rotating pointer type, with a dial deflection of 200 degrees to 270 degrees and 40 mph near the top of the dial. The speedometer shall meet size and accuracy requirements found in either SAE J678 or J1226. The LCD instrument panel shall include a State of Charge gauge, an air pressure gauge with indicators for primary and secondary air tanks, and 12 volt and 24 volt voltmeter(s) (if space is available) to indicate the operating voltage across the Coach batteries. The LCD screen instrumental panel shall be able to show exit door activities via the surveillance camera system when the exit doors are open. The LCD screen shall also show reverse, backup activity via the rear exterior surveillance camera when the coach is in reverse. The delay of the backup camera and exit door camera displays shall be less than 50 milliseconds (ms). The instrument panel wiring shall be easily accessible for service from the operator's seat or from the top of the panel. Wiring shall have sufficient length and be routed to permit service without stretching or chafing the wires.

FIGURE 4-1 OPERATOR CONTROL REQUIREMENTS

SUBJECT	SPEC/DESIGN
Steering wheel adjustment	2.5" vertical minimum; 6" Horizontal Steering, or as otherwise approved by the SFMTA
Steering wheel	18" to 20" diameter unless otherwise approved by the SFMTA
5th percentile acc. pedal angle at rest	SAE J287-J941-J1052 and J1522
5th percentile brake pedal angle at rest	SAE J1516
95th percentile acc. pedal angle at rest	SAE J1516
95th percentile brake pedal angle at rest	SAE J1516
Turn signal controls left foot	35 - 45 degrees platform
Control handreach – side	SAE J287
Control handreach – front	SAE J287
Seat dimensions	Min. Width - 18" Slope - 5 +/- 5 degrees
Seatback to cushion angle	95 - 110 degrees
Seat height adjustment	13" – 19" from floor to top of uncompressed seat
Seat adjustment forward	Min. 9"
Object detection	42" height at 26" in front of Coach
Horizontal view	Min. 90 degrees
Obstruction – divider	Less than 3 degrees
Obstruction – pillar	Less than 10 degrees
Upward view	Greater than 15 degrees
Brake	Range of resistance 10 –80 lbs. Angle from the horizontal: 45; freeplay: 1.2 degrees; Pedal Travel: 0.5" – 2.5"; height above accelerator: 1.2"
Accelerator	Range of resistance: 4 – 10 lbs. Angle from the horizontal: 45; freeplay: 5 degrees Maximum travel: 20 degrees

FIGURE 4-2 OPERATOR SWITCHES AND CONTROLS

SWITCHES
Master Run Switch
Start button
Kneel switch (with cover)
Over raise feature
Hill holder switch, with or without cover
Interior lighting switch
Wheelchair ramp switch
Power door switch
Operator area lighting switch
Hazard light switch
Pedal adjustment
Silent alarm switch
Speaker selection switch
Hazard warning switch, with extension arm
Diagnostic light panel test switch
Rear door override switch
Foot-controlled turn signal switches
Horn button in steering wheel hub
Foot-controlled headlight dimmer switch
Fire suppression system manual activation switch
Sweeper switch
Turn signal disable switch
Event marker button
High beam switch
Regen disable switch

CONTROLS
Accelerator pedal
Brake pedal
Door Controller
Windshield wipers
Windshield washers
Interior climate control
Defroster control
Operator's heater controls
Parking brake control (also acts as direction control neutral actuator)
Wheelchair ramp controls
Harris radio MDT
Destination sign controls
Exterior side mirror adjustment control
Instrument panel lighting intensity control

4.1.3 Indicators

Critical systems or components shall be monitored by a built-in diagnostic system with visible and audible indicators. The diagnostic indicator lamp panel shall be located in clear sight of the operator. The intensity of indicator lamps shall permit easy determination of "on"/"off" status in bright sunlight but shall not cause a distraction or visibility problem at night. All indicators shall have a method of momentarily testing the operation of the lamp. Whenever possible, sensors shall be of the closed-circuit type so that failure of the circuit or sensor shall activate the malfunction indicator. Sensors shall be accurate to +/- two ercent of the manufacturer's specified value. An audible alarm shall be loud enough for the operator to be aware of its operation and to be inclined to discontinue operation of the Coach. Diagnostic indicators are listed in Figure 4-3, (Onboard Diagnostic Indicators). Space shall be provided on the panel for future additions of no less than five indicators.

FIGURE 4-3 ONBOARD DIAGNOSTIC INDICATORS

VISIBLE INDICATOR	AUDIBLE ALARM	FUNCTION
Low coolant	Yes	Coolant Pressure low
Battery overheat	Yes	Battery coolant temperature high
Low Air	Yes	Air system low in primary or secondary reservoir
Kneel	Yes	Kneeling system activated
Wheelchair ramp	Yes	System activated
Fire	Yes- 75 dB (min)	Over temperature in service compartment
Low hydraulic fluid	Yes	Hydraulic fluid low fluid level
Check system and stop system indicator	Yes	Check System and Stop System indicator.
Mobility aid passenger exit signal	No	Mobility aid passengers want to get off
High headlamp	No	High headlamp is on
Right and Left turn	Yes, with disable switch	Indication of left-turn or right-turn
Hazard warning	No	Warning signal to other drivers. (may be common with turn indicators)
Rear doors open or enabled	No	Rear doors are opened
Parking brake not applied	Yes- 75 dB (min)	Parking brake is not applied and Master Run Switch is at “OFF” position
Parking brake applied	No	Parking brake is applied
Seat belt	Yes	Warning signal to operator for not wearing seat belt
Interlock is off	Yes	Interlock is turned off
Service brake applied	No	Service brake is applied. (may be common with parking brake indicator)
Energy storage unit Temperature	Yes	Warning of high temperature and/or fire and/or smoke condition
Energy Use	No	Dynamic energy usage efficiency indicator(s)
Low HV isolation	Yes	voltage system
Controller	Yes	Overheat
State of Charge (SOC)	Yes*	Progressive low power indicator(s) *Indicator at 20%, audible alarm at 5%.
Estimated range remaining	No	Indication of estimated range remaining on state of charge.
Wait to start	No	Indicates Bus electric drive is not ready to be started
Door obstruction sensor	Yes	Indication of rear door sensitive edge activation
High voltage system fault	No	Detects high voltage faults and initiates drive system shutoff and battery disconnection.
ABS failure	No	Detects failure in ABS system
HVAC failure	No	Detects failure in HVAC system
Charging system low/high	No	Detects a fault in the charge rate, initiating a time-delay shutoff if necessary

The instrument panel and wiring shall be easily accessible for service from the operator seat or top of the panel. Wiring shall have sufficient length and be routed to permit service without stretching or chafing the wires.

4.1.4 Door Controls

Controls for the front entrance and rear exit doors shall be either a single 5-position master door switch or a push button control, conveniently located and operable in a horizontal plane by the operator's left hand. The setting of this control shall be easily determined by position and touch. The 5-position master door switch shall also activate the hazard light whenever the switch is not in the "centered" position. In the case of the push button control, the hazard light shall be activated whenever the front or rear doors are opened or enabled. The 5-position master door switch shall have the following settings:

FIGURE 4-4

Second Position Forward	Front door open, rear doors enabled
First Position Forward	Front door open, rear doors disabled
Centered	Front door closed, rear doors disabled
First Position Rearward	Front door closed, rear doors enabled
Second Position Rearward	Front door open, rear doors enabled

Contractor shall provide Proof-Of-Payment (POP) push buttons on the outside of the Vehicle by each of the exit door. Whenever the operator enabled the rear exit doors, passengers on the outside of the Vehicle shall be able to push the POP button to open the door. Contractor shall provide the design for SFMTA approval.

4.1.4.1 Door Operations

The designs, configurations, locations, operations and mounting installations must be approved by the SFMTA.

A separate switch, convenient to the operator, shall convert the rear doors to power doors with simultaneous opening and closing of both door valves controlled by the operator.

Operation of, and power to, the passenger doors shall be completely controlled by the operator. Doors shall open or close completely within 2 – 4 seconds from the time of actuation, and shall be subject to the adjustment requirements of Section 3.2.6 (Actuator). Activation of the door mechanism can be accomplished using electric power. Electric powered doors shall operate similarly to the following description for air-powered doors.

The rear exit door panels shall include a sensitive edge for the purpose of alarming and reversing door operation in the event an individual or an individual's limb would be caught between the doors on closure. The sensitive edge will activate a toned alarm in the operator's area, and immediately open the exit door. Once the obstruction is cleared, the operator will be

required to recycle the door controller to the open position before being able to again activate closure of the doors. Detailed specifications are listed in 3.2.8 (Sensitive Edges).

4.1.4.2 Interlock

When any door controls are activated, an accelerator interlock shall inhibit the acceleration of the Vehicle, and a braking interlock shall engage the rear axle service brake system. The interlocks shall not release until the front and rear doors have closed and the operator has positioned the door control to the "all doors closed" position. If the Vehicle is not stationary when the interlock is engaged, a loud, momentary alarm will sound. Reference Section 6.1.5 (Propulsion System Interlocks).

4.1.4.3 Interlock Override Switch

An interlock override switch, enclosed in the front destination sign compartment or located on the street side overhead panel above the driver, shall, when set in the "off" position, release and deactivate the door interlocks, allowing the release of the inhibited throttle, and enabling the front doors. An audible alarm shall be activated when the override switch is in the “off” position. The design and access to the interlock override switch must be approved by the SFMTA during design review.

4.1.5 Steering Wheel and Horn Button

The steering wheel shall last the life of the Coach, and shall be constructed of a hard, smooth black material impervious to, cleaning fluids, and body acids. The steering wheel shall be no less than 18 inches in diameter and shall be shaped with a soft rim grip for comfort for long periods of time. The steering wheel spokes or rim shall not obstruct the operator's vision of the instruments when the steering wheel is in the straight-ahead position. The steering column shall be capable of a minimum six inch horizontal adjustment and a two-inch vertical adjustment from the operator seat. Clearance requirements shall be met in all positions. Reference Section 5.2.3 (Turning Effort).

Dual electric horns shall be provided, mounted to prevent entry of water and dirt into horn trumpets. The horns shall sound high and low notes (notes D & F) that are clearly audible over 80 dBA traffic noises at a distance of 300 feet. The horn button shall be located in the steering wheel hub and shall be protected from debris accumulation and shall not incorporate any manufacturers' logo.

The steering wheel shall be Vehicle Improvement Products BKBL1824D4SS, BKBL2D24D4V, V4105-42W, or approved equal and the horn assembly shall be a Vehicle Improvement Products HB9T, HB10NB3, V4P-001PRO2, or approved equal.

4.1.6 Accelerator and Brake Pedal

Contractor shall install an adjustable pedal system by Kongsberg or approved equal. The adjustable pedal system shall simultaneously slide the brake and accelerator pedals for three

inches both forward and rearward. The adjustment shall be made by use of a dash mounted toggle or rocker switch. The switch shall be clearly labeled to identify it as pedal adjustment and shall be within easy reach of the operator. The design and locations shall be determined at the design review.

Accelerator and brake pedals shall be designed for ankle motion and shall meet the requirements of SAE J1516. Foot surfaces of the pedals shall be faced with wear-resistant, nonskid, replaceable material. Force to activate the brake pedal control shall be an essentially linear function of the Coach deceleration rate and shall not exceed 80 pounds at a point seven inches above the heel point of the pedal to achieve maximum braking. The heel point is the location of the driver's heel when foot is rested flat on the pedal and the heel is touching the floor or heel pad of the pedal. Brake and accelerator design shall refer to Figure 4-1 (Operator Control Requirements).

4.1.7 Master Run Switch

Controls for propulsion operation shall be closely grouped within the operator's area. These controls include a separate master run switch and start switch or button. The master run switch shall be a four-position (Stop Propulsion/Day Run/ Night Run/ Night Park) five-position (Off/Acc/On/Night/CLID) rotary switch located conveniently to the operator's left.

4.1.8 Hill Holder

The Contractor shall provide an automatic hill holding system, but if manual control is necessary, the hill holder control shall be conveniently located to the operator's left. Reference Section 5.3.8 (Hill Holder).

4.1.9 Turn Signal

Turn signal controls shall be foot-controlled, water-resistant, heavy-duty momentary contact switches, floor-mounted on a platform in a manner that precludes confusion among the left, right, and high-beam switches. Whenever the turn signal control is activated, an external audible warning shall sound to warn other drivers that the Coach is preparing to make a turn. The external audible curbside turn signal alarm, a Mallory Sonalert SC628JR, a suitable model from ECCO, or approved equal, shall be located on the exterior of the Bus in an optimal audible location, and shall sound whenever the turn signal is activated.

The Contractor shall install two independent override toggle switches, one for the left turn beeper and one for the right turn beeper, in a secured locking compartment on the Vehicle, only accessible by 4M mechanics,. The location shall be review and approved by the SFMTA.

4.1.10 Destination Sign Control & Automatic Next Stop Passenger Information System

Reference Section 3.10 (Destination Signs), and Section 3.11 (Digital Voice Announcement System).

4.1.11 Fare Collection Area Light Control

Reference Section 4.7 (Operator's Area Lighting).

4.1.12 Climate Control

The climate control shall provide switches or display panel on the instrument panel to control the heating and ventilating. All switches or display panel locations must be reviewed and approved by the SFMTA.

Reference Section 3.4 (Interior Climate Control), Section 3.5 (ROOF VENTILATORS), and Section 4.3 (OPERATOR'S VENT AND HEATER/DEFROSTER).)

Operator Heater/Defroster: There shall be a minimum 2-speed switch to control the heater/defroster.

4.1.13 Silent Alarm and Event Marker

Contractor shall install a silent alarm switch in a location to be determined at the design review. When the silent alarm switch is activated, the following events shall occur:

- The recording system must protect a window of recorded data that extends beyond the beginning and ending of an event. Reference Section 3.13.2 (Silent Alarm Requirements).
- A help message (subject to SFMTA approval) shall display on the front- and rear-facing destination signs.
- SFMTA Central Control shall be alerted to notify proper authorities.

At the discretion of the operator, a control event marker (pushbutton or equivalent) shall be available to mark an event in the same manner as specified for the silent alarm in Section 3.13.2.

4.2 OPERATOR SEAT

The operator seat shall be a USSC 9100 ALX, modified to meet the specifications listed below in Section 4.2.1, Dimensions and Adjustability, or approved equal. It shall be easily removable from the Coach for service or repair. A non-removable headrest is required; however, it shall be easily removed and installed by a mechanic. Installation must be approved by the SFMTA.

The Contractor shall install a parking alert alarm on the Vehicle. The alarm shall sound if the Operator unbuckles the seatbelt and leaving the operator seat but the parking brake is not set. The Contractor may utilize the seat belt fastening as the sensing element. The Contractor is required to submit a proposal to the SFMTA for review and approval.

4.2.1 Dimensions and Adjustability

The operator's seat shall be adjustable so that persons ranging in size from the 95th percentile male to the 5th percentile female may safely and comfortably operate the Coach. A footrest shall be provided for the operator's left foot. The operator's seat cushion shall have a minimum width of 18 inches, a depth of 16 inches and a rearward slope with a total range of adjustability of 10 degrees. The operator seatback height, measured from the point of intersection of the uncompressed seat cushion with the seatback to the top of the back, shall be a minimum of 23 inches. The angle formed between the seat back and the seat cushion shall be adjustable in the range of 95 to 120 degrees. The height of the seat shall be adjustable so that the distance between the top of the uncompressed seat cushion and the floor shall vary between 12 and 20 inches. The height of the lumbar support from the seat shall vary between 9 and 12 inches. The seat shall be adjustable forward and rearward for a minimum travel of 12 inches and shall provide a minimum of 33.5 inches of horizontal distance between the seat reference point and heel of the driver on accelerator pedal. While seated, the operator shall be able to make all adjustments by hand, easily and conveniently. Adjustment mechanisms shall hold the adjustments and shall not be subject to inadvertent changes.

4.2.2 Structure and Materials

The operator's seat shall be contoured to provide maximum comfort and safety for extended periods of time. Cushions shall be padded with at least three inches of closed cell molded self-skinning polyurethane on the seat cushion and back, and shall comply with FMVSS fire and smoke requirements. Supplementary cushioning shall be provided by air suspension of the seat assembly. The spring rate of the supplementary suspension and the seat height shall be independently adjustable by the operator. Seat suspension shall effectively dampen road shock, so the seat shall not oscillate excessively during normal driving conditions, including passing over potholes. Upholstery shall be H012 Hampton Black Vinyl, or approved equal, and must be approved by the SFMTA during prototype review.

All visually exposed metal on the operator seat, including the pedestal, shall be aluminum and stainless steel. The seat shall be adjusted without unfastening the seat belts. The seat shall be supplied with belt assemblies, lap belt system and shall accommodate all drivers in all positions of the seat. Seat belts shall be stored in automatic retractors. The color of the operator seat shall be black and the seat belt shall be orange.

4.3 OPERATOR'S VENT AND HEATER/DEFROSTER

A separate operator-controlled heater and blower shall be provided to heat the operator area and defrost the windshield. The unit shall be sized and designed to operate in the San Francisco environment providing a comfortable work area during normal transit operation. The blower shall have at least two speeds. Adjustments shall permit variable distribution or shutting off of the airflow. The windshield defroster unit shall comply with the SAE recommended practices J381 or J382. If the proposed ventilation system does not meet these requirements the Contractor shall submit their alternative to the SFMTA for final approval. Placement and operation must be approved by the SFMTA.

Contractor shall demonstrate the operator's area heating and ventilation system's compliance with the specification.

4.4 OPERATOR WINDOWS

4.4.1 Windshield

The windshield shall permit an operator's field of view as specified in SAE Recommended Practice J1050. The vertically upward view shall be at least 14 degrees, measured above the horizontal and excluding any shaded band. The vertically downward view shall permit detection of an object 42" high at no more than 26" in front of the Coach. The horizontal view shall be a minimum of 90 degrees above the line of sight. Windshield pillars shall not exceed 10 degrees of binocular obscuration. The windshield shall be designed and installed to minimize external glare as well as reflections from inside the Coach.

The windshield shall be laminated safety glass of minimum of 1/4-inch-thick and conforms to the requirements of ANSI Z26.1-1983 Standard for Type AS-1. The windshield shall be easily replaceable by removing zip-locks from the windshield retaining moldings. Bonded-in-place windshields shall not be used. The glazing material shall have single-density tint. The upper portion of the windshield above the operator's field of view may have a dark, shaded band with a minimum luminous transmittance of 6 percent when tested according to ASTM D-1003. The SFMTA prefers windshields with flat glass.

4.4.2 Side Window

The operator's side-window shall be safety glass of minimum of 5 mm thick and conform to the requirements of ANSI Z26.1-1983 Standard for Type AS-2. The entire side window area shall contain a two-section sash. The front section shall slide horizontally and be glazed with float-type, single-density, tinted safety glass that is neutral gray with approximately 76 percent light transmission. The assembly shall have a ratchet mechanism to prevent uncontrolled sliding. The window tracks, channels, and seals shall be designed to last the service life of the Coach. Contractor shall provide glass dimensions and specifications. The side window shall be equipped with a visor or approved equal. The design of the operator's side window and locking arrangement must be approved by the SFMTA.

4.5 MIRRORS

4.5.1 Exterior

The Coach shall be equipped with a pair of corrosion-resistant exterior rearview mirrors on each side of the Coach. Both mirrors shall be Hadley or approved equal. Both mirrors shall be remote adjustable. The mirrors shall be separately adjustable and replaceable. The mirrors shall permit the operator to view the highway along both sides of the Coach, including the rear wheels. The exterior rearview mirrors should have turn signals embedded to the mirror lens. Both mirrors shall be mounted on swivel arm no less than 74 inches above the street surface.

Mirrors shall be firmly attached to the Coach to prevent vibration and loss of adjustment, but not so firmly attached that the Coach or its structure is damaged if the mirror is struck, and shall

retract or fold sufficiently to allow Coach-washing operations. All exterior mirrors electrical wiring shall utilize Quick Disconnect Connectors located as close as possible to the mirror for ease of maintenance. The mirrors shall be mounted on spring-loaded brackets and be guarded from hitting the Coach sides in the retracted position. Mounting arms shall not protrude beyond the outside mirror edge. The mirrors, mirror bracket construction, mounting location and installation must be approved by the SFMTA.

4.5.2 Interior

Rear view mirrors shall be provided and arranged so that the operator can observe passengers throughout the Coach without leaving the operator's seat and without shoulder movement. With a full standee load, including standees in the vestibule, the operator shall be able to observe passengers anywhere in the aisles, and in the rear seats. Interior mirrors shall not be in the line of sight to the exterior curbside mirror. Mountings shall be sturdy to resist flexing, vibration, and vandalism.

Interior observation shall be accomplished by a swivel-mounted flat rear view mirror of 8 inches by 15 inches attached above and to the right of the operator's head. The locations of mirror mountings must be approved by the SFMTA, including assurance the step well mirror does not encroach upon passenger doors during access/egress.

4.6 PUBLIC ADDRESS SYSTEM

The public address system shall be activated by a floor-mounted momentary switch to permit driver to make internal announcement and / or external announcement only - switching from inside to outside speakers shall not require volume adjustment. Switch shall be easily accessible to the operator. Contractor shall provide a Stealth Mic hands-free digital microphone system by Digital Recorders Inc. or approved equal. Reference Section 3.12 (Public Address System).

4.7 OPERATOR'S AREA LIGHTING

The operator's area shall have a light to provide general illumination, and it shall illuminate the half of the steering wheel nearest the operator to a level of 10 to 15 foot-candles. This light shall be controlled by a switch convenient to the operator.

A high-intensity bullet light mounted in the ceiling shall spotlight the money receptacle of the fare box when the front door is open and the master run switch is in the "RUN" position.

4.8 OPERATOR BARRIER

An operator barrier in the operator's area shall be provided on all of the Vehicles delivered. The barrier shall be designed to have no glare, reflection and rattle as design criteria. The barrier shall be an Arow Global sliding barrier with an extended slider to provide added protection to the operator. The barrier shall have an opening such that the lower half only or both halves can be closed or safely left opened at the operator's discretion. The barrier shall extend high and low

enough to offer suitable protection to the operator. The final barrier design must be approved by the SFMTA. Where visibility is required, clear Lexan type material or laminated safety glass can be used to comply with all FMVSS visibility and safety requirements. The barrier shall extend to within one inch of the floor, ceiling and walls. The design of the operator barrier must be approved during the design review and shall comply with all applicable regulations. The barrier color should be black or gray in color. The barrier shall meet the strength requirements described in Section 2.3.1 (Divider and Side Trim Panel). The latching mechanism shall be easily accessible to all operator heights. The Contractor shall review the barrier on the existing SFMTA fleet prior to submitting a proposal for the SFMTA to review and approve.

4.9 TRASH RECEPTACLE

Contractor shall provide and install a cylindrical plastic trash receptacle, 13 inches high and six inches in diameter.. It shall be mounted on the door of the operator barrier and shall not rest on the Coach floor.

4.10 FARE COLLECTION EQUIPMENT

Refer to Section 3.16 (Fare Collection).

4.11 SUN VISOR

Contractor shall provide an adjustable sun visor for use on the operator's front and side of the windshield. The front visor shall be a scissor type roller blind with 20 inches of travel. The side visor shall be a black padded visor which shall not obstruct the street side exterior mirror. The visors shall be shaped to minimize light leakage between the visor and windshield pillars. The visors shall store out of the way and shall not obstruct airflow from the climate control system or foul other equipment, such as the destination sign control. Deployment of the visor shall not restrict vision of the rearview mirrors. Visor adjustments shall be made easily by hand with positive locking and releasing devices and shall not be subject to damage by over tightening. Sun visor construction and materials shall be strong enough to resist breakage during adjustments. The visor, when deployed, shall be effective in the operator's field of view at angles more than 5 degrees above the horizontal. A spring-loaded clip not less than 3 inches wide shall be securely riveted to each side of the sun visor to retain operator's run sheet. Covering on the visor shall be black vinyl similar to that of the operator's seat.

4.12 STORAGE LOCKER

The contractor shall furnish and install one storage locker with latch in the curbside wheel well or in the operator area. The locker shall be at least 1.25 cubic feet. Location, design and materials must be approved by the SFMTA.

4.13 OPERATOR'S PLATFORM

The operator's platform shall be finished with no sharp edges and shall not interfere or impede wheelchairs or other mobility aids. The SFMTA prefers that the Contractor provide Operator's platforms similar to those on the SFMTA's existing motor coaches.

The floor in the operator's area must be capable of being easily cleaned and shall be arranged to prevent debris accumulation. Floor covering shall be Altro Transflor TFFG2704F "Rocket", or approved equal.

5 CHASSIS

5.1 SUSPENSION AND AXLES

5.1.1 General Requirement

All axle suspensions shall be pneumatic type and shall have a load rating compatible with that of the axles. The Coach should be equipped with an anti-sway bar or other equipment approved by the SFMTA to limit Bus sway. The basic elements of the suspension system shall last the life of the Coach without major overhaul or replacement. Suspension beams, weldments and structural members shall be considered as parts of the basic body structure. Items such as bushings and air springs shall be easily and quickly replaceable by a 4M mechanic in an hour or less. Suspension pivots shall be replaceable. Bushings shall be permanently lubricated and interchangeable at all positions. Adjustment points shall be minimized and shall not be subject to a loss of adjustment in service. Necessary adjustment shall be easily accomplished with minimum disassembly or removal of components. Caster and toe-in adjustments shall be possible without removal of any component. Contractor shall provide axle tool kits which contain specialty tools required for axle nuts, flanges, bearing replacement, seal installation, service brake reline / hardware replacement etc.

5.1.2 Axles

All axles shall have a minimum load rating sufficient for the Coach loaded to GVWR and shall operate for 200,000 miles on the design operating profile without repairs. The axle gearing shall be easily accessible for lubrication and all axles must be approved by the SFMTA.

The front axle suspension system shall be dropped beam with hollow section M.A.N., Rockwell, Meritor, ZF, or approved equal. The Contractor may propose an alternate independent front suspension system.

The rear axle shall be heavy-duty non-steerable type M.A.N., ZF, or approved equal. End tubes shall be removable and shall be threaded to allow for adjustment of wheel bearing nuts. The lubrication drain plug shall be magnetic type.

Reusable axle hub bolts are preferred.

Minimum axle load ratings are encouraged to be rated so that GVWR is maximized.

5.1.3 Wheel Bearings

Wheel bearings shall provide smooth low friction rotation of the wheels under all operating conditions. The wheel bearings shall be easily accessible, maintainable, and replaceable. Wheel bearing inner grease seal shall run on a replaceable-chromed wiper ring or the tube. All bearings shall be sealed properly to prevent leakage of lubricant. The non-drive axle bearings shall be grease unitized bearings by SKF, Inc., FAG, or approved equal.

5.1.4 Air Bellows

The air suspension system shall consist of at least two, and preferably four, air bellows per axle. The system shall use leveling valves and bellows to maintain constant spring characteristics and Coach body height, regardless of Coach loading. Leveling valve exhaust ports shall be guarded to avoid plugging with road dirt.

Air bellows shall be removable, replaceable and serviceable without removal of any wheels while the Coach is on standard in-ground hoists, above ground hoists or in a pit area. The type and manufacturer of the air bellows requires the approval of the SFMTA.

5.1.5 Travel

The suspension system shall permit a minimum wheel travel of 2½ inches in jounce-upward travel of a wheel when the Coach hits a bump (higher than street surface). And a minimum of 2 inches rebound–downward travel when the Coach comes off a bump and the wheels fall relative to the body. Elastomeric bumpers shall be provided at the limit of jounce travel. Rebound travel may be limited by elastomeric bumpers or hydraulically within the shock absorbers. Suspensions shall incorporate appropriate devices for automatic height control, so that regardless of load the Coach height relative to the centerline of the wheels does not change more than ±½ inch at any point.

5.1.6 Damping

Vertical damping of the suspension system shall be accomplished by multi-shock absorbers mounted to the suspension arms or axles and attached with replaceable bolts and nuts to appropriate locations on the chassis. Damping shall be sufficient to control Coach motion to three cycles or less after hitting road perturbations. Shock absorbers shall maintain their effectiveness for at least 50,000 miles and each shock absorber unit shall be individually replaceable by a 4M mechanic in less than 30 minutes. Variations in passenger loading shall not adversely affect the handling characteristics of the Coach sufficient to classify it as dangerous, unsatisfactory, and uncontrollable.

5.1.7 Kneeling

The Coach must kneel evenly on both sides. The operator-actuated kneeling device shall lower the step at the front door to a height of no more than 12 inches, measured at the longitudinal centerline of the front door to the ground. Brake and throttle interlocks shall prevent movement when the Coach is kneeled. The kneeling control shall be disabled when the Bus is in motion. The kneeling controls shall not be operational while the wheelchair ramp is deployed. A three-position, spring-loaded, normally centered switch located in the operator's area shall control kneeling of the Coach. A downward force on the switch shall activate the kneeling function. The Coach shall complete kneeling in a maximum of five seconds from the time the switch is

activated. During the lowering and raising operations, the maximum acceleration shall not exceed 0.2g, and the jerk shall not exceed 0.3g per second, measured on a front step tread. An indicator, visible to the operator, shall be illuminated whenever the Coach is too low for safe street travel and the interlocks are engaged. An audible alarm and visual signal mounted near the door pillar shall operate when the Coach's kneeler is in motion. The audible alarm shall be a different frequency than other alarms and beeper. The sound and operation of this alarm must be approved by SFMTA at the design review.

The Coach shall remain kneeled when the control switch is released. An upward force on the switch shall be required to raise the Coach. The Coach shall rise to the correct operating height within seven seconds.

5.1.8 Over-Raise Feature

Due to the topography of the SFMTA Bus routes, the Contractor shall provide an over-raise switch on the side-panel console of the Operator platform. The over-raise feature shall be activated and sustained its raised height during a predetermined speed range limit and de-activated once the speed exceeds the allowable speed limit. The SFMTA prefers that the over-raise feature have the capability to activate while the Vehicle is in motion at low speed operations. The design and operations shall be determined and approved by the SFMTA at the design review.

The over-raise feature shall allow the Buses to traverse all routes in the SFMTA service areas without scraping the pavement.

5.1.9 Lubrication

All elements of steering, suspension, and drive systems requiring scheduled lubrication shall be provided with grease fittings conforming to SAE Standard J534. These fittings shall be located for ease of inspection, and shall be accessible with a standard grease gun with flexible hose ends, from a pit or with the Coach on a hoist. Each element that requires lubrication shall have its own grease fitting with relief path. The lubricant specified shall be standard for all elements on the Coach to the greatest extent possible. The manufacturer shall supply the SFMTA with a maintenance schedule and protocol.

5.2 STEERING

Electrically assisted or hydraulically driven steering shall be provided. The steering column shall have telescoping and tilt column adjustments. The steering gear shall be an integral type with the number and length of flexible hydraulic fluid lines minimized. Fatigue life of all steering components must exceed 1,000,000 miles. No element of the steering system shall sustain a Class 1 failure when one of the tires hits a curb or strikes a severe road hazard at 40 MPH or slower.

The steering gear shall be an integral type hydraulically driven power steering system. Approved equals must have similar performance, durability, housing size, height and telescoping range. Any failure of the electric powered assist shall result in the system defaulting to standard hydraulic power steering with no loss of steering control. System shall be wired so that the controlling ECU correctly recognizes straight wheel position even after the Bus has been shut off. Electrically assisted steering shall be provided to reduce steering effort (see Section 5.2.3 below).

5.2.1 Strength

Fatigue life of all mechanical steering components shall exceed the service life of the Coach. No element of the mechanical steering system shall fail before suspension system components when one of the tires strikes a severe road hazard. The mechanical steering system shall be considered as part of the basic body structure.

The manufacturer shall provide the SFMTA with certificates that validate the strength and security of the suspension and steering system, along with any test documentation for tests that have been conducted.

5.2.2 Turning Radius

The outside body corner turning radius shall not exceed 45 feet with the Coach at Seated Load Weight.

5.2.3 Turning Effort

Steering torque applied by the operator shall not exceed 9 foot-pounds with the front wheels straight ahead to turned 10 degrees. Steering torque may increase to 70 foot-pounds when the wheels are approaching the steering stops. Steering effort shall be measured with the Coach at GVWR, stopped with the brakes released, and electric drive at normal operating speed (as applicable) on clean, dry, level, commercial asphalt pavement and the tires inflated to recommended pressure. Power steering failure shall not result in loss of steering control. With the Coach in operation, the steering effort shall not exceed 55 pounds at the steering wheel rim, and perceived free play in the steering system shall not materially increase as a result of power assist failure. Gearing shall require no more than seven urns of the steering wheel lock-to-lock.

Caster angle shall be set to provide a tendency for the return of the front wheels to the straight position with minimal assistance from the operator.

5.3 BRAKES

5.3.1 Description

The SFMTA prefers to have air actuated disc brakes. The disc brake system and replacement parts shall be commercially available in North America.

5.3.2 Actuation

Service brakes shall be compressed air operated and controlled with a single actuator at each wheel. Force to activate the brake pedal shall be as specified in Section 4.1.6 (Accelerator and Brake Pedal).

Disc brakes shall have either axial or radial air actuation with a single floating caliper operation.

5.3.3 Friction Material

The entire service brake system, including friction materials, shall be designed to have an overhaul or replacement life of 30,000 miles with brake retardation through regenerative braking. Disc pad friction material shall be non-asbestos and bonded to the pad.

5.3.4 Rotors

Brake rotors shall be sized to the Vehicle weight and wheel diameter and meet all FMVSS requirements. The brake rotors shall be able to be resurfaced in the field and have the minimum thickness size stamped in the casting.

Wheel bearing seals shall run on replaceable wear surfaces. Wheel bearing and hub seals shall not leak or weep lubricant for 50,000 miles when running on operating profile.

5.3.5 Brake Adjustment

Disc brakes shall not require in-service adjustment and have mechanical or electronic brake wear indicators for lining thickness on each brake assembly.

5.3.6 Parking Brake

The parking brake shall be spring applied and air released, controlled by manual valve (Bendix or approved equal) and shall be mounted on the left side of the driver's seat. The design and location must be approved by SFMTA.

The parking brake system shall hold the Coach loaded to GVWR in both forward and rearward directions on a 23 percent grade, and shall be capable of locking the braked wheels on a surface with a skid number of .75 at speeds up to 20 mph. This brake shall comply with FMVSS-121 requirements. A separate "Parking Brake Applied" (see Section 4.1.3: Indicators) indicator with audible alarm shall be provided on the panel and it shall:

- Activate an interior audible warning alarm and blinking warning lights if the parking brake is not applied and the Master Run Switch is set to the "Off" position. A visual message on the dash may replace the alarm if approved by the SFMTA
- Illuminate the "Parking Brake Applied" indicator upon activation of the control.

5.3.7 Anti-Lock Braking System with Traction Control

The Coach shall be equipped with all wheel anti-lock braking system (ABS) with traction control by Rockwell, Wabco, Bendix or approved equal. The Contractor shall provide complete performance data and system design of the brake system with ABS. The design must be approved by SFMTA. ABS brake diagnostic cartridge, if required, shall be supplied by the Contractor. All essential information and equipment needed to test, troubleshoot, and repair the brake system controller shall be provided to the SFMTA by the Contractor. This information and equipment shall encompass the system on the Coach and the repair of the individual sub-assemblies down to the components on the printed circuit boards of the sub-assemblies.

5.3.8 Hill Holder

An automatic hill holder system incorporated in the propulsion system shall be provided. A conventional hill holder system shall be incorporated in to the braking system. If configured for manual operation, control of the hill holder shall be a spring-loaded, guarded switch, which is normally “off” located to the left of the operator. Activation of the switch shall engage the same rear service brake system as the interlock system described in Section 4.1.4.2 (Interlock). Regardless of whether the hill holder is configured for automatic or manual operation, accelerator operation shall not be affected by activation of the hill holder. Activation of the hill holder shall light the brake lamps and prevent roll back.

5.3.9 Brake Jerk

Jerk, the rate of change of acceleration measured at the centerline, floor level of the Coach shall be minimized throughout acceleration and regenerative braking or other methodologies of auxiliary braking and shall be no greater than 0.3 g/sec. for duration of a quarter-second or more.

5.4 REGENERATIVE BRAKING

Energy regeneration shall not cause the driver to lose control of the Coach regardless of the surface coefficient (μ) that the Coach is being operated on. Total brake rate shall be 3.5 mph/s or otherwise approved by the SFMTA.

Brake lights shall illuminate when brake regeneration is activated.

Brake regeneration shall become engaged (with a resulting deceleration of no greater than 0.03 g) when the throttle is completely released (e.g., zero throttle). With brake regeneration, when the brake pedal is depressed to engage the service brakes, the resulting maximum resulting deceleration shall be 0.13 g. The resulting deceleration specified shall include the effects of regenerative braking, wind resistance and rolling resistance.

The Contractor shall also be responsible for a system design that takes into account any necessary regenerative braking cutout when the storage system becomes fully charged and the Bus is still in a downhill braking situation.

Braking effort derived from energy regeneration or dynamic braking shall be blended with the standard air brake system such that the braking response of the Vehicle is similar to that of a conventional diesel Coach and requires no additional driver skill or training to operate than a conventional diesel Coach. The regenerative brake controller shall be a full range control. Stepping controls are not permitted.

Regenerative braking force shall remain consistent and predictable to the operator. The system shall be designed in a manner to effectively dissipate excess energy while providing consistent auxiliary braking.

5.5 AIR SYSTEM

The Coach air system shall operate all accessories and the braking system with reserve capacity. The new Coach shall not leak down more than five psi as indicated on the instrument panel mounted air gauges, within 15 minutes from the point of governor cut-off. The air system shall be equipped with check valve and a pressure protection relief valve to assure partial operation in case of line failures. Load and demand calculations shall be submitted to the SFMTA for approval.

Provision shall be made to apply shop air to the Coach Air systems through Amflo CP2 female charging port or approved equal. These valves shall be conveniently located in the motor compartment, behind the front bumper, and just inside the front door and shall mount into a 1/4" Amflo fitting. The Contractor may submit alternative locations for these valves for approval by the SFMTA. Metal identification plates shall be placed near the charging parts to identify the correct airline attachment. Final locations of the valves must be approved by the SFMTA during prototype review.

5.5.1 Air Compressor

The air compressor shall be a direct coupled scroll compressor from Hydroyane or Powerex, a Knorr oil flooded screw, or an approved equal. The air compressor shall have the capacity to charge the air system from 40 psi to the governor cutoff pressure in less than four inutes. The compressor output rating shall be dependent on the manufacturer’s calculations of the required volumes necessary for normal transit operation including but not limited to braking, door operation, air suspension and all other components requiring pneumatic power. This calculation shall be presented and explained to the SFMTA for approval during prototype review.

5.5.2 Air Lines and Fittings

Air lines, except necessary flexible lines, shall conform to the installation and material requirements of SAE Standard J1149 for copper tubing with standard brass flared or ball-sleeve

fittings, or SAE Standard J844 for nylon tubing. The routing shall preclude the nylon tubing from being subjected to temperatures over 200°F. Air lines shall be cleaned and blown out before installation and shall be installed to minimize air leaks. All air lines shall be sloped toward a reservoir and routed to prevent water traps. If the Contractor has different color coding other than what is listed in Table 5.5.2, then the Contractor shall submit the alternates to the SFMTA for approval. Nylon tubing shall be installed in accordance with the following standard color coding:

TABLE 5.5.2

GREEN	Primary brakes and supply
RED	Secondary brakes
BROWN	Parking brake
BLACK	Accessories
BLUE	Suspension

Nylon lines may be grouped and shall be continuously supported and prevented from any movement, flexing, tension strain, and vibration. Copper lines shall be supported by looms at intervals of no more than five eet to prevent movement, flexing, tension strain, and vibration. Copper lines shall be prevented from touching one another or any component in the Coach. To the extent practicable and before installation, the copper lines shall be pre-formed on a fixture that prevents tube flattening or excessive local strain. Copper lines shall be bent only once at any point, including pre-bending and installation, to avoid fatigue of the tubing.

Flexible hoses shall be as short as practicable and individually supported. They shall not touch one another or any part of the Coach except for the supporting grommets. Flexible lines shall be supported at 30” intervals or less. Grommets for bulkhead fittings shall protect the air lines at all points where they pass through under structure components.

The compressor discharge line between the air compressor and the bulkhead shall be flexible convoluted copper or flexible Teflon hose with a braided stainless steel jacket. The line between the bulkhead and the air dryer shall have a minimum inside diameter of one inch. End fittings shall be standard SAE or JIC brass or steel flanged, reusable, swivel-type fittings.

All hoses and lines shall contain adequate separation to ensure no contact between lines.

5.5.3 Air Reservoirs

Air reservoir tanks shall supply air for the Vehicle’s air suspension system, door operating mechanism and brake system. These air tanks may be mounted in the ceiling behind the interior LED lights or underneath the Coach, easily accessible for inspection and maintenance. The number of tanks required with a 25% reserve, sizes, mounting and final locations must be approved by the SFMTA.

All air reservoirs shall meet the requirements of FMVSS Standard 121 and SAE Standard J10. The air tanks shall include drain valves that are easily accessible. Major structural members shall be provided to protect these valves from road hazards.

5.5.4 Air Dryer

A QBA series air dryer from Wabtec, Bendix or approved equal, shall meet the following salient characteristics:

A. Dryer shall be sized for the air system volume and compressor capacity
B. Continuous flow capacity based on continuous inlet temperatures of 200*F
C. Twin tower desiccant style dryer capable of switching towers for regeneration
D. Dryer shall have an ambient operating temperature range from –40*F to 150*F
E. Dryer shall have a filtration package that conditions the air before the towers. This includes a pre-filter for bulk carbon, oil and water removal and a coalescing filter with a 99.9% efficiency rating in addition to removal of water and oil aerosols down to .03 micron, and dirt and carbon down to .3 micron.
F. An automatic discharge for accumulated contaminants.

5.6 HYDRAULIC SYSTEM

All hydraulic systems shall demonstrate a mean time between repairs in excess of 50,000 miles. Hydraulic system service tasks shall be minimized, and scheduled no more frequently than those of other major Coach systems. All elements of the hydraulic system shall be easily accessible for service or unit replacement. A priority system shall prevent the loss of power steering during operation of the Coach if other devices are powered by the same hydraulic system.

The hydraulic system shall operate within the allowable temperature range as specified by the lubricant manufacturer.

Sensors in the main hydraulic system, excluding those in the power steering system, shall indicate on the driver’s on-board diagnostic panel conditions of low hydraulic fluid level.

The hydraulic system shall be pressurized by means of an electric motor located near the front of the Bus or at another approved location. If required, a cooling system may be employed to keep the hydraulic fluid at a safe working temperature. The SFMTA expects the hydraulic pump to be automatically switched on and off. Only being run when the hydraulic system requires charging. Interior passenger compartment noise shall not vary more than 5 dB between the hydraulic pump being on or off. If the noise contains an audible discrete frequency that can easily be heard in the passenger compartment the design will be deemed unacceptable. The design is subject to SFMTA approval and must be submitted for engineering review before the 1st Bus starts production.

Filtering shall be provided as recommended by the manufacturers of the hydraulically powered units. Spin-on filters are preferred. Filters shall be provided to protect the hydraulic systems down to 10-micron from contamination. Indicators on the reservoirs shall allow visual detection of low hydraulic fluid level. Permanent diagnostic quick-coupler ports, or approved equal, shall be installed at all locations necessary to provide complete troubleshooting of all hydraulic systems. Filtering system must be approved by the SFMTA.

5.6.1 Hydraulic Lines

Flexible lines shall be minimized in quantity and length. Flexible hydraulic lines shall be Aeroquip, Balflex Rubber or approved equal. Equator 1 (EQ1), Equator 2 (EQ2), 2807 PTFE and GH100 shall be used to accommodate the different ratings as required. Lines of the same size and with the same fittings as those on other piping systems of the Coach, but interchangeable, shall be tagged or marked for use on the hydraulic systems only. It shall not be possible to connect the input lines to the output lines.

Hydraulic lines shall be individually and rigidly supported to prevent chafing damage, fatigue failures, and tension strain on the lines and fittings. Rigid tubing lines shall be continuous from the forward most bulkhead or cross member to rearmost bulkhead or cross member. Welded unions shall be permitted at maximum intervals of 20 feet for lines longer than 20 feet.

5.7 FLUID LINES

Flexible fluid lines shall be kept at a minimum and shall be as short as practicable. Flexible lines shall be Teflon hoses with braided stainless-steel jackets, except in applications where premium hoses are required, and shall have standard SAE or JIC brass fittings. Hoses shall be individually supported and shall not touch one another or any part of the Coach. High-pressure hydraulic lines shall be Aeroquip, Manuli, Balflex or approved equal.

All lines shall be rigidly supported to prevent chafing damage, Fatigue Failures, degradation and tension strain. Lines should be sufficiently flexible to minimize mechanical loads on the components. Lines passing through a panel, frame or bulkhead shall be protected by grommets (or similar devices) that fit snugly to both the line and the perimeter of the hole that the line passes through to prevent chafing and wear. Pipes and fluid hoses shall not be bundled with or used to support electrical wire harnesses.

All hoses, pipes, lines and fittings shall be specified and installed per the manufacturer’s recommendations. Cooling system piping shall be stainless steel or brass. If practicable, rubber hoses shall be eliminated.

Necessary hoses shall be silicone or EPDM rubber type or approved equal that are impervious to all Bus fluids. All hoses shall be as short as practicable. All hoses shall be secured with stainless steel or coated for corrosion resistance clamps that provide a complete 360-degree seal. The clamps shall maintain a constant tension at all times, expanding and contracting with the hose in response to temperature changes and aging of the hose material.

5.8 WHEELS AND TIRES

5.8.1 Wheels

Wheels and rims shall be hub piloted and shall be aluminum one piece, Alcoa Dura-Brite or approved equal. All wheels shall be interchangeable and shall be removable without a puller. Wheels shall be compatible with tires in size and load-carrying capacity front wheels and tires shall be provided in accordance with the SFMTA's requirements.

5.8.2 Tires

The Contractor shall provide Michelin 305/70R22.5 x InCity tires, Michelin X InCity Energy Z LR L-315/80R22 tires, or an approved alternative. Contractor shall provide "plain" valve stem caps with each mounted tire. No valve stem tool will be permitted on the valve stem cap. Current SFMTA Fleet equipped with Michelin 305/70R/22.5 X In City. Tires may come equipped with an external air pressure monitoring system.

5.9 ELECTRONIC ODOMETER DATA RECORDER

Each Coach shall be supplied with a Fleetwatch Bus-mounted data recorder unit. The Bus-mounted data recorder unit shall be suitable for mounting on the Coach and connect directly to a J1939 connector on the Coach. Bus-mounted data recorders shall be programmable with Vehicle number and codes for defining the set of data to be provided to allow for re-program the recorder unit at any time. The recorder shall be programmed to respond to a beacon signal sent from a receiver unit and upon receipt of such beacon signal; the recorder shall transmit via radio frequency the Bus number and other defined data to the receiver unit. The Bus-mounted data recorder unit shall be compatible with the existing SFMTA system. The Contractor is required to seek SFMTA approval during design review.

The Contractor shall provide equipment needed to test, troubleshoot and repair the Bus-mounted data recorder. The task of the final commissioning onsite at the SFMTA shall be included in the Contract price.

5.10 FIRE DETECTION / SUPPRESSION

Contractor shall furnish and install fully automatic fire detection and complete dry chemical fire suppression system manufactured by Fogmaker, Amerex, Kidde, or approved equal.

The automatic detection and activation system shall provide 24-our fire protection for the traction motor compartment and areas of the Coach to be wetted by leaking flammable fluids, including the house battery compartment. Detection of a fire may be by means of infrared/heat or rate of rise/heat. Detection system must be capable of operating without false detection from normally occurring drive temperatures, any source of light, or steam cleaning. It shall be impervious to oils, fuels, and chemicals normally found in a garage environment, and to UV light. It must provide detection capability to all risk zones. In addition to the other alarm sensors, a thermostat detector shall be provided to monitor the temperature of the rear propulsion

compartment. Power for the fire detection system shall be provided by the Bus electrical system directly from the vehicle battery terminals or through dedicated power and ground Buss bars. Nominal power consumption of the system should not exceed 300mA. A battery-backup system shall be provided to give system functionality in the event primary system power is interrupted. The battery must be easily replaceable and must be either readily available through retail outlets or else have a minimum life of 500 hours at system amperage.

The system shall also provide both a manual and automatic means to pneumatically or electrically actuate the fire suppression system. The fire detection layout and the location of the manual actuation switch must be approved by the SFMTA.

Contractor shall supply the fire suppression system testing kit, if required.

The system shall have a 25 pounds dry chemical agent or a 22 pounds purple “K” storage tank and an external expellant gas tank, or an approved equal system. Fire suppression material shall have a chemical composition that does not accelerate metal corrosion due to its exposure.

Two or more linear detection wires shall be installed in the Coach. The contractor will install a sensor with an audible alarm to detect approaching combustion temperatures in the propulsion battery area. The system shall monitor the heat levels and activate an overheat warning light in the driver’s compartment when the temperature returns to normal the overheated alarm shall be deactivated. Also provide appropriate status and warning lights on the driver’s dashboard and audible fire detection warning. This alarm shall sound in both fire and fault conditions. The system shall be false alarm immune from sunlight, flashlight, lightning (excluding a direct hit) and welding arc. The sensor shall have a suppression monitor to determine that each individual component is correctly installed. The system control module shall be fully programmable via laptop computer or PC. Programming features shall include at least the time delay cycles from fire detection to Vehicle shutdown and from Vehicle shutdown to fire suppression system actuation. If a fire is detected, the detection/suppression system shall automatically:

- Activate an audible warning alarm and warning lights.
- Shut off and close off the ventilation system.
- Shut off the flow of hydraulic fluids.
- Reduce propulsion and disconnect propulsion battery power to slow the Coach.
- Flood the propulsion system with sufficient dry chemical agent to extinguish the fire when either the Vehicle speed falls below 15 mph or after certain time delay, adjustable between zero (0) and 15 seconds.

6 PROPULSION SYSTEM

6.1 PROPULSION SYSTEM DESCRIPTION

The Coach shall be powered by a battery electric propulsion system. Function and operation of the Coach shall be transparent to the Coach Operator and passengers. The prime contractor shall assure that the Coach structure can successfully accept the installation of the propulsion system and be operated on a San Francisco duty-cycle for a period of 12 years without a structural failure. Durability of the battery electric propulsion system and its components shall not be reduced and the performance requirements shall be met.

Certified approval for the battery electric system, by the manufacturers of the ESS and electric drive, for the combination of the systems that are to be used, must be submitted by the Contractor. The Vehicle shall not be capable of operating while parked.

Drivetrain components and all other related components shall communicate data using SAE Recommended Communications Protocols J1939. Data communication components shall be compatible with the ViriCiti DataHub onboard vehicle telematics device and with version 1.6 or later of the Open Charge Point Protocol (OCPP) standard.

The electronically controlled energy storage and drive system shall have on-board diagnostic capabilities, able to monitor functions, store out-of-parameter conditions in memory, and communicate faults and vital conditions to service personnel. A diagnostic reader device connector port, suitably protected against dirt and moisture, shall be provided in the operator's area. The on-board diagnostic system shall trigger a visual alarm to the operator when the electronic control unit detects a malfunction. The energy storage shall contain built- in protection software to guard against severe damage.

The drive controllers, power inverters, DC-DC converters, energy storage batteries and energy storage shall be removable as units and shall be interchangeable between similar Buses. Should any of these units require software or firmware reconfiguration the contractor will provide the necessary software and programming tools.

6.1.1 Top Speed

The Coach shall be capable of a top speed of 63 mph on a straight, level road at GVWR with all accessories operating (Reference Section 1.3, PROPULSION SYSTEM PERFORMANCE).

6.1.2 Gradeability

Gradeability requirements shall be met on grades with a dry commercial asphalt or concrete pavement. Reference Section 1.3 (Propulsion System Performance).

6.1.3 Acceleration

The minimum acceleration requirements are given in Section 1.3 (Propulsion System Performance).

6.1.4 Operating Range

The average operating range of the coach operating on all of the routes specified below shall be at least 160 miles on a full charge at the beginning of Vehicle life, while operating in 60°F weather and carrying a 52-passenger load:

- 22 Fillmore
- 9 San Bruno
- 1 California
- 24 Divisadero
- 29 Sunset
- 43 Masonic
- 44 O'Shaugnessy

6.1.5 Propulsion System Interlocks

The electronic foot pedal accelerator shall be interlocked (disabled) when:

- Any door of the Coach is activated by the operator door control (4.1.4.2 Interlock)
- The Coach kneeling system is activated
- The wheelchair ramp is activated, not stowed and locked completely or as indicated by Federal or California State Regulations.

The propulsion system interlock arrangement and control must be approved by the SFMTA.

6.2 PROPULSION SYSTEM SERVICE

For the electric Bus propulsion system additional service compartment gauges required are a drive hour meter, a voltmeter for the 12-volt system, a voltmeter for the 24-volt system, and energy storage main pressure and temperature gauge. Both drive and energy storage temperature gauges shall be mechanical with a resettable maximum temperature indicator. The drive system controller, power inverters, DC-DC converters, and ESS components shall be removable and interchangeable between similar Buses. Should any of these units require software or firmware reconfiguration, the contractor will provide the necessary software and programming tools.

The propulsion system shall be arranged so that accessibility for all routine maintenance is assured. No special tools, other than dollies and hoists, shall be required to remove the propulsion system or any subsystems. Any other component requiring service or replacement

shall be easily removable. Contractor shall provide all special tools and diagnostic equipment required for maintaining the propulsion system.

6.2.1 Energy Storage and Controller

The energy storage system shall include a voltage equalization system designed to provide automatic real-time equalization of voltage between individual energy storage devices within each module. Design and performance must be approved by the SFMTA.

Energy storage shall be of a commercial design capable of operating in the San Francisco transit environment. Charging of the energy storage device shall be accomplished by external charging stations and regenerative braking.

In the event external, stationary chargers are required, Contractor shall provide chargers and all special tools required for maintaining this requirement.

6.3 BATTERY ELECTRIC PROPULSION SYSTEM

Contractor shall provide design and performance data shall be provided to the SFMTA. Energy storage shall be of a commercial design capable of operating in the SFMTA transit environment. The primary charging of the energy storage system shall be accomplished by an external DC charger, the on-board Electric Drive system controller and regenerative braking.

Thermal management will be provided to ensure optimal life and performance of the ESS over the environmental operating range.

The Bus shall have a heavy duty energy storage unit, designed to last the life of the Bus, which, coordinated with the electric drive and the rear axle drive ratio, enables the vehicle to achieve the specified range, top speed, acceleration and hill climbing capability while still maintaining passenger comfort and providing a smooth ride. The ESS shall be rated to operate at the GVWR of the Bus. ESS will be designed to retain 80% of its as new energy carrying capacity after 12 years or 500,000 miles of operation.

The drive energy storage system shall include a management system to monitor and control the operating conditions within each energy storage system module, including voltage, current, and temperature. This system shall include an over-current and an over-temperature protection feature that disconnects flow of current to and from the energy storage modules in the event of an over-temperature or over-current condition. The provided ESS and drive unit diagnostics software shall provide real time data for all sensors in the ESS (voltage, current, temperature, etc.)

The drive energy storage system shall include a voltage equalization system that will provide real-time equalization of voltage between individual energy storage cells within each module. This equalization function shall be accomplished automatically, and shall not require manual intervention by the Bus operator or maintenance personnel.

Altoona testing results for kWh/miles must be submitted for the proposed power plant. Preference will be given for systems that deliver the best performance, with the test Bus configuration taken into account.

The Bus body shall be designed and constructed to ensure passengers and the operator will not be exposed to electrical current either in normal operation or in the event of a vehicle accident. Analysis to validate the design and test data shall be provided to the Agency. The energy storage system shall be designed and constructed to prevent gassing or fumes from the energy storage system from entering the interior of the Bus.

6.3.1 Battery Specification

The Coach shall make use of an Energy Storage System (ESS) composed of battery cells using lithium iron phosphate, lithium nickel manganese cobalt oxide, lithium titanate, or other lithium battery chemistries. The Energy Storage System shall comply with UN/DOT 38.3 requirements for lithium batteries or similar standards for non-lithium batteries.

The Energy Storage System shall be designed so that the required maintenance tasks can be accomplished with minimal labor, and without requiring a mechanic to open the energy storage module enclosures.

The battery cells in the ESS shall be packaged into modules and mounted into enclosures which allows for ease of servicing. These enclosures shall be designed to minimize shock hazard to maintenance personnel. The enclosures shall be designed to last for at least 12 years in transit service operations. The batteries shall be load distributed within the Bus to equalize weight between the wheels on the same axles and to achieve appropriate weight distribution between axles so as not to adversely affect handling of the Bus.

Written confirmation from the battery manufacturer attesting to the safety of the proposed battery system in the specified application and charging profile shall be submitted as part of the proposal, and shall include full disclosure and discussion of any and all issues or prior incidents relating to safety.

Test results from the FTA ABD Cycle economy tests or other applicable test procedures shall be provided to the SFMTA. Results shall include vehicle configuration and test environment information. Energy economy data shall be provided for each design operating profile. The design operating profile is assumed to be defined by the FTA ABD Cycle.

ESS energy consumption tests shall be run on these four duty cycles:

- Manhattan: 6.8 mph
- Orange County: 12.7 mph
- UDDS: 19 mph
- Idle time

This data should include a breakdown of power consumption by subsystem and equivalent comparison to diesel Bus performance.

The SFMTA expects energy consumption data to be provided for each of the listed test cycles. For evaluation purposes, the SFMTA will only use the Orange County cycle.

6.3.2 Charging System (On Board)

All charging systems listed in this section must meet all applicable recommendations from SAE J1772 (or J3068 if released). SFMTA requires that any charging system used is capable of 2-way communication with the Bus ESS and BMS. The Charging System must include the following protections and driver alerts: (i) dynamic state of charge of the Energy Storage System, and (ii) charge rate. The SFMTA requires that both the Bus and charger systems can independently command an emergency stop of the recharge cycle should a critical fault occur.

The SFMTA expects that all charging for the in service use of the initial Buses purchased on this RFP will be done at an SFMTA maintenance facility using a direct single port plug-in style charger.

The SFMTA expects that all Buses accept single port DC charging input from an in yard “plug-in style” DC charging system that can safely recharge the Bus ESS from 10% SOC to 100% in less than four ours. The ESS shall maintain this charge rate throughout the 12-year life of the Bus, or up to 500,000 miles, whichever occurs first.

Provisions for overhead chargers compliant with SAE J3105 (ISO 15118 and IEC 61851 Parts 1 and 23) must be provided. The ESS must be able to accept a charge rate of 300kW for a continuous period of 15 minutes. The center of the overhead charging rails shall be installed above or in front of the center of the front axle of the Coach.

The Buses must be immobilized during all charging operations. Upon successful engagement of the charging interface, the Bus shall be interlocked such that propulsion is rendered non-tractive and the brakes applied.

6.3.3 Conductive Manual Interface (On Board)

The SFMTA requires a contact style charging interface to be provided on the rear of the Bus on both streetside and curbside. The charging ports shall be protected from water and debris intrusion. The ports shall be easily accessible from the outside of the Bus through a separate body access hatch. The ports shall be at a minimum 3 feet above the road surface with the Bus air suspension adjusted to ride height. The ports shall not be more than 5 feet above the road surface with the air suspension adjusted to ride height. Contractor shall provide drawings of the Bus charging ports layout will be provided by the Contractor to the SFMTA.

The SFMTA requires charging ports that comply with the SAE J1772 CCS Type 1 quick charging connector standard or approved equal.

At a minimum, the SFMTA expects the system to be able to charge at 150 kW via single port plug-in style charging, or at 200 amps and the maximum voltage that can be supplied to the traction battery.

6.3.4 Charging Stations

Vendor must provide a Bus that is compatible with ChargePoint Express Plus DC charging stations. SFMTA may exercise the option to buy a charging solution from the vendor. The charging station must be capable of dispensing charge for nine Buses at a maximum power rate of at least 150kW each.

6.3.5 Charging Station Data Collection and Transmission

The systems shall collect, store, and transmit additional data such as past Bus warning, error codes and charging details to remote locations, and automatically output this data and integrate it into the SFMTA's data collection system.

6.3.6 Electric Bus Fire Wall

A fireproof bulkhead (firewall) shall separate the passenger and battery compartment (or compartments, if applicable); the bulkhead shall preclude or retard propagation of a battery fire into the passenger compartment. Any passageways for the climate control system air shall be automatically separated from the battery compartment(s) by fireproof material when a fire is detected. All piping, connectors, fittings, access panels, and fasteners shall be fabricated of fireproof material. These panels, their fasteners, and the firewall shall be constructed and reinforced to minimize warping that would compromise the integrity of the firewall during a fire.

6.4 DRIVE SYSTEM CONTROLLER (DSC)

The DSC (or similar onboard system) shall regulate energy flow throughout electric drive and power system components in order to provide motive performance and accessory loads, while maintaining critical system parameters (e.g., voltages, currents, temperatures) within specified operating ranges.

The controller shall monitor and process inputs and execute outputs as appropriate to control the operation of all propulsion system components.

Energy storage system SOC correction methods stated in SAE J2711 shall be utilized.

The drive system parameters may be configurable to allow optimization of acceleration and regenerative braking, overall performance and electric power efficiency. Manufacturer shall supply performance data for each set of parameters. The configuration default file may be based upon operator route selection via destination sign code.

The system shall provide the following functionality:

Storage of the Bus's data file generated on a day-to-day basis, to include:

- At a minimum, duty cycle information (e.g., time stamp, vehicle speed, elevation, location, ambient temperature), and energy profile information (e.g., voltage and current from the traction motor, auxiliary systems, ESS, power electronics, onboard charging system) at 1-second intervals
- History of charging sessions, energy in, time stamp, SOC
- Incidents and alarms
- Health monitoring and diagnostics information
- The Contractor may offer an expert level software such that the Bus is optimized per duty cycle on the fly, e.g., "adaptive learning" to consider, route, time of day. The objective is to maintain the Bus's level of expected performance, meanwhile minimize the cost of the electric utility used for charging. If the proposed PSC controller does not have the capability to perform "adaptive learning", the Contractor shall perform parameter tuning to help optimize the efficiency of the vehicle to the given route.
- A means of executing "limp home" instruction such that the Bus is able to travel 10 miles without charge assistance on flat ground with the HVAC disabled. The parameters and details of this feature must be approved by the SFMTA during the Pre-Production Meeting.
- A wireless means of communication to the on route and depot charging stations, and/or if probed via a WLAN in close proximity but may remain separate from the Driver System Controller.
- The system is assumed to include current / power sensors at strategic locations throughout the propulsion system components such that real time comparisons can be made between anticipated power flow and actual power. This feature shall facilitate health checking of components to indicate "open", "shorted" and/or components that have considerable variance.
- The system is assumed to include the necessary sensor inputs at strategic locations, such as, temperature, voltage, pressure, etc. such that the entire array of devices is monitored in real time. This feature shall be able to execute commands for the self-preservation of component life, health, reliability and safety. The on-board diagnostic system shall trigger a visual and audible alarm to the operator when the motor controller detects a malfunction and the protection systems are activated.
- The system shall protect the traction motor(s) against progressive damage. The system shall monitor conditions critical for safe operation and automatically de-rate power and/or speed.
- The system shall include a subsystem capable of monitoring the level of connectivity between all propulsion components and associated cabling / connectors to the Bus's chassis and low (12/24 vdc) systems to insure isolation. The energy storage module shall have at least two automatic means / devices of disconnect and one manual capable of interrupting the positive and negative connections within the module enclosure, and rated for disconnect at maximum current.

- The system shall have an interlock that prevents engagement when the charger is connected to the traction battery.

6.5 TRACTION MOTOR

The Coach shall be powered by a traction motor to meet or exceed the performance requirements of this specification for the strenuous service requirements of public transportation in San Francisco. The traction motor should be optimized for use in the electric propulsion system as well as in the areas of reliability, audible noise, and vibration.

A. Two 4M Mechanics shall be able to remove, replace, and prepare the traction motor for service in less than 20 total combined man-hours.
B. The traction motor shall have diagnostic capability via a laptop computer. Remote communication is encouraged. Reference Section 9.3 (Vehicle Subsystems Integration and Diagnostic Testing Requirements.)
C. Contractor shall provide all special tools required for maintaining and rebuilding the traction motor, if applicable.
D. “Check motor” and “stop motor” lights and an audible alarm shall be provided at the operator’s dashboard area.

6.5.1 Traction Motor Protection

All components specified within this section shall be housed within a weatherproof box. The traction motor shall be protected by an electronic control system recommended by the motor manufacturer.

The Digital Input Controller (DICO) shall be equipped with self-diagnostic system as well as system protection and performance diagnostic as a minimum. The DICO shall retain/record a motor failure which can be uploaded to a PC, laptop, or a diagnostic reader (D.R.) for evaluation/analysis. Two D.R. plug-ins shall be provided for the D.R., one shall be at the operator's dashboard and the second shall be at the motor compartment. Locations must be approved by SFMTA**.**

Both plugs shall be permanently affixed to the Coach for ease of plug-in. The option to include remote diagnostic communication is encouraged. All Coaches shall complete all MCM programming prior to delivery.

6.5.2 Propulsion System Interlocks

The electronic foot pedal accelerator shall be interlocked (disabled) when:

- Any door of the Coach is activated by the operator door control (4.1.4.2 Interlock)
- The Coach kneeling system is activated
- The wheelchair ramp is activated, not stowed and locked completely or as indicated by Federal or California State Regulations.

- Propulsion system interlock arrangement and control must be approved by SFMTA.

6.6 BATTERY MANAGEMENT SYSTEM (BMS)

The energy storage system shall include a Battery Management System (BMS) which provides automatic real-time equalization of voltage between individual energy storage devices within each module and controls the operating conditions within each energy storage system module, including the voltage, current, and temperature. This system shall include over-current and over-temperature protection that will cease the flow of current to and from the ESS modules in the event of an over-current or over-temperature condition. Thermal management will be provided to ensure optimal life and performance of the ESS over the environmental operating range. Battery thermal management must be powered from an onboard source at all times. Thermal management must be continuously monitored at all times with appropriate safety interlocks installed to react to adverse conditions as stated in SAE J1772.

The BMS system must be capable of communicating when a battery fault (as defined by the battery manufacturer) has occurred and must be able to identify and communicate the faulty battery in order to perform maintenance. The BMS system must be able to monitor the battery state-of charge and update a gauge viewed by the operator at least once every 15 seconds.

Design and performance of the BMS must be approved by the SFMTA.

6.7 HIGH VOLTAGE DISCONNECT SYSTEM

The high-voltage system shall be fitted with automatic disconnecting contactors located as closely as possible to the positive and negative battery output terminals so as to minimize the external circuitry that is not de- energized when the devices open. These contractors shall be in addition to any such devices incorporated in the motor controller, and shall not require electrical power to operate (that is, they shall be normally open when unpowered). The contactors shall be rated as capable of interrupting the maximum normally encountered charging or operating current at the highest voltage likely to be encountered (maximum charger- output voltage, or charger-input voltage, whichever is greater). Contactors shall be controlled by the “High Voltage Disconnect” switch, and any safety-critical interlocks and interlock loops, motor-controller overcurrent-protection functions, and vehicle crash and/or fire sensors. Reset of the contactors shall require the deliberate action of the operator or maintenance personnel. Contactors should provide a visual or electrical indication of their status (open or closed) or of a failure to function.

All access to high voltage enclosures must be interlocked, such that opening an enclosure automatically disconnects the high voltage system.

This feature could be part of the emergency shutdown system, providing an organized / fail safe method for shutting the high voltage system down by manual activation of an emergency switch (red palm button), sensed isolation fault between high voltage and chassis, opening an interlocked panel, or disconnecting high voltage cables of five amps or greater.

6.8 COOLING SYSTEM

The cooling systems shall be of sufficient size to maintain all electric drive, ESS systems, and the traction motor, at continuous operating temperatures during the most severe operations possible. The fan control system shall be designed with a fail-safe mode of "fan on." The cooling system shall meet the requirements stated in the operating environment.

If a liquid cooling system is provided, a sight glass to determine satisfactory system coolant level shall be provided and shall be accessible by opening one of the compartment's access doors at the ground level or at an approved location. A spring-loaded, pushbutton type, lever type, or approved alterative valve to safely release pressure or vacuum in the cooling system shall be provided. An overflow reservoir is to be provided, unless otherwise approved by the SFMTA. The overflow reservoir is to provide extra capacity to the system. It will be sized to sufficiently replace any common air pockets that form in the system. An expansion tank shall be provided to eliminate air pockets.

Unless otherwise approved by the SFMTA, any radiator used shall be of durable corrosion-resistant construction with bolted-on removable tanks, or welded header tanks. The radiator shall be designed so that a 2M mechanic can gain access to a substantial portion of the side facing the in board side of the Bus for the purpose of cleaning the radiator in five minutes or less.

Any radiator used shall be designed to withstand thermal fatigue and vibration associated with the installed configuration for not less than 300,000 miles without failure.

All liquid high voltage cooling systems shall be equipped with a properly sized water filter. Electrically driven, temperature controlled cooling fans shall be provided.

Any radiator used shall be of tube and fin construction. If serpentine fins are used, they must have hemmed edges.

Time for removal and replacement of the radiator by a 4M mechanic shall not exceed 8 hours.

A Test Port, MAC tools part number RFK-02 "Pete's Plug", shall be provided on the surge tank, and shall be easily accessible through the rear access door or shall be roof mounted. An alternative location for the surge tank may be submitted to the SFMTA for approval. EDPM or silicone hoses shall be used and the cooling system piping shall be fabricated to include rolled ends to enhance clamp retention where hoses connect. The fan system shall include electronic feedback control and have diagnostics capability through a standard SAE J1939 diagnostics port. Diagnostics shall be accessible through standard laptop computers. Fan system diagnostics shall identify individual fans that have failed. The fan system may be integrated into other onboard diagnostics systems.

The fan control system may assure maximum efficiency of the system by activating only those fans necessary to maintain the drive system at proper operating temperatures, or by reducing

the fan speed. It may also include a feature to automatically reduce fan speed, when temperature conditions allow, and whenever the vehicle stops so as to minimize ambient noise. Fan system may include a reversible feature to aid in cleaning the radiator. The fan system must be compatible with the Bus fire control system to assure fans are all turned off within 10 seconds of a fire being detected. See Service Features above, in this section, a switch for manual activation of the fans may be included in the electric drive compartment.

All electrically driven cooling pump are to be of a brushless motor design. Additionally, there shall be no seals that prevent liquid from the pump impeller from entering the electric drive motor. They are to be brushless and seal-less pumps. The pumps shall be fully sealed, maintenance free and rated at a minimum of 40,000 hours of operation at full load.

6.9 DRIVE SHAFT

The drive shaft and universal joints shall be a heavy-duty type. The drive shaft shall be guarded to prevent it from striking the floor of the Coach or the ground in the event of a tube or universal joint failure. Universal joints and drive shaft slip joints shall have separate grease fitting accessible by a standard grease gun. The drive shaft assembly, mounting and components are required to be approved by the SFMTA.

6.10 GEAR RATIO

The gear ratio shall provide the Coach with the ability to maximize acceleration and climbing while still maintaining the ability to achieve the maximum specified speed and meets the performance of these specifications. Reference Section 1.3, (Propulsion System Performance). The final drive gear ratio requires SFMTA review and approval.

6.11 LUBRICATION

Traction motor shall have an oil sampling device compatible with the Probalyzer system or approved equal. The location of the sampling plug requires SFMTA review and approval.

6.12 ACCESSORIES

Accessory drive systems shall operate without failure or unscheduled adjustment for 50,000 miles. These accessories shall be driven at speeds sufficient to assure adequate system performance during extended periods of idle and low route speeds typical of SFMTA operation. Belt guards shall be provided for all belts. All accessories shall be electrically powered and shall not draw so much power from the ESS that the Coach performance during normal use fails to meet the stated performance metrics in Section 1.3 (Propulsion System Performance).

7 ELECTRICAL

The Coach shall be equipped with a Programmable Logic Control (PLC) system that is computer-based and completely modular. All electrical components or equipment shall comply with all the following subsections.

7.1 POWER REQUIREMENT

The electrical power system shall supply a nominal 12 and 24 volts of direct current (DC). Consumable items such as, but not limited to, light bulbs and headlamps shall be supplied at a nominal 12 volts DC. Precautions shall be taken to minimize hazards to service personnel.

The propulsion system shall be sized to provide sufficient power to enable the Bus to meet the defined acceleration, top speed and gradability requirements, and operate all propulsion-driven accessories using actual road test results and computerized vehicle performance data.

The loss of power to the Bus shall not cause the driver to lose control of the Bus or to lose steering or braking. The Bus shall be able to be safely brought to a controlled stop.

7.2 CIRCUIT PROTECTION

Manual reset circuit breakers or fuses shall protect all circuits, except for those involved in propulsion system start-up. Fuses shall be used only where it can be demonstrated that circuit breakers are not practicable, such as areas where the current exceeds 80 amps, and they shall be easily accessible for replacement. All fuses and circuit breakers shall be easily accessible for replacement or reset by being located in areas where special equipment (ladder or hoist) is not required for service or reset. Precautions shall be taken to minimize hazards to service personnel. All manual reset circuit breakers shall provide visual trip indicators and manual on/off trip functions to aid in isolating circuits for troubleshooting.

All circuits and circuit branches (except starter solenoid, headlamp and battery 12 & 24-volt feeds to the driver's apparatus panel) shall be protected by manual reset circuit breakers, soft fuses, fusable links, or other approved protective devices. Manual reset circuit breakers that are critical to the operation of the Coach shall be mounted with visible indication of open circuits. All wire shall be rated as high as the protection (circuit breaker) for that circuit. Circuit breaker connections shall be crimped and soldered on both sides of the breaker with rosin core electrical solder, or a weather pack connector may be used. Other methods of connecting circuit breakers may be approved by the SFMTA. All high voltage control (600 VDC) and power (1000 VDC) wiring shall have insulation protection rated for utilization in environments up to 125 degrees C.

7.3 GROUNDING

Grounds shall not be carried through water piping, hinges, and bolted joints (except those specifically designed as electrical connectors). Electrical equipment shall not be located in an environment that will reduce the performance or shorten the life of the component or electrical

system. Major wiring harnesses shall not be located under the Coach floor, and under-floor wiring shall be eliminated to the extent practicable. Wiring and electrical equipment necessarily located under the Coach shall be insulated from water, heat, corrosion, and mechanical damage, and shall be contained in sealed conduit or split loom tubing. Insulation of grounds shall in no way conflict with other vehicular operations.

7.4 SHIELDING

All wiring that requires shielding shall meet the following minimum requirements. A shield shall be generated by connecting to a ground, which is sourced from a power distribution Coach bar or chassis. A shield shall be connected at one location only, typically at one end of the cable. However certain standards or special requirements, such as SAE J1939 or RF applications, have separate shielding techniques that shall also be used as applicable. Note: A shield grounded at both ends forms a ground loop, which can cause intermittent control or faults. When using shielded or coaxial cable, upon stripping of the insulation, the metallic braid shall be free from frayed strands, which can penetrate the insulation of the inner wires. To prevent the introduction of noise, the shield shall not be connected to the common side of a logic circuit.

7.5 ELECTRICAL COMPONENTS

All electrical components, including switches, relays, flashers, and circuit breakers, shall be heavy-duty designs. These components shall be longest lasting commercially available designed to last the service life of the Coach and shall be replaceable in less than 5 minutes by a 4M mechanic. Any manual - reset circuit breaker critical to the operation of the Coach shall be mounted in a location convenient to the operator and provide visible indication of open circuits. Unless otherwise approved by the SFMTA, all electric motors shall be heavy-duty brushless type, with a constant duty rating of no less than 40,000 hours. Electric motors shall be located for easy replacement and shall be replaceable in less than 15 minutes by a 4M mechanic.

7.6 MODULAR DESIGN

Design of the electrical system shall be modular so that a major component, apparatus panel, or wiring bundle is easily separable with standard hand tools or by means of connectors. Each module, except the main body wiring harness, shall be removable and replaceable in less than 30 minutes by a 4M mechanic. ESS wiring shall be an independent wiring module. Replacement of the service compartment wiring module(s) shall not require pulling wires through any bulkhead or removing any terminals from the wires.

7.7 WIRING, AND TERMINALS

All lamp sockets shall be of two-wire design with Cannon-Shearson, Weather-Pak, Deutch, or equal disconnects to eliminate corrosion or ground problems. To facilitate servicing, all lamp wires shall have leaders of at least six inches.

All wiring between major electrical components and terminations, shall have double electrical insulation, shall be waterproof, and shall conform to specification requirements of SAE Recommended Practice J1127 and J1128. Except as interrupted by the master battery disconnect switch or a junction box, battery and starter wiring shall be continuous cables grouped numbered and/or color-coded with connections secured by bolted terminals, and shall conform to specification requirement of SAE Standard J1127-Type SGT or SGX and SAE recommended Practice J541. The SFMTA prefers that a minimum of eight colors be used and that no one color be repeated within a single harness. Wiring numbers shall be labeled with ink-jet or hot-stamped every six inches. Installation shall permit ease of replacement. Where all possible, all wiring harnesses over five feet long and containing at least five wires shall include 10% excess wires for spares that are the same size as the largest wire in the harness, excluding the battery cables. Wiring harnesses shall not contain wires of different voltages unless all wires within the harness are sized to carry the current and insulated for the highest voltage wire in the harness. Ground harnesses, except for battery cables, shall be neutral or off-white in color.

Double insulation shall be maintained as close to the terminals, junction box, or electrical compartments as possible and is only applicable to wiring outside the electric panels. The requirement for double insulation shall be met by sheathing all wires and harnesses with nonconductive conduit. Where possible, strain-relief fittings shall be provided within 18 inches where wiring enters all electrical components. Grommets of elastomeric material shall be provided at points where wiring penetrates metal structure outside of electrical enclosures. Any clamps used throughout the electrical system shall be stainless steel and of aircraft-type quality and shall be "dipped". Wiring supports shall be nonconductive. Precautions shall be taken to avoid damage from heat, water, solvents, or chafing. Wiring length shall allow replacement of end terminals twice without pulling, stretching, or replacing the wire. Except for large wires such as battery cables, terminals shall be crimped to the wiring and may be soldered only if the wire is not stiffened above the terminal and no flux residue remains on the terminal. Terminals shall be corrosion-resistant full ring type, Faston, or interlocking lugs with insulating ferrules where appropriate. "T" splices may be used when there is less than 25,000 circular mills of copper in the cross-section, a mechanical clamp is used in addition to solder on the splice; the wire supports no mechanical load in the area of the splice, and the wire is supported to prevent flexing. Connectors shall be common, weather pack, Deutsch, Metri, or approved equal.

7.8 JUNCTION BOXES

All relays, controllers, flashers, circuit breakers, and other electrical components shall be grouped according to voltage and, if appropriate, mounted in easily accessible junction boxes. Exterior boxes shall be sealed to prevent moisture from normal sources, including motor compartment cleaning, from reaching the electrical components and shall prevent what may occur inside the box from propagating outside the box. The components and circuits in each box shall be identified and their locations shall be permanently recorded on a schematic drawing glued to or printed on the inside of the box cover or door. The drawing shall be protected from oil, grease, fuel, and abrasion. The front junction box shall be completely serviceable from the street side exterior of the Coach, or from inside the header over the operator's seat. Other

arrangements may be approved by the SFMTA. It shall be replaceable as a unit in less than 15 minutes by a single 4M mechanic.

7.9 MULTIPLEX WIRING SYSTEM

The electrical system shall be controlled by "MULTIPLEX" programmable logic controller, which shall be I/O Controls, Vansco, Continental ZR32-B, or VBEA multiplex system, or approved equal and shall be located in a sealed compartment. Contractor shall provide complete details of the design of the PLC system during the design review. Versatility and future expansion shall be provided for by system architecture. Multiplex Wiring System shall provide and distribute power to ensure satisfactory performance of all electrical components. The system shall be capable of monitoring and recording all Coach systems including, but not limited to, passenger counts, door operation, ramp operation, electric motor, energy storage system, and traction motor. Reference Section 7.6 (MODULAR DESIGN.) The system shall store and retrieve data for the mechanical and electrical functions of the Coach. All electrical and all electronic devices subsystems and components shall be repairable and maintainable by the SFMTA. The SFMTA shall be granted a no cost license to utilize the software as long as the Coach remains in service.

The components of the multiplex system shall be of modular design thereby providing for ease of replacement by maintenance personnel. The modules shall be easily accessible for troubleshooting electrical failures and performing system maintenance. Each module shall be shielded to prevent interference by EMI and RFI; and may utilize LEDs to indicate circuit integrity and assist in rapid circuit diagnostics and verification of the load and wiring integrity. Each circuit shall be capable of providing a current a load of no less than 1 amp. The internal controls shall be a solid-state device providing an extended service life. Wiring for data Coach node module power shall consist of three, 22 gauge or larger, UL approved, shielded, twisted pairs.

Protection to each individual circuit shall be provided. A single test button or switch mounted on a panel at the driver's compartment area, upon activation, will provide a system check of the circuits. Failure points will be indicated by corresponding LED lights on the panel. The system shall be hosted on an IBM-compatible personal computer as well as a hand held field diagnostic unit capable of reading the network data, control function and address data, or function code. The mechanic shall be able to use either unit to check Coach wire function. Laptop computer programmer and maintenance reader shall be supplied by the Contractor.

The contractor shall provide the SFMTA all essential information and identify equipment needed to test and troubleshoot the Multiplex system controller. This information and equipment shall encompass the system on the Coach and the repair of the individual sub-assemblies down to the components on the circuit board of the sub-assemblies.

7.10 LOW-VOLTAGE BATTERIES

At least two X2Power deep cycle AGM, DEKA 8A8D Absorbed Glass Mat (AGM) MagnaPower, Odyssey PC2150S Group 31, Contractor OEM, or approved equal batteries shall be provided. Batteries shall be of premium construction. They shall bear an initial warranty date no earlier than 60 days prior to Coach manufacture. In the event of a temporary failure of the battery charging system, the low voltage batteries shall be able to maintain an adequate charge to operate the low voltage control system and the interior lighting system for a minimum of two hours. The Coach shall be equipped with a low voltage battery management system to prevent deep discharging. The low-voltage battery management system shall continually monitor the SOC of the low-voltage batteries. Once the batteries have discharged to specified SOC (approved by the SFMTA), the batteries will be disconnected after a period of three minutes, leaving only the fire suppression and other critical systems on. Positive and negative terminals shall have different size studs, or the battery terminals and cables shall be arranged to prevent incorrect installation. Battery terminals shall be located for access in less than 30 seconds with jumper cables. Battery cables shall be flexible and sufficiently long to reach the batteries in the extended tray position without stretching or pulling on any connection. Cables shall not lie on top of the batteries, and shall be sheathed and wrapped to prevent corrosion. The battery terminals and cable-ends shall be color-coded with red for the primary positive and black for the negative.

Battery terminals shall be located for access with jumper cables. Batteries shall be stamped with the date of manufacture.

Batteries shall not be abused or quick-charged before delivery to the SFMTA. Despite battery configuration, the Contractor shall be responsible for analysis and selection of a battery of adequate capacity to supply the load.

A battery management system shall be provided, to protect the battery from operating outside of the manufacturer’s safe operating area. The system shall protect the battery from overcharging by limiting the current and/or voltage to prevent electrolyte degradation. The battery management system shall be capable of monitoring the voltage, temperature, State of Charge, and variable % health of the battery when compared to its original capacity.

Battery cables shall be flexible and sufficiently long to reach the batteries without stretching or pulling on any connections when the tray is extended. The battery cables shall not lie on top of the batteries. The battery cables shall be color-coded with red for primary positive, black for negative, and any other color for intermediate voltage cables. Battery cables shall be a minimum 4/0 or sized accordingly to handle the load from the battery.

The battery cable terminal connections shall be capable of withstanding the mechanical stress and vibrations commonly experienced during Coach revenue service.

The batteries shall be sufficiently protected from over temperature or meltdown.

7.10.1 Battery Tray

The battery tray shall be made of 304 stainless steel, polyethylene, or approved corrosion resistant materials and shall properly support the batteries during service. Battery trays may be e-coated or powder coated to assist with corrosion or abrasion resistance. A positive lock shall retain the battery tray in the normal position. Batteries shall be easily accessible for inspection, serviceable only from outside the Coach. The battery containment area shall be vented to the outside allowing for the mitigation of fumes from gassing batteries and provisions made for the drainage of cleaning liquid. The containment area access door shall be able to be opened without the use of a special key.

7.11 LOW VOLTAGE MASTER BATTERY SWITCH

A master battery switch shall be provided for complete disconnection from all Coach electrical systems except systems that require 24-7 power supply. The master battery switch shall be located in an outside compartment, which requires no tool(s) to access. The location of the master battery switch shall be clearly identified on the access panel and be accessible in less than 10 seconds for activation. The master switch shall be capable of carrying and interrupting the total circuit load.

7.12 ELECTRICAL AND ELECTRONIC NOISE

Electrical and electronic subsystems and components shall not emit directly or indirectly electromagnetic radiation that will cause undesirable electrical and electronic noise interference on radio and television transmission and reception, radiation at unsafe levels, or radiation that will cause undesirable responses, degraded performance, or malfunction of equipment. This includes but is not limited to the following systems and equipment:

- Commercial radio and television transmission and reception
- FCC and official local and state radio and television transmission and reception
- Onboard equipment supplied by the SFMTA or by the Contractor
- Pacemakers and other implanted medical devices.

The performance of the Coach shall not be degraded by electromagnetic interference from external sources. The Coaches shall meet all applicable FCC and FTA requirements in addition to the latest revisions of some of the agreed upon standards and guidelines listed below:

- Federal Communications Commission (FCC) Procedure for Measuring RF Emissions from Computing Devices and meet part 15 of FCC regulations
- CISPR 12 – Vehicles, Boats and Internal Combustion Engines – Radio Disturbance Characteristics – Limits and Methods of Measurements for the Protection of Off-Board Receivers
- ICES-002 – Vehicles, Boats and Other Devices Propelled by an Internal Combustion Engine, Electrical Means or Both
- MIL-STD-461 - Requirements for the Control of Electromagnetic Interference Emissions and Susceptibility
- MIL-STD-462D - Measurement of Electromagnetic Interference Characteristics
- American Conference of Governmental Industrial Hygienists (ACGIH) (See ATTACHMENT 4)
- UMTA-MA-06 0153-10 (DOT-TSC-UMTA-88-1) Radiated Interference in Rapid Transit Systems Volume I: Theory & Data
- UMTA-MA-06-0153-11 (DOT-TSC-UMTA-87-4) Radiated Interference in Rapid Transit Systems, Volume II: Suggested Test Procedures
- SAE J551 Performance Levels and Methods of Measurement of Electromagnetic Compatibility of Vehicles, Boats (up to 15m), and Machines (16.6 Hz to 18 GHz)
- SAE Recommended Practice ARP 1393: “Electromagnetic Compatibility and Interference Control for Rapid Transit Vehicles”

The Contractor shall develop and submit an EMI/EMC Control Plan for SFMTA review and approval prior to submittal of final drawings. The plan shall delineate the manner in which EMI and EMC will be mitigated and meet the requirements in this section.

8 MATERIALS AND OVERALL WORK QUALITY

8.1 MATERIALS

All materials used in the construction of the Coach and all of its parts shall be in accordance with the stated specification or description unless written approval for substitution is obtained. All materials shall comply with the standards established by ASTM, SAE, or similar association standards. Materials used shall be duplicated in manufacture, design, and construction on each Coach and be marked so as to be readily identified.

Whenever under the Contract Documents it is provided that the Contractor shall furnish materials or manufactured components or shall do Work for which no detailed specifications are set forth, the Work performed shall be in full conformity and harmony with the intent to secure the best standards of manufacture in the Work as a whole or in part. The Contractor shall not take advantage of the omission of any part or detail which goes to make the Coach complete and ready for service, even though such part or detail is not mentioned in the Specifications or in the Contractor's approved design.

Foreign matter such as shavings, chips, etc., shall be completely removed from all parts of the Coach whether hidden or exposed.

A. All painted aluminum sheets shall be thoroughly cleaned and coated on the inside and outside with zinc-chromate or zinc-phosphate protective paint prior to assembly in Coach.
B. All joints shall be protected by application of a zinc-chromate metallic compound, Silaflex 221, or approved equal adhesive at assembly.
C. All bolts, nuts, washers and exposed linkage shall be stainless steel or zinc plated (where applicable) to prevent corrosion. The SFMTA prefers that all bolts on the Coaches are in compliance with SAE Standard J429.

8.1.1 Hazardous Materials

It shall be the design objective to eliminate from the Coaches all materials that are or may become hazardous to passengers, operators, or maintenance personnel. Of particular concern are materials that produce toxic smoke or gases when heated, possibly due to an accidental fire or when bodywork using welding equipment or cutting torches is necessary. No parts on the Coach shall contain lead, asbestos or PCBs. The Contractor shall provide for SFMTA approval of the material safety data sheets (MSDS) of any hazardous materials or fluids that must be used in the construction, operation or maintenance of the Vehicle.

The SFMTA has the option to reject the use of any hazardous materials proposed for use on the Vehicles.

8.1.2 Consumables

The following list of consumable items shall be available in the United States from U.S. manufacturers, but no limited to:

- Air filters
- Ventilating air filters
- Coolant and oil filters
- Belts
- Lamps
- Fuses
- Brake lining material
- Hoses and lines – air, coolant and hydraulic
- Wire terminations and connectors
- Air bags
- Brake Rotors

Any similar items shall also meet the above requirements. Any exceptions require the prior approval of the SFMTA.

8.2 OVERALL WORK QUALITY

Overall work quality shall be of the best grade and shall conform in all respects to the best practice in the industry.

Material and equipment shall be new and of a quality equal to that specified or accepted as the best industry practice. Mechanical, electrical and electronic equipment and components shall be the products of manufacturers of established good reputations regularly engaged in the fabrication of such equipment and components.

The work shall be executed in conformity with the best-accepted standard practice of the trade so as to contribute to maximum efficiency if operation, accessibility, pleasing appearance and minimum cost of maintenance.

The fit and finish of the exterior and interior components shall be to the best of the industry standards of the automotive trade.

8.2.1 Welding

Welding procedures, welding materials, and qualifications of welding personnel shall be in accordance with the current standards of the ASTM and AWS. Work performed outside or in the U.S. must conform to U.S. welding standards as approved by the SFMTA.

Where metal is welded to metal, the contact surfaces shall be free of scale, grease, and paint.

8.2.2 Mechanical Fastening

No protruding screws, mounting bolts, or similar items shall be permitted in the interior or the exterior of the Coach. Where possible, fasteners not exposed to passengers on the inside of the Coach shall be stainless steel or zinc-plated steel. Where possible, all fasteners used in the Vehicle body exterior, even if not exposed to passengers, shall be of stainless steel except where mechanical requirements impose graded steel fasteners, or to minimize galvanic corrosion. These fasteners shall be zinc-plated as per specification, with treatments to prevent hydrogen embrittlement if required. Where non-anodized metal is riveted or bolted to metal, contact surfaces shall be thoroughly cleaned and properly primed. The use of stretch to torque fasteners is discouraged.

8.2.2.1 Rivets

Rivets shall completely fill the holes. No blind rivets shall be used. All rivets shall be of the solid center type, and shall be stainless steel except where mechanical requirements impose graded steel fasteners, or to minimize galvanic corrosion. External rivet heads shall be concentric with the body of the rivets and free from rings, pits, burrs and fins. Surfaces exposed to passengers, operator, or maintenance personnel shall be smooth and free of burrs, fins, sharp edges, and dangerous protrusions.

8.2.2.2 Screws

On the Coach interior, all screws exposed to passengers shall be stainless steel with a flat or oval head. Self-tapping screws shall not be used in areas requiring dismantling for servicing. At least 1-1/2 screw threads shall be visible beyond all nuts.

8.2.2.3 Bolts

All bolts or rods passing through composite flooring or exposed to the elements shall be an approved grade stainless steel or, with SFMTA pre-approval, zinc-plated. All nuts and bolts exposed to passengers shall be an approved grade stainless steel unless otherwise specified. The design strengths for Grade 2 bolts and Class A nuts shall be used in sizing the mounting and attachment bolts for under floor mounted equipment, support structures, or brackets. However, all structural or load carrying bolts shall be domestic manufacture, grade 5 or better. Bolts or screws used for structural connections shall have full-size bodies in areas subjected to bearing and/or shear loads. All structural or load carrying bolts shall be specified and installed appropriately for their intended loads. For bolted joints subject to steady vibration, bolts with appropriate locking arrangement may be used. Nuts shall be of a self-locking type where appropriate. Wherever possible, bolts smaller than 1/4 inch shall not project more than 1-1/2 threads plus 1/4 inch, and bolts 1/4 inch or larger shall not project more than eight threads. All hardware is to be installed and torqued per ANSI guidelines.

8.2.3 Finishing

Special care shall be taken with the outside sheathing; roof, roof bonnets, and interior finish so that all kinks and buckles are removed before assembly to present a true and smooth finish. This shall be accomplished without excessive grinding, which may weaken the structure material. All painted surfaces shall have a true and smooth surface that will not show sanding or grinding marks after painting. All steel and aluminum body parts that are to be painted shall be thoroughly cleaned and treated before priming with a primer compatible with the paint system.

8.2.4 Electrical

All electrical connections shall be of the locking type. All electrical wiring harnesses should be tie-wrapped and supported at regular intervals. When wires, cables, hoses or tubes go through walls or panels, the bulkhead holes shall have protective grommets/molding and the wires, cables, hoses or tubes shall be clamped on both sides of the bulkhead hold. A 1/4-inch minimum clearance is required. Reference Section 7.7 (Wiring, Terminals). All electrical wires shall be installed to as not to have any chaffing or rubbing with other components.

8.3 PROOF OF COMPLIANCE WITH CONTRACT

In order that SFMTA may attempt to determine whether the Contractor has complied with the requirements of the Contract Documents not readily determinable through inspection and test of equipment, components or materials utilized in the Work, the Contractor shall, at any time when requested, submit to the SFMTA Project Manager properly authenticated test results, design documents or other satisfactory proof as to its compliance with such requirements.

8.4 DEFECTIVE WORKMANSHIP AND MATERIALS

When and as often as the SFMTA determines that the Work done or being done under the Contract, or the kind or quality of components, equipment or materials supplied in connection therewith, is not fully and completely in accordance with any requirement of the Contract Documents, it may give notice of such noncompliance to the Contractor in writing and the Contractor shall immediately upon receipt of such notice do all things required to remedy such noncompliance at no additional cost to the SFMTA.

9 TRAINING, PUBLICATION, DIAGNOSTICS TESTING SOFTWARE

9.1 TRAINING

Training shall be designed and presented to ensure that each participant will be able to perform specific tasks or be able to demonstrate specific knowledge in his/her working area. Training shall provide specific course goals and objectives outlined in the lesson plans with pre-course tests and post-course tests. Dates, hours, and locations of training shall be at the discretion of the SFMTA. For training starting days and completion days, refer to Section 13.1 (Preferred Delivery Schedule).

All manuals and lesson plans shall be provided electronically and with hard copies to all participating trainees. All computer software programs must be approved by the SFMTA.

The SFMTA reserves the right to copy all computer information for future use. Six copies of all training aids (such as videos, slides, and audiotapes) shall be provided to the SFMTA Maintenance Training Department.

The Contractor shall submit its recommendations for training hours and categories for review and approval by the SFMTA.

9.1.1 Training Plan

Contractor shall submit a training plan per the schedule in Section 13.1 (Preferred Delivery Schedule). The training plan shall delineate the manner in which the Contractor plans to meet the requirements of this specification. The plan shall include:

- Specific trainee performance objectives
- Draft lesson plans
- Specific topics to be covered including subsystem groupings for mechanics and electronic technician training
- Probable training aids and materials
- Training schedule
- Training facilities required.

9.1.2 Training Materials and Personnel

Contractor shall provide detailed instructional guides, outlining training philosophy, and weighted areas of instruction based on Contractor's understanding of the complexity of the equipment from a maintenance performance standpoint. In addition, Contractor shall identify recommended course length with basic electrical/electronic knowledge-driven instruction leading to a proficiency level suitable for new Vehicle maintenance.

Instructors shall be totally familiar with the technical information being taught, shall use instructional materials properly, and shall possess the skills required to make effective presentations. Safety must be an integral part of all instruction. Instructors must be transit literate and factory certified to teach the specific system being taught. The SFMTA prefers that all training instructors are employees or technical representatives from the maker of the equipment to provide the training sessions.

Upon commencement of classroom instruction, instructor shall be dedicated to the task of teaching without a break in the continuity of the instruction to perform other duties. Instructor shall be fluent in English.

The Contractor shall provide all handouts, training aids, audio-visual equipment, and visual aids for each class. Training materials, including audio-visual hardware, slides, view graphs, mock-ups, charts, and other aids, will become the property of the SFMTA upon the completion of the training course. Mock-ups shall include as minimum a door header with all operating equipment, a brake system (air components) and an air system. The SFMTA or its designee may use such materials in subsequent training sessions for any other purposes. A training manual shall be prepared for each personnel classification and distributed to personnel in training prior to or at class start up.

9.1.3 Operations Instructors, Maintenance Instructors, Street Operations, and Managers

The purpose of these training sessions shall be to provide the necessary information to the SFMTA's operations instructors, maintenance instructors, and training management and operations managers so that they may train SFMTA operators, transit inspectors and maintenance personnel. This training shall cover all operational and maintenance aspects of the Coach, with emphasis on features of the Coach that are unique or may not have been encountered by SFMTA personnel. Separate training session shall be provided for street operation inspectors.

9.1.4 Maintenance Manager Training

These training sessions shall be geared to acquaint maintenance superintendents, general foremen, and foremen with the design, use, limitations, preventive maintenance, warranty periods, and special features of the Coach. This training can be included in the general orientation, or used for specific in-depth training time.

9.1.5 Service Personnel Training

Service personnel shall be trained in basic daily servicing requirements, including cleaning, inspection, towing, trained first responders, and routine servicing and the preventive maintenance inspections.

9.1.6 Mechanic

These sessions shall provide the mechanics with the basic knowledge necessary to utilize the maintenance manuals and to safely perform preventive maintenance, troubleshooting, repairs, and overhauls. Sessions shall concentrate on individual subsystems and components, such as body, doors, propulsion, suspension, brakes, and operator controls. The Contractor shall include, as part of the training plan, a list of proposed subsystem groupings. Training shall include demonstrations of Time to Repair and Accessibility of Coach components and subsystems. Training for shop technicians will cover test equipment and subassembly bench repair and calibration.

Maintenance engineer training shall focus on overall system design, maintainability, computer diagnostic techniques, control systems, data collection and retrieval, life cycle predictions, optimization programming, electronic maintenance techniques, and special tools.

The Contractor shall provide to the SFMTA sufficient training and documentation needed to test, troubleshoot, maintain and repair all electronic systems and subsystems.

The training shall review all electronic schematic diagrams and shall provide troubleshooting flow charts and block diagrams.

Road Call sessions shall provide the mechanics with knowledge necessary to troubleshoot and fix, if possible, subsystems which may fail and cause service interruption. Mechanics shall be made to understand how to proficiently use all necessary troubleshooting equipment. Mechanics shall be provided with both hands-on and classroom training.

9.1.7 Surveillance Camera System Training

The Contractor shall provide training classes on how to operate and maintain the surveillance camera system (the number of classes and hours are subject to SFMTA approval, which may be based on Contractor's recommendations).

Test equipment and special tools required maintaining the system shall be provided by the Contractor. Contractor shall provide one test fixture, which duplicates an entire Vehicle system. The test fixture will easily allow for the substitution of individual components of the system for test and repair purposes. One viewing station (in addition to Section 3.13.6) shall also be provided. The viewing station shall be assembled in such as a maner as to allow for ease of component exchange.

9.1.8 Videos

The SFMTA may require digital recordings of any or all of the Contractor's training sessions, at the SFMTA's discretion, or at least one session of each discrete training class. These recordings will be provided electronically by the Contractor for distribution within the SFMTA.

In addition, the Contractor shall be required to provide a complete set of training videos for each classroom training session on a specific topic and a video for each Vehicle "hands-on" training session on a specific topic. Videos shall be no longer than 30 minutes in length. Topics requiring more time to cover in complete detail shall be segmented into 30-minute modules. A single compilation videos incorporating all of the training sessions shall also be produced. At minimum, Contractor shall cover the following topics, but not limited to:

- Propulsion and energy storage systems
- Axle and suspension systems
- Auxiliary electrical system
- Wheelchair ramp assembly
- Air and brake systems
- Door system
- Power steering system
- Heating and ventilating system
- Vehicle body components & repair techniques (e.g. special welding, interior panel replacement)
- Preventive maintenance practices for all preventive maintenance required on each Vehicle

Contractor shall submit a complete set of master recordings to the SFMTA in an approved electronic format, along with a complete set of training media.

The Contractor shall maintain a complete set of reproducible recordings on file for a period of 12 years for use by the SFMTA.

The Contractor shall provide two sample discs with the draft training plan. One disc shall be representative of a classroom instruction, and one disc shall be representative of a Vehicle "hands-on" instruction. These sample discs shall be submitted for SFMTA approval and shall be representative of the level of quality of the product that the SFMTA can expect for the balance of the training discs to be delivered.

9.1.8.1 Video Quality

Contractor shall have in-house capability, or subcontract with a company approved by the SFMTA, for the following requirements:

- All work associated with video recording and production shall be performed by the Contractor or subcontractor approved by the SFMTA.
- The Contractor shall have script writing capabilities and be experienced with transit organizations and issues.
- Studio and/or field acquisition capabilities.
- CD-ROM and DVD for wide distribution shall have the ability to be viewed on any modern desktop or laptop computer equipment (possessing basic, modern multimedia software such as Windows Media Player) in a smooth video tape-like manner, without lagging, freezing, or stuttering, and without compromising or “crashing” the computer.

The Contractor may elect to use its own actors, or SFMTA employees in actual classroom and Vehicle “hands-on” sessions. However, if the Contractor chooses to use SFMTA employees at least two ssions of each topic shall be filmed and proper editing performed to result in a quality product. Tapes shall be professionally edited to eliminate unnecessary and irrelevant sections that are common to live, on-location filming.

9.1.9 Training Charts

The Contractor shall provide three copies of the following schematic charts used for training and working reference: (a) the electrical system, (b) the air and brake system (c) the door system, and (d) battery cooling systems. The charts shall be three feet by five feet, clearly legible, and suitable for classroom viewing. Two rigid frames shall be provided for mounting the charts. Charts shall be consistent with those provided in the Maintenance Manual and subject to SFMTA approval, and available for use at commencement of the training course. Schematic charts shall be laminated.

9.1.10 Interactive Multimedia Training

Contractor shall provide a series of interactive training modules on Coach maintenance procedures to be delivered using standard interactive electronic technology. This training must be specific to the Coach for this procurement, and to maintenance practices that are used by the SFMTA. The interactive training should be electronically formatted computer based training (CBT) or approved equal, and compatible with all modern computer windows-type operating systems, office programs, and latest multimedia software. The files shall include video clips of component operation and critical adjustments.

Project milestones shall consist of the following:

- Detailed design document, to be developed with SFMTA participation and completed 10 months prior to delivery of first production Coach.
- Video production
- Completion and review of video editing
- Prototype module delivery (test, review, and feedback of first module)
- Pre-production module delivery (test, review, and feedback of all modules)
- Delivery of completed program, including Trainer's Manual and Guide shall be completed per the schedule in Section 13.1 (Preferred Delivery Schedule). (The delivery must include system setup and troubleshooting, program administration guidelines, and answers to test questions.)

9.1.10.1 Training Module

The training module shall have on screen text as well as voice over descriptions of the procedure being demonstrated. The module shall have a complete demonstration of the maintenance procedure followed by a self-paced post examination of the student. Only the student and the Training Manager shall have access to the scores for each training module. In addition, SFMTA shall have all licensing rights to unlimited reproduction of the electronic training module. The Contractor shall have the responsibility for providing all updates and revisions to the electronic training modules until all engineering modifications and final engineering have been approved and acceptance of the last production Coach.

The training modules shall address the most critical systems pertaining to Coach Maintenance. One module shall be produced on each of the following systems:

- Programmable logic controller system
- Ramp installation and maintenance
- Door system control maintenance
- Electrical and electronics systems control maintenance, including multiplexing

- Disc brake installation and maintenance
- Energy Storage System (ESS)
- Electric Drive System (EDS)
- HVAC System

Each module shall include the following program elements:

- Overview on system components, operations and relationship with other relevant systems
- Step-by-step video demonstration of maintenance procedures (not more than 50 steps in the process), with random access to each step and multiple choice quiz questions on critical steps
- Interactive job simulation exercises using three-dimensional solid modeling to graphically represent job setting and function on critical steps
- Built-in user performance tracking for confidential review by Maintenance Training Supervisor
- Visual-based parts identification and ordering information system (using three-dimensional solid model and/or stills)
- Contractor shall demonstrate the ability to produce interactive multimedia training that contains each of the program elements for the critical subsystems as described above.

9.2 PUBLICATIONS: MAINTENANCE MANUALS, ILLUSTRATED PARTS MANUALS, OPERATOR'S MANUALS, & VEHICLE RECORD BOOKS

The Contractor shall provide maintenance, illustrated parts and operational manuals for each of the Vehicle type according to the schedule in Figure 9-1.

The Contractor shall provide all electronic copies of the Vehicle drawings as necessary for the pre-production process approvals.

These drawings include Seating Layout Drawings, Dash layouts, Camera Layouts, AVA AVL drawings, Paint Scheme, APC layout, Fleet Management system drawings, Antenna layouts, Clipper location, and Radio provisions layouts. Contractor agrees to share additional drawings as they are needed by the SFMTA, for example the vehicle frame drawings, in PDF format. The intent and purpose of all maintenance and operating documents provided to the SFMTA by the Contractor shall be to facilitate the safe and reliable operation of the Vehicle by the SFMTA during the entire expected operational life of the Vehicle. Using the information provided in the Contractor's maintenance documentation, the SFMTA itself must be able to perform any and all procedures necessary to ensure the safe and reliable operation and maintenance of the Vehicle during its service lifetime. The Contractor shall submit a draft copy of each of the manuals for review and approval by the SFMTA before or upon receipt of the first Coach.

Release copies of the manuals shall reflect the most recent information available at the time of their release and shall be delivered to the SFMTA on or before delivery of the last production Coach. Manuals need to be updated in a timely manner whenever there is a FSRP issued.

FIGURE 9-1

Manuals	**Quantity / Vehicle type**	**Maintain up-to-date after the date of acceptance of the Coaches**
Contractor Maintenance Manual	5	6 years
Contractor Parts Manual	5	12 years
Contractor Operator's Manuals	100	6 years

The supplied manuals shall provide complete, concise and clear documentation for all equipment ordered on the Vehicle and shall not include superfluous documentation for equipment that was not provided with the Vehicle. In addition to the printed copies of the manuals specified above, all maintenance operations and illustrated parts manuals shall be provided in digital format.

All such electronic documentation shall be viewable using modern, basic office and multimedia software such as Microsoft Office and Windows Media Player. Contractor Published Bus Manuals can be supplied without security after the SFMTA signs a limited copyright agreement form. OEM component supplier manuals are not available in an "unsecured" file format. Within the relevant Vehicle warranty period provided for by the Contractor, the SFMTA will make no changes to the Contractor-provided documentation where such changes would compromise the intent of the Contractor's original documentation with respect to the safe operation or reliability of the Vehicle, unless such change is agreed to in writing by both the SFMTA and the vendor. Where such changes are made, both the SFMTA and the Contractor shall maintain coordinated records of the changes, including the SFMTA contract number, manual part number, title, page number(s), date the change was made, who authorized the change, why the change was made, and before-and-after copies of the change. Contractor will provide such changes in the same digital format as used for the initial delivery of the manuals. At the expiration of the time periods specified above for Contractor maintenance of the documentation, or upon default of the Contractor in providing such document maintenance, the SFMTA shall have the right to reproduce copies of such documentation for internal use only, subject to the warranty concerns expressed herein.

Contractor and sub-supplier maintenance documents shall be supplied in an integrated electronic format and shall be generated for best readability on a current computer monitor. The default page setup for all printed maintenance and parts manuals shall be standard U.S. letter

size (8.5" by 11") in portrait mode with a gutter suitable for use in a standard 3-ring binder. Wherever feasible, printed manuals should be organized so that updates or corrections to the manuals can be made with minimal impact to the overall document. Where drawings or other documents are too large to be easily legible in the default page size, such pages may be provided either as 11" tall by 14" (or longer) pages, or as 22" tall by 16" "four-up" pages. In both these cases of oversized pages, the printed page shall be capable of being neatly folded up into the default page size, and shall have suitable reinforcement at the 3-hole edge of the page. Major sections of the maintenance manuals shall be separated by 1/3- or 1/5-cut tabbed and labeled, reinforced index dividers. The printed Operator's Manual shall be a single softbound volume; with at least medium-weight, glossy-stock covers for durability, and may be smaller than the default 8.5" by 11" size, as dictated by the best compromise of readability and portability. Bus Electrical, Air, Hydraulic, PLC, HVAC, cooling system schematics and diagrams are all output in a convenient 11”x17” format and included in a separate sturdy 3-hole plastic binder and not within the Bus Service Manuals. An emphasis should be placed on durability and portability. In the interest of readability and clarity, the SFMTA may dictate that the Operator's Manual be printed in color.

9.2.1 Maintenance Manuals

Contractor maintenance manuals shall be integrated so that all subsystems of the Coach are contained in a logically indexed, contiguous series of chapters and/or volumes. Sub-supplier maintenance manuals shall be supplied and referenced in the contractor’s manuals for ease of access. Manual organization must be approved by the SFMTA before work begins on the manuals.

All standard and specialized maintenance or overhaul procedures that involve potential health and safety issues for the repair technician shall be clearly noted in the documentation with the international safety warning symbol appropriate to the level of potential danger involved. Procedures where the proper performance of the task is critical to the safe operation of the Vehicle shall also be clearly marked for emphasis. Maintenance manuals shall contain the complete data required for routine and periodic maintenance of all parts of the Coach, including as a minimum the following:

At the beginning of each manual, it shall contain a table of contents, a list of abbreviations, instructions on how to use the manual, special safety precautions for maintenance and/or overhaul procedures, General overview / introduction to the Vehicle and its systems and subsystems, and recommended required and/or specialized maintenance and overhaul tool lists, including electronic test equipment where appropriate. Main components of the manual shall include, but are not limited to, the following:

A. Detailed theory/principles of operation of each primary system (e.g., the braking system) on the Vehicle and its relationship to and interactions with other primary systems on the Vehicle and, where applicable, to any off-board systems.

B. Detailed theory/principles of operation of each subsystem (e.g., ABS) within its primary system, and the relationship and interactions of the subsystem to other subsystems within the primary system, and, where applicable, to other primary systems or the subsystems of those other primary systems.
C. Field and shop troubleshooting procedures for all systems and subsystems using a combination of text, flowcharts and images as best suits the procedure.
D. Shop overhaul procedures for all rebuildable or repairable systems on the Vehicle.
E. Recommended preventive maintenance (e.g., lubrication and adjustment) requirements and schedule. Reference Section 9.2.2 (Preventive Maintenance Manual).
F. Schematic and wiring location diagrams (including wire and cable size and rating schedules, where appropriate) for all electrical systems and subsystems on the Vehicle.
G. Air and hydraulic system diagrams showing locations in the Coach of air and hydraulic components.
H. Detailed, illustrated procedures for component change-out, and run-in information as required.
I. Body and structural information and materials specifications for major accident repairs.
J. Electronic systems and subsystems documentation including schematics and diagnostic procedures, where applicable. Reference Section 9.2.6 (Electronic Systems Documentation.)

9.2.2 Preventive Maintenance Manual

Contractor shall provide a Preventive Maintenance (PM) section within the maintenance manuals specifying the recommended preventive maintenance procedures and the scheduling of those procedures. The manual shall provide an outline PM program with checklist, which can be used to perform PMs. The PM checklist pages shall be formatted so that copies can be made to stand as individual SFMTA documents, including lined space at the end of the document for additions and notes. The preventive maintenance manual shall also include recommendations for the scheduled overhaul of major systems above and beyond the normal maintenance procedures, where such overhaul is known to significantly improve the long-term reliability, maintainability and/or useful life span of the Vehicle.

In addition to the above requirements, the structure of the PM schedule must include the interval between each procedure (calendar based, mileage based, hours based, other, i.e., every 30 days or 3,000 miles, whichever comes first). The Contractor shall also provide the following items, but may choose to do so in documents separate from the preventative maintenance manual:

1) List of parts (Manufacturer Part #, Description, Quantity, UOM) required for the procedure, and recommended but not required for the procedure
2) Estimated hours by craft to perform procedure

9.2.3 Illustrated Parts Manual

The Illustrated Parts Manuals shall be designed so that all systems and subsystems of the Vehicle are broken down to the component level in a logically indexed, contiguous series of chapters and/or volumes. Page setup requirements for the parts manuals shall conform to the requirements in Section 9.2 (Publications: Maintenance Manuals, Illustrated Parts Manuals, Operator's Manuals, & Vehicle Record Books). Illustrations and their corresponding parts lists shall be arranged as to minimize the amount of cross-searching necessary to locate a part in the parts list from its drawing reference, or to locate the part on an illustration from its entry in the parts list. The parts list shall include the following data:

- Drawing reference (locator)
- Manufacturer's part number
- Part description, including type, and size or value or reference to another drawing where such reference contains a more useful description of the part)
- Quantity used in the currently illustrated system or subsystem

Illustrated parts manuals shall be arranged so that part numbers can be readily found and identified in the illustration for each system, subsystem, assembly, subassembly, or component part from an orderly breakdown of the complete Coach. The manual shall contain a ready-reference alphanumeric part number index listing the Contractor's part number against the page in the illustrated manual where it appears. The parts lists shall identify the equivalent generic part, which is physically identified by the Contractor and shall be listed under Part Description field in the manual. In no case may any replaceable part remain unidentified.

Isometric exploded views or two-dimensional drawings that are detailed enough to show the relative location of each part shall be used to identify all Vehicle systems and subsystems. The technique to be used in the rendering of these two-dimensional drawings must be approved by the SFMTA before the draft manuals are created.

The Supplier shall supply a separate price list showing the Contractor's part number against the current net price (including freight) to the SFMTA of all non-generic parts used in the Vehicle at the time of delivery of the manuals.

Refer also to Section 10.3.3 (Database Information).

9.2.4 Parts Tables in Electronic Format

The Contractor shall supply parts data in a multiple deliverable file format such as MS Excel complete listing of all parts as they appear in the Parts Manual (logical and structured Section - System - Assembly - Sub-assembly parts) and as specified under 10.3.3.2 (Illustrated Parts Catalog Master File). The listing shall include.

- Item Number

- Quantity
- OEM Part Number
- OEM Color Code#
- Description
- PM and RSL Part Identified
- Subject Title
- Illustration #
- Page#
- SFMTA Bus Unit#
- OEM Supplier Name
- OEM Supplier Part Number#

The purpose of these tables shall be to provide system and component parts data that is readily suitable for loading into the SFMTA SHOPS (or equivalent) data processing system. The tables should include all information that is presented in the IPC. At the highest level, the tables should make it possible to identify, by their serial numbers all of the major assemblies installed on each individual Coach and thereafter all major sub-assemblies that are installed in each major assembly down to the lowest serialized sub assembly. The Contractor may use their own internal part number for these tables.

9.2.5 Operator's Manuals

The operator's manual shall completely, clearly and concisely illustrate the recommended procedures for the safe and efficient operation of the Vehicle, including but not limited to pre- and in-service check-outs, response to safety alarm systems, control of lighting and auxiliary Vehicle systems, Coach mechanical operation, maintenance checks, turning characteristics of the Coach, and emergency actions.

9.2.6 Electronic Systems Documentation

Where an electronic system is an intrinsic part of the Vehicle, and where the contract for a Vehicle specifies that an electronic system is field- or shop-repairable, the Contractor shall at a minimum identify these components by part number, circuit or schematic diagrams, voltage, method of diagnosis and replacement procedure as part of the service and/or parts manuals in keeping with the requirements of Section 9.2.1 (Maintenance Manuals). The information within the Multiplex User guides, Bus service and parts manuals and Bus electrical schematics will provide the procedures necessary to maintain and service the equipment. Other data control modules such as battery unit ECUs would also be covered within the OEM manuals and Bus manuals and schematics.

9.2.7 Vehicle Records

The Contractor shall provide a Vehicle record book to be included in each Coach upon its arrival at the transit property. Vehicle record books are to include as a minimum the following:

- Subcomponent serial numbers
- Test records
- Inspection records
- Shipping and Acceptance dates.

Each book shall be indelibly marked with the serial number of the Vehicle it accompanies. Vehicle record books must be approved by the SFMTA or the designated SFMTA Resident Inspector before shipment. This information must also be provided electronically as defined in Section 10.3.3 (Database Information).

9.2.8 Computerized Maintenance, Preventive Maintenance, and Illustrated Parts Manual System

The Contractor shall supply the Contractor's published Bus Parts Manual content in the following formats to allow the SFMTA to incorporate into its asset management system software: Parts Listing as detailed in MS Excel as per 10.3.3.2 Illustrated Parts Catalog Master File. Contractor shall supply Parts Manual illustrations in either SVG vector or compressed JPG file format, whichever works better for the SFMTA.

The Contractor will supply its published Bus Maintenance Manual content in Adobe PDF format to allow the SFMTA to incorporate into its asset management system software. These files will be supplied with the draft Bus Manual delivery (with First Bus delivery) and again with Final Bus Manual delivery (30 Days after receipt of SFMTA comments).

9.3 VEHICLE SUBSYSTEMS INTEGRATION AND DIAGNOSTIC TESTING REQUIREMENTS

Contractor shall integrate all electronic systems on the Vehicle that can communicate using the latest data link protocol as well as the Coach multiplex system. The integration shall include software and hardware that collects and stores all available data in a logical manner. The software shall automatically generate an event log of all data and shall incorporate data from, but not limited to, the propulsion, energy storage unit, traction motor, ABS brakes, multiplexing, video surveillance system, destination sign, Vehicle speed, farebox, automatic passenger counter, and fire detection/suppression system. The integration shall provide for a minimum storage time of two weeks. Contractor shall provide system integration details at design review. Function and suitability of design must be approved by the SFMTA.

The Contractor shall provide Self-Diagnostic Testing Software (SDTS) that analyzes the stored data for irregularities or failures to the maximum extent possible. At a minimum, the SDTS shall provide:

- A visual status indicator that all systems are functioning properly
- Trouble-shooting capability to locate trouble areas down to the circuit level (for example, a PCB or module in the ABS System) for each component or sub-component on the Coach.
- Flexibility to allow SFMTA to select or de-select the data to be stored

The software shall be user-friendly, simple to operate and able to function simultaneously and/or without affecting the integrity of the data from each of the other systems. The Contractor shall provide sufficient training and manuals for SFMTA personnel to operate the diagnostic testing software. All software shall be compatible with any PC laptop or desktop computer and must be approved by the SFMTA.

The integration shall also include the ability to retrieve this data through rugged, environmentally protected ports located strategically in the Coach. One data port shall be installed in the motor compartment and one in an easily accessible location at the front of the Coach. The SFMTA will work with the Contractor to determine the optimum locations for the data ports. The Contractor shall provide details of all required equipment to retrieve diagnostic data and/or event log from these ports during the design review and the data ports shall have the capability to access and download all information as specified in this section.

10 WARRANTY AND SPARE PARTS

10.1 BASIC PROVISIONS

10.1.1 Warranty Requirements

Warranties in this document are in addition to any statutory remedies or warranties imposed on the Contractor. Consistent with this requirement, the Contractor shall warrant and guarantee to the SFMTA each complete Coach and specific subsystems and components according to the following provisions:

The Contractor shall ensure in its procurement arrangements that the warranty requirements of this Contract are enforceable through and against the Contractor's suppliers, vendors, and subcontractors. Any inconsistency or difference between the warranties extended to the SFMTA by the Contractor and those extended to the Contractor by its suppliers, vendors, and subcontractors, shall be at the risk and expense of the Contractor. Such inconsistency or difference will not excuse the Contractor's full compliance with its obligations under the Contract Documents.

Upon request of the SFMTA, the Contractor promptly shall provide to the Project Manager complete copies of written warranties or guarantees and of documentation of any other arrangement relating to such warranties or guarantees extended by the Contractor's suppliers, sub suppliers, vendors, and subcontractors covering parts, components, and systems utilized in the Coach. If any vendor/supplier to the Contractor offers a warranty on a component that is longer or more comprehensive than the required warranties stated in Figure 10-1, the Contractor shall inform the SFMTA of this additional warranty and pass it through to the SFMTA at no additional cost to the SFMTA.

The Contractor shall ensure that such suppliers, sub suppliers, vendors, and subcontractors satisfactorily perform warranty-related work.

10.1.1.1 Complete Coach

The Coach shall be warranted and guaranteed to be free from Defects and related Defects for two years or 100,000 miles, whichever comes first, beginning on the date of Acceptance or Conditional Acceptance of each Coach. During this warranty period, the Coach shall maintain its structural and functional integrity. The warranty shall be based on regular operation of the Coach under the operating conditions prevailing in the SFMTA service area.

10.1.1.2 Subsystem and Components

Specific subsystems and components shall be warranted and guaranteed to be free from Defects and related Defects. Contractor shall provide the respective warranties to meet the times or mileages given in Figure 10-1 (Component Warranty), beginning on the date of Acceptance of each Coach or, if the Coach is Conditionally Accepted, any component, system,

or piece of equipment that is accepted after Conditional Acceptance of the Coach. The basic body structure is composed of all components that are welded or riveted together to form the mainframe and body construction, including exterior panels, interior panels, roof, ceiling, and driver's barrier. Suspension beams, weldments, and structural members shall be considered as parts of the basic body structure. Bolted-on components and operating hardware are considered add-ons and therefore are not a part of the basic body structure.

Primary load carrying members of the Coach structure, including structural elements of the suspension, shall be warranted against corrosion failure and/or fatigue failure sufficient to cause physical safety or Mean Distance Between Service Failure (MDBSF) for a period of 12 years or 500,000 miles, whichever comes first.

The ESS shall be warranted and guaranteed to be free from Defects and related Defects for a period of 12 years or 500,000 miles, whichever comes first. The ESS warranty shall cover the replacement of any ESS modules and components required to ensure that the Coach retains at least 80% of the original usable energy capacity throughout the warranty period.

10.1.2 Voiding Of Warranty

The warranty shall not apply to any part or component of the Coach that has failed as a direct result of misuse, negligence, or accident, or that has been repaired or altered in any way so as to affect adversely its performance or reliability, except insofar as such repairs were in accordance with the Contractor's maintenance manuals and the workmanship was in accordance with recognized standards of the industry.

The warranty on any part or component of the Coach shall also be void if the SFMTA fails to conduct normal inspections and scheduled preventive maintenance procedures on the same part or component substantially as recommended in the Contractor's maintenance manuals, and such failure by the SFMTA is the sole cause of the part or component failure.

FIGURE 10-1 ELECTRIC BUS SUBSYSTEM AND COMPONENT WARRANTY

Items	Description	Years*	Mileage*
1	Traction Motor and control system	5	300,000
2	Traction Inverter and control system	5	300,000
3	Energy Storage System and control system	12	500,000
4	Drive and non-Drive Axles	5	300,000
5	Suspension	2	100,000
6	Brake System (excluding friction material)	3	150,000
7	Basic Body Structure	3	150,000
8	Structural Integrity and Corrosion Protection	12	500,000
9	Cooling System including electric fans	3	150,000
10	Heating and Ventilation Units	3	150,000
11	Power Steering System	3	150,000
12	Wheelchair Ramp System	3	150,000
13	Destination Sign and Voice Annunciation System	3	150,000
14	Door System	3	150,000
15	Air System, not limited to Compressor, Dryer, Tanks, Valves	3	150,000
16	Flooring	6	250,000

*Whichever Occurs First

10.1.3 Exceptions to Warranty

The warranty shall not apply to scheduled maintenance items and items furnished by the SFMTA, except insofar as such equipment may be damaged by the failure of a part or component for which the Contractor is responsible.

10.1.4 Detection of Defects

If SFMTA detects a Defect within the warranty periods defined in Section 10.1.1, it shall notify the Contractor's representative within a reasonable time after discovery of the Defect. Within five working days after receipt of notification, the Contractor's representative shall either agree that the Defect is in fact covered by warranty, or reserve judgment until the subsystem or component is inspected by the Contractor's representative or is removed and examined at SFMTA property or at the Contractor's plant. At that time the status of warranty coverage on the subsystem or component shall be mutually resolved between the SFMTA and the Contractor. Work necessary to commence the inspection or repairs, under the provisions of Section 10.2 (Repair ProcedURES), shall commence within two working days after receipt of notification by the Contractor, unless such time is extended the by the SFMTA, and shall be conducted in accordance with Section 10.2.1 (Repairs by Contractor). Specific detail about a manufacturer repair shall be reported to the SFMTA within 24 hours of said repair.

If the SFMTA and Contractor are unable to agree whether a Defect is covered by the warranty provisions, the SFMTA may direct the Contractor to commence repairs in accordance with

Section 10.2.1 (Repairs by Contractor), pending agreement by the SFMTA and Contractor whether the repairs are covered by the warranty provisions. The Contractor shall promptly comply with such a request by the SFMTA.

10.1.5 Fleet Defects

10.1.5.1 Definition of Fleet Defect

A "Fleet Defect" is defined as the failure of identical subsystems or components on at least 20 percent, but not less than two, of Vehicles ordered by the SFMTA in any calendar year, where such failure occurs prior to the expiration of the of the Fleet Defect warranty period applicable to the last such Vehicles accepted by the SFMTA.

Where, in the SFMTA's opinion, such failure on multiple Vehicles creates a safety hazard or may result in damage to the Vehicle, such failure may, at the SFMTA's discretion, be considered a Fleet Defect, regardless of the proportion of such Defects identified. For illustration purposes only, if the SFMTA places an order for 25 Vehicles and five of these Vehicles manifest a Defect in identical subsystems or components that creates a safety hazard or may result in damage to the Vehicle, Contractor shall treat the failure as a Fleet Defect.

For the purposes of identifying and addressing Fleet Defects, identical items include Major Components and subsystems purchased by the Contractor as complete units and/or serviced as complete units, such as the power train. If it can be demonstrated to the SFMTA's satisfaction that only a component of a complete unit or subsystem needs to be changed or replaced to correct the problem, then changing or replacing such component in all Vehicles may be acceptable. If it can be demonstrated to the SFMTA's satisfaction that Defects can be isolated to a specific production batch, then changing or replacing components or subsystems of the specific production batch may be acceptable.

The Fleet Defect warranty shall not apply to normal wear and tear items (including, but not limited to, consumables such as tires, brake pads or components supplied by the SFMTA).

Where a Fleet Defect of a Major Component is not recognized by the applicable Major Component manufacturer or supplier as a Fleet Defect or to be covered under a fleet defect warranty of such manufacturer or supplier, Contractor shall make all commercially reasonable efforts to assist the SFMTA with obtaining a remedy from the Major Component manufacturer or supplier.

10.1.5.2 Repair Procedure; Corrective Action Plan

Following written notification of a Fleet Defect, it shall be the Contractor's responsibility to investigate and provide a permanent resolution regardless of failed component origin. This includes the management, notification and communications with any and all suppliers, sub-suppliers, and/or subcontractors. The resolution shall be inclusive of all parts and materials used in the manufacture and delivery of an Acceptable Vehicle.

Within 10 working days of receipt of notification of a Fleet Defect (unless the SFMTA grants an extension), the Contractor shall provide the SFMTA with a corrective action plan, subject to review and approval by the SFMTA, which shall be applied to all past, pending and future Bus orders under this Contract. After a corrective action plan has been established and approved by the SFMTA, the Contractor shall specify how and when all Buses shall be corrected. After approval of the final work plan and schedule, the Contractor shall promptly undertake and complete the work program within the timeline established in the approved corrective action plan. The corrective work shall be reasonably designed to prevent the occurrence of the same Defect (including Related Defects) on all other Coaches and spare parts purchased under this Contract. Any proposed changes to a corrective action plan or program must be submitted to the SFMTA for its approval.

The SFMTA reserves the right to suspend delivery or acceptance whenever a Fleet Defect has been identified and the contractor is not meeting its obligations with respect to warranty service.

10.1.5.3 Responsibility for Corrective Work

The Contractor shall pay for all necessary labor and material to effect all repairs or modifications to all Vehicles, including Buses for which the warranty had expired. If one or more of the Contractor's suppliers do not honor these Fleet Defect provisions, Contractor shall bear full responsibility for the repair of all Fleet Defects.

10.1.5.4 Warranty after Replacement or Repair of Fleet Defects

The warranty on parts or components used to remedy Fleet Defects shall begin when the retrofit parts are installed and shall be extended for the time and/or miles remaining on the original Coach warranty or the part manufacturer's warranty, whichever is greater.

10.1.5.5 Supply of Parts

If a retrofit requires the Contractor to supply parts to the City, the Contractor shall ship the parts in individual kits, each kit consisting only of all of the parts necessary to complete the repair/retrofit on one Bus. If retrofit parts are delivered to the City in any form other than individual kits, the Contractor shall reimburse the City (through the warranty claim process) for the cost of labor and materials incurred by the City to assemble parts into individual kits.

Should the retrofit or redesign necessitated by a Fleet Defect render parts in the City's inventory obsolete, the City will return the obsolete parts to the Contractor for a full refund of their original cost, with no restocking fee or shipping cost, or, to the extent feasible, require the Contractor to supply new parts to replace the obsolete parts.

10.1.5.6 Failure to Comply -- Corrective Action Plan

If (a) Contractor does not provide a plan for correction within the time specified above (or as extended by the SFMTA); or (b) a specific declared fleet Defect is not fully corrected within the

time specified in the plan; or (c) the remainder of the Coaches are not corrected in accordance with the Contractor's work program; the SFMTA may begin assessing liquidated damages in accordance with Section 19 of the Contract 15 Days after providing written notice to Contractor.

10.1.5.7 Voiding of Warranty Provisions

The fleet Defect provisions shall not apply to Coach Defects solely caused by noncompliance with the Contractor's recommended normal maintenance practices and procedures or caused solely by abuse of the equipment.

10.1.5.8 Exceptions to Warranty Provisions

Fleet Defect warranty provisions shall not apply to damage that is a result of normal wear and tear in service. The provisions shall not apply to SFMTA-supplied items.

10.1.6 Contractor's Representative

The Contractor shall, at its own expense, provide qualified factory authorized service personnel at SFMTA facilities from the time the first Coach is delivered until 60 days after the last Coach is accepted. The Contractor's service personnel shall be available on request to assist the SFMTA in the solution of engineering or design problems that are within the scope of the Technical Specifications and that may arise during the warranty period. Maintenance or repair instructions or suggestions from these representatives affecting warranty shall be in writing and directed to the SFMTA Project Manager. The Contractor's service personnel shall have authority to accept and approve warranty claims and make timely decisions affecting the repair of Defects.

On a daily basis, Contractor shall supply a record of Contractor's personnel working within SFMTA property to the SFMTA supervisor or superintendent on site.

The record shall contain the following information: Date, Name, and SFMTA Vehicle ID number. Contractor shall inform the SFMTA in advance of any modifications proposed on the Vehicle during the warranty period.

The SFMTA will work with the Contractor's representatives as much as possible to minimize the costs and time involved in conducting warranty repairs; however, due to space constraints and labor agreements, the SFMTA cannot guarantee that any Contractor work will be performed on SFMTA property.

10.2 REPAIR PROCEDURES

The Contractor shall be responsible for all warranty-covered repair work. The Contractor or its designated representative shall secure parts and perform all affected warranty repair work. At its discretion, the SFMTA may perform such work if it determines it needs to do so based on transit service or other requirements. The Contractor shall be responsible, and shall reimburse

the SFMTA, for all costs for warranty work performed by SFMTA personnel or by any contractor(s) hired by the SFMTA to perform warranty work, as described in Section 10.2.2, Repairs by SFMTA.

10.2.1 Repairs by Contractor

When the SFMTA requires the Contractor to perform warranty-covered repairs, the Contractor's representative must begin work necessary to effect repairs in a proper and timely manner, within 10 working days after receiving notification of a Defect from the SFMTA. Whenever the Contractor makes warranty repairs, new parts, subcomponents and subsystems shall be used, unless the repair of original parts is authorized in writing by the SFMTA. The SFMTA shall make the Coach available to complete repairs timely with the Contractor's repair schedule.

The Contractor shall provide, at its own expense, all spare parts, labor, tools and space required to complete repairs. The Contractor shall reimburse the SFMTA for all expenses incurred, including labor for driving Coaches, or towing charges for Coaches transported, between SFMTA's facilities and Contractor's service center or the facilities of its subcontractors or suppliers. The Contractor may use SFMTA shop space for repairs if approved by the SFMTA. If SFMTA does not approve shop space the supplier shall use their own offsite location to repair the Bus. If the Coach is removed from SFMTA property, the Contractor's representative shall diligently pursue the acquisition of parts and repair procedures. The schedule and scope of the repairs must be approved by SFMTA, and performed within 10 working days unless otherwise approved in writing by the SFMTA.

10.2.2 Repairs by SFMTA

If the SFMTA elects to perform or procure a contractor to perform, the warranty-covered repairs, the following shall apply.

10.2.2.1 Parts Used

The SFMTA shall use new parts, subcomponents and subsystems that Contractor shall provide specifically for this repair. Contractor shall stock the majority of parts, including those of its sub-suppliers. All parts shall be stamped or permanently marked with the OEM part number, and serial number if applicable. Warranties on parts used shall begin once the Vehicle has been repaired. The OEM warranty will apply to the newly installed part with the manufacturer acknowledging the passed-through warranty.

The SFMTA shall use parts or components available from its own stock only on an emergency basis. Monthly reports, or reports at intervals mutually agreed upon, of all repairs covered by warranty will be submitted by the SFMTA to the Contractor for reimbursement or replacement of parts or components. The Contractor shall provide forms for these reports.

10.2.2.2 Contractor-Supplied Parts

Contractor shall furnish parts for all warranty work, whether the warranty labor is performed by the Contractor or by the SFMTA. Contractor shall deliver, prepaid, warranty parts for repairs within 72 hours of notification from the SFMTA. If longer than 72 hours, the Contractor must provide justification.

10.2.2.3 Defective Parts Return

The Contractor may request that Defective parts or components covered by warranty be returned to the manufacturing plant. The Contractor shall pay the total cost for this action. Materials will be returned in accordance with the Contractor's instructions. Contractor shall provide such instructions to the SFMTA Project Manager at the beginning of the project.

The Contractor's representative shall meet with an SFMTA representative on a biweekly basis to determine which parts need to be returned to the manufacturer for evaluation, or which parts may be discarded.

10.2.2.4 Reimbursement for Labor

The Contractor shall provide reimbursement to the SFMTA. The amount shall be determined by multiplying the number of person-hours required by a qualified mechanic to correct the Defect. The warranty labor rate charged to the Contractor will be the day shift fully burdened hourly wage rate of a Mechanic. As of July 1, 2020, the warranty rate is $164.36/hour, based on the Mechanic wage rate of $45.88/hour. The labor rate shall be agreed to, in writing, at the beginning of Coach Acceptance, and is to be fixed for a period of one year. The adjustment for each year must not exceed the Producer Price Index (WPU1413--Truck and Bus Bodies) for that year. The labor hours spent on diagnostic time will be not be included in the warranty claim.

Contractor shall reimburse the SFMTA for approved warranty claims within 60 Days after each warranty claim has been submitted by the SFMTA. If the SFMTA does not receive payment within 60 Days, the SFMTA may deduct the amount of the approved claim from the progress payments due to Contractor.

10.2.2.5 Reimbursement for Parts; Towing

In the event the SFMTA deems it necessary to contract out for warranty repairs, the SFMTA shall notify and the contractor shall approve the warranty repair before the SFMTA proceeds with contracting out the repair. The Contractor shall reimburse the SFMTA for the actual cost of the repair, including charges for any warrantable parts, consequential parts or damages, labor, and towing or transportation. The SFMTA may impose a handling charge of 15% of the total cost of the warranty parts not to exceed $250 per claim plus applicable taxes.

The Contractor will be responsible for the cost of towing for two years or 100,000 miles if such action was necessary and if the Coach was in the normal service area. The Contractor shall not be responsible for the cost of towing resulting from a Major Component failure.

Contractor shall reimburse SFMTA for approved warranty claims within 60 Days after each warranty claim has been submitted by the SFMTA. If the SFMTA does not receive payment within 60 Days, the SFMTA may deduct the amount of the approved claim from the progress payments due to Contractor.

10.2.2.6 Major Component Repairs

To the extent that suppliers of Major Components require that warranty repairs be performed by an authorized dealer for those components, the SFMTA acknowledges that if it elects to repair these components without written permission from the original equipment manufacturer, the remaining warranty may be voided.

10.2.3 Warranty after Replacement or Repairs

The warranty on parts, components or subsystems replaced as a result of a standard warranty repair shall have the unexpired warranty period of the original subsystem, effective the replacement date. Extended warranties shall begin on the date of the repair or replacement of the parts, components, or subsystems.

10.2.4 Failure Analysis

At the SFMTA's request, the Contractor, at its cost, shall conduct a failure analysis of a failed part involved in a Fleet Defect or that is safety-related or a Major Component that could affect fleet operation that has been removed from Coaches under the terms of the warranty. The analysis shall be documented and compiled into a report. The failure analysis reports shall be delivered to the SFMTA Project Manager within 60 Days of the receipt of failed parts.

10.3 DATA PROCESSING

10.3.1 Warranty and Computer Program

The SFMTA’s preference is to use the latest SFMTA in-house warranty module for all tracking and submission of Warranty repairs and/or claims. All systems modifications, parts retrofits, and factory recalls must be documented for integration into warranty software.

If an alternative Warranty technology is proposed, it shall be made available to the appropriate SFMTA staff without any restrictions.

10.3.2 Warranty Data

The warranty data shall be provided in Microsoft Excel format with the following data elements for Contractor’s warranty and manufacturer warranties on all individual components and part(s).

The SFMTA will provide Vendor IDs to be used for this data. At the start of the project, Contractor shall provide a complete list of all manufacturers and/or vendors that Contractor will use in building the Vehicles. The SFMTA will provide Vendor IDs for use for the following warranty data.

10.3.2.1 Main Header Information

The main header shall include the name of the recipient of the Warranty, Vendor ID, name that is contracted to perform the warranty work, and a vendor contract number if there is one.

10.3.2.2 Details of the Warranty Conditions

A. If the warranty is a Vehicle Class warranty, give the term value, unit of measure and reimbursement type.
B. If the warranty is system-related, give the term value, unit of measure, reimbursement type, whether the condition is prorated, and whether the warranty term value flows down to underlying attached components of the system.
C. If the warranty is a component-type of warranty, give the term value, unit of measure, reimbursement type, whether the condition is prorated, and whether the warranty term value flows down to underlying attached components.
D. If the warranty condition is an item warranty from Contractor or a subcontractor that manufactures parts for Contractor, then please provide the following information: Main header information as described above, manufacturer part number, part description, term value, unit of measure, term type, reimbursement type, and whether the condition is prorated.
E. Data and data processing procedures must be approved by the SFMTA to ensure compliance with these specifications and compatibility with SFMTA's data processing methods.

10.3.3 Database Information

Contractor shall supply data on the fleet to the SFMTA in an electronic format in order to facilitate its loading into the SFMTA in house inventory software system. This section provides layouts and data requirements for the required data elements. Contractor may supply this information in its choice of:

- Microsoft Excel
- Microsoft Access
- Oracle tables

The SFMTA has no preference among the above, but all provided database files must be in the same format. Files will be provided on CD-ROM or latest technology electronic data storage media using the Contractor's choice of format from the above options. At the SFMTA's discretion, Contractor may transmit these files electronically directly to the SFMTA.

10.3.3.1 Coach Master File

The Contractor shall provide a record for each Coach at the time of delivery.

This record shall be intended for import into the SFMTA's own database system, shall have no access restrictions, and shall not be indexed. Contractor may supply a single file, which contains records for multiple Coaches.

At a minimum, the following Vehicle components shall be serialized and included in the record for the Coach:

Differential	Steering gear box
Traction Motor	Brake booster
Energy Storage System (ESS)	Front axle
ECU (Electronic Control Unit or similar)	Rear axle
Destination sign(s)	Hydraulic pump
Air compressor	Wheelchair ramp
Any auxiliary modules such as a radio or GPS system, which is installed by the vendor	

The Coach master file shall include at least the following data for all Coach and all systems/components listed above:

SFMTA Equip Code	Description	Mfr. name	Mfr. part #	Model #	Serial #	Location on Coach or other Equip	UOM	Next Higher Assembly Equip Code
CHAR(35) *	CHAR(60)	CHAR (10)**	CHAR (30)	CHAR (25)	CHAR (30)	CHAR(5) ***	CHAR(2) *	CHAR(35) (if applicable)

* The SFMTA will provide a coding structure for Contractor to use when creating this equipment master file

** The SFMTA will provide a code and description list of Manufacturer values; Contractor will use the appropriate code from the list in this column

*** The SFMTA will provide a code and description list of Location values; Contractor will use the appropriate code from the list in this column.

Serialized tire "brands" table records will also be provided in the same format as above, but will be provided in a separate file. The Locations for tires on each Coach are as follows (see ** note on above data table):

- Left front
- Right front
- Inner left rear
- Outer left rear
- Inner right rear
- Outer right rear

10.3.3.2 Illustrated Parts Catalog Master File

The Contractor shall provide the SFMTA with the following database information on MPC-compliant latest technology electronic media for the Illustrated Parts Manual.

The parts catalog data must be provided in Microsoft Excel rows and columns. Columns with data will consist of at least the following: Section, Graphic Title, Figure #, Item # (item 1, 2, 3, etc. on the graphic), Manufacturer Part Number, Part Description, QTY, Unit of Measure. For example see below.

Section	Fig #	Item #	Mfr.	Mfg. Part #	Description	Qty.	UOM	GRAPHIC_TITLE
(14)	(14)	(14)	CHAR (5)*	CHAR (30)	CHAR (60)	#(14,4)	CHAR (3)**	Coach-1-1-curb side locations

* SFMTA will provide a code and description list of Manufacturer values, Contractor will use the appropriate code from the list in this column

** SFMTA will provide a code and description list of UOM values, vendor will use the appropriate code from the list in this column.

Example:

Section	Fig #	Item #	Mfr	PN	Description	Qty	UOM	GRAPHIC_TITLE
2	1	1	Am Seat	500895	INSTALLATION DRIVER S BARRIER	1	EA	Coach-1-1-curb side locations

Images – Parts catalog images must be provided in TIF format and they must comply with the CCITT3 compression level. Image naming will match Graphic Title contained in the record defined above.

The parts catalog data must be provided in Microsoft Excel rows and columns. Columns with data will consist of the following: Section, Graphic Title, Figure #, Item # (item 1, 2, 3 etc. on the

graphic), Manufacturer Part Number, Part Description, QTY, Unit of Measure. For example, see below.

Section #	Fig #	Item #	Mfr	Mfg Part #	Description	Qty	UOM	GRAPHIC_TITLE
(14)	(14)	(14)	CHAR(5)*	CHAR(30)	CHAR(60)	#(14,4)	CHAR(3)**	Coach-1-1-curb side locations

* The SFMTA will provide a code and description list of Manufacturer values; Contractor will use the appropriate code from the list in this column

** The SFMTA will provide a code and description list of UOM values; vendor will use the appropriate code from the list in this column.

Example:

Section	Fig	Item	Mfr	PN	Description	Qty	UOM	GRAPHIC_TITLE
2	1	1	Am Seat	500895	INSTALLATION DRIVER S BARRIER	1	EA	Coach-1-1-curb side locations

Images – Parts catalog images must be provided in TIF format and they must comply with the CCITT3 compression level. Image naming will match Graphic Title contained in the record defined above.

The Contractor shall provide the SFMTA with the following database information on MPC-compliant latest technology electronic data storage media for all parts used on the Coach:

Mfr name	Mfr part #	Description	Net price w/freight	UOM	Next Higher Assembly Part #
CHAR(5)	CHAR(30)	CHAR(60)	NUMBER(14,2)	CHAR(2)*	CHAR(30) (if applicable)

* The SFMTA will provide a code and description list of Manufacturer values; Contractor will use the appropriate code from the list in this column.

** The SFMTA will provide a code and description list of UOM values, vendor will use the appropriate code from the list in this column.

All warranty repairs done by the Coach manufacturer at its shop must include a copy of the work performed to document work history by the SFMTA into in-house inventory software.

10.3.3.3 Publications Software

The Contractor shall provide the following drawings on USB storage devices, including all pertinent software and licenses.

- Maintenance Manuals
- Parts Manuals
- Training Manuals
- Wiring and Air Diagrams

The wiring diagrams and schematics shall be provided in CAD format such that the SFMTA can modify the drawings as needed. In lieu of providing the wiring diagrams and schematics in CAD format, the Contractor shall modify the wiring diagrams and schematics upon request by the SFMTA for the 12-year life of the Coach. The schematics shall be updated within 60 Days of the SFMTA's request.

10.4 SPARE PARTS

The Contractor shall furnish the spare parts and tools per Section 4.9 of the Agreement. The parts and equipment shall be identical to and totally interchangeable with like items supplied with the Coaches. Delivery of these parts and equipment shall be completed prior to delivery of the first production Coach.

Each Coach shall be delivered with a preventative maintenance filter kit, specific to the Coach.

Parts manuals (both paper (1 copy) and electronic Excel format) shall be completed prior to the delivery of the first production Coach. Production of the remaining Coaches shall not commence until the SFMTA has reviewed and Accepted the parts manuals.

Contract or shall provide a parts cross reference table, identifying sub-suppliers and their part numbers for all parts that are not manufactured by the Contractor.

The Contractor shall update the parts books (both paper and electronic Excel format) of any changes made for the 12 years after the initial production of the SFMTA Coaches described in this request. Any urgent updates shall be handled on a case-by-case basis, at the SFMTA's discretion. The parts books shall have the following indexes sorted in the following order:

- By Bus manufacturer's description
- By Bus manufacturer's part number

The Supplier shall provide 30-Day pricing information to help support the SFMTA in stocking of parts. The detail of the parts books shall be to the level of providing bolt size, lengths and metal grades in addition to cross reference to the part manufacturer or component manufacturer's part number. In the event there are updates which affect the durability, reliability or safety of spare parts and components supplied as part of this contract, or if there is a running change made during production, the Contractor shall exchange on a one-for-one basis the originally purchased parts with the new superseded parts within 60 Days of their release.

10.4.1 Recommended Spare Parts from Build Sheet

The Contractor shall submit a recommended spare parts list for the SFMTA's use when planning and ordering spare parts and to support the SFMTA's initial start-up for revenue operation.

The quantities shall be based on the quantity of Coaches on order at the time the parts list is generated, and shall be sufficient to cover the SFMTA's reasonable needs for five years.

Spare parts shall be interchangeable with their corresponding part. All spare parts shall be reconfigured to the latest revision during the warranty period. The recommended spare parts list shall take into consideration the potential for certain unused parts and assemblies to "age" and otherwise experience degradation in performance or reliability when installed. All such parts and assemblies should be clearly marked with date of manufacture, ideal storage conditions information, and shelf life date. This information tag should be clearly visible when the part, container, or assembly is stored.

10.4.1.1 Contractor's Recommendations/Prices

The Contractor's recommended spare parts list shall include the following:

A. Grouping by system, and special tool for stocking identification.
B. Generic name, trade name, description, rating, accuracy, Contractor's part number, original equipment manufacture's (OEM's) name, OEM's part number, drawing references, and correlation with the maintenance manuals.
C. Correlation for the recommended quantities with reliability requirements and lead time on the basis of the following classifications:

- Consumable – Parts with an expected life of less than five years.
- Wear – Parts that may be expected to require regular replacement under normal maintenance schedules, such as mechanical parts subject to continuous operation.
- One Shot – Parts that normally require replacement after performing their function one time, such as fuses.
- Long Lead (three months or greater) – Parts that are not readily available from distributors or manufacturer, such as specially made.

D. Exchange Assemblies – Assemblies that will be exchanges with failed units (or units that are not responding as specified) on the supplied equipment and that must be inventoried as complete assemblies.
E. A cross-reference and indexing system for replacement components common to more than one subsystem (whether Vehicle, test equipment, or special tool). Such components shall have only one-part number.
F. Alternate sources of supply for all commercially available replacement parts.
G. Current prices for all replacement parts.

10.4.2 Availability

The Contractor shall guarantee the availability of replacement parts for the Coaches for at least a 15-year period after the date of Acceptance of the last Coach. Spare parts shall be interchangeable with the original equipment and shall be manufactured in accordance with the Quality Assurance Provisions in these Technical Specifications. Contractor shall guarantee availability of 14-Day delivery or less from receipt of normal purchase order. Contractor shall not make exclusive agreements with sub-suppliers that would preclude the SFMTA from purchasing components directly from sub-suppliers. Contractor shall be able to expedite delivery (e.g. overnight delivery) of emergency shipments for 85% of the Coach parts.

Spare parts must be available to repair all electronic assemblies, subassemblies, and sub-subassemblies. Special provisions shall be made to supply those components that are not readily available on the commercial market (custom parts, for example). Any custom-made transformers, inductors, programmable components, or other devices containing proprietary firmware, shall be made available to the SFMTA as spare parts. When the original manufacturer is no longer able to supply the spare IC's, the associated proprietary firmware, transformer design specifications, and other relevant detail must be provided to the SFMTA at that time.

The SFMTA will work with the Contractor's representative as much as possible to minimize the costs and time involved with conducting warranty repairs, however due to space constraints and labor agreements; the SFMTA cannot guarantee that any Contractor work will be performed on SFMTA property.

11 RELIABILITY, MAINTAINABILITY, SAFETY

The Contractor shall establish and maintain an efficient reliability program to maintain the Mean Distances Between Failures (MDBF) as specified in Section 11.2, VEHICLE RELIABILITY REQUIREMENTS. The reliability engineering tasks shall focus on the prevention, detection and correction of reliability design deficiencies, weak parts and overall work quality Defects. Reliability engineering shall be an integral part of the Vehicle design process, including design changes. The reliability program shall monitor and control sub-suppliers' design and manufacture of parts to ensure compliance with the Reliability requirements (see Section 11.2) and the Contract terms.

11.1 SERVICE LIFE

The Coach, including all subsystems, shall be designed to operate in transit service for at least 12 years or 500,000 miles. It shall be capable of operating at least 40,000 miles per year, up to and including its 12th year. Components and structural members shall be designed to withstand the loads and motor torque reactions expected in revenue service on any route in San Francisco.

11.2 VEHICLE RELIABILITY REQUIREMENTS

The Vehicles shall be designed to meet the service goal for a Mean Distance Between Failures (MDBF) of 8,000 miles. The Contractor shall demonstrate compliance with these reliability requirements in both analysis and in revenue service of the first 10 Accepted production Coaches delivered during the first year or the first 40,000 miles.

11.3 FAILURES

Failure definitions are for the purpose of reliability demonstration testing, specification compliance and warranty administration.

11.3.1 Accountable Failures

Failures that are determined by the Failure Review Board (see Section 11.4) to have been caused by a design flaw or Defect in the Vehicle subsystems or components shall be tallied against the applicable warranty and Fleet Defect provisions of this Contract. Failures that are tallied for calculating the achieved reliability are those that meet the following criteria:

A. They are detected on the equipment during any period the test is in process and test time is being accumulated and recorded - all safety-critical failures are accountable;
B. They are verified by subsequent re-testing or investigation; and
C. They are independent (primary) failures.

In addition, an item failure will be accountable and included in the MDBF calculations when one or more of the following conditions exists:

- Inability of the equipment to attain or sustain minimum specified output requirements;
- Item failure symptoms that are detected under operations in test and recur in subsequent re-testing, but diagnosis and determination of the basic cause cannot be accomplished; or
- Multiple independent (primary) item failures detected on the equipment during measurement test time. (These will be individually accountable.)

11.3.2 Non-Accountable Failures

Item failures will be excluded from the MDBSF computations when one of the following conditions exists:

- The item failure cannot be duplicated during subsequent re-test, and the cause cannot be determined by investigation and analysis. The SFMTA will judge the adequacy of the Contractor's analysis for this determination;
- The item failure is a dependent (secondary) failure resulting from an independent (primary) failure;
- The item failure is caused by mishandling, aBuse, improper storage or accidental damage;
- The item failure is the direct result of improper test procedure or improper test equipment;
- The failure is a recurrence of one thought to have been corrected by adjustment or repair, and occurs within 20 test hours of the original failure; or,
- The item failure occurred in a unit that had been subjected to verified operational or environmental stresses beyond design requirements.

11.4 FAILURE REVIEW BOARD

A Failure Review Board with members from the SFMTA and the Contractor shall be convened to periodically review and determine the relevance of each failure and to recommend appropriate corrective action, both for Vehicles undergoing reliability demonstration testing and for those under warranty. The Failure Review Board shall be in effect during the complete warranty period of each Coach, and as necessary to resolve Fleet Defects.

11.5 MAINTAINABILITY

The Contractor shall establish and maintain an efficient maintainability program to support the maintainability requirements as specified in Section 11.5.4 (Maintenance and Inspection) of the Contract. Maintainability engineering shall be an integral part of the Vehicle design process, including design changes. Methods shall be taken to assure the sub-suppliers efforts are consistent with the overall system requirements.

All systems or components serviced as part of periodic maintenance or whose failure may cause a physical safety hazard or road call shall be readily accessible for service and inspection. To the extent practicable, removal or physical movement of components unrelated to

the specific maintenance or repair tasks involved shall be unnecessary. Relative accessibility of components, measured in time required to gain access, shall be inversely proportional to frequency of maintenance and repair of the components. Accessibility to components needing frequent maintenance shall be considered during the design reviews. The body and structure of all Coaches shall be designed for ease of maintenance and repair. Ease of repair shall correspond to the vulnerability of the item to damage in service.

Contractor shall provide all maintenance manuals to the SFMTA.

(Reference Section 9.2, Publications: Maintenance Manuals, Illustrated Parts Manuals, Operator's Manuals, & Vehicle Record Books).

11.5.1 Special Tools and Diagnostics Equipment

Each Coach shall be designed for disassembly, re-assembly, servicing, and maintenance by use of tools and items, which are normally available as commercial standard items. All grease fittings shall be capable of being serviced from a pitted area. Electronics assemblies and subassemblies shall also be maintainable by the use of standard, commercially available test equipment and maintenance tools. The Contractor must provide any special tools or special information that is needed to repair and reassemble electronic assemblies. Jacks or dollies shall be supplied to remove the energy storage system, traction motor, ramp and other large equipment boxes.

The following list of special tools and diagnostic equipment shall be provided by the Contractor upon delivery of the first Bus. All tools and electronic test equipment described throughout this section must be of heavy duty industrial grade quality approved by the SFMTA. Where software is provided to operate diagnostic equipment, a subscription for maintenance, support, and updates to that software should be included for the warranty period, including access to calibration codes.

11.5.1.1 Special Purpose Electrical and Electronic Diagnostic Tools

Contractor shall provide one complete set of industrial quality electrical and electronic system test equipment and diagnostic tools, to include digital multi-meters (Fluke 87E or approved equal), scope meters (Fluke 124 or approved equal), carbon pile testers, inductive pick-up ammeters, PLC logic analysis software and computer interface connectors, and other software.

Contractor shall provide one complete set of ESS maintenance, tune-up, and diagnostic tools, to include laptop computers, software and connectors. Laptops are to be Dell Latitude Rugged 14 or equivalent, having the storage and performance capacity to effectively handle all the diagnostics utilized on the Bus, or approved equal having equivalent or superior durability, dependability and ease of use. At a minimum they are to be equipped with 500 GB of SSD memory, 8 GB of RAM, one USB and one serial (RS232) port.

11.5.1.2 Special Purpose Electric Drive System Tools

Contractor shall provide one complete set of electric drive maintenance and diagnostic tools, to include electronic diagnostic data software, computer connectors, printers, and hand-held diagnostic data readers shall be used for reading trouble codes stored in ECM memory and for providing operating information about the electric drive system; one electric drive stand with adapters for overhaul purposes; and one set of dynamometer controls and adapter plates to mate the electric drive supplied to the SFMTA transmission dynamometer.

11.5.1.3 Special Differential and Propeller System Tools

Contractor shall provide one complete set of OEM installation and removal tools needed to maintain the differential and propeller shaft systems and two sets of differential overhaul tools.

11.5.1.4 Tow Equipment

Contractor shall provide three sets of specialized tow adapters, if required.

11.5.2 Electrical

Electrical subsystems shall consist of replaceable units so that each major component, apparatus panel, or wiring harness is easily separable with standard hand tools or by means of connectors. Each unit, except the main body wiring harness, shall be removable and replaceable in less than 30 minutes by a 4M mechanic.

11.5.3 Tire

A 4M mechanic shall complete jacking and changing any one tire in less than 30 minutes from the time the Coach is approached.

11.5.4 Maintenance and Inspection

Scheduled maintenance or inspection tasks as specified by the Contractor shall be within the prevailing industry practices and subject to SFMTA approval. OEM shall provide a list of maintenance activities that can be performed while the vehicle is charging.

Scheduled maintenance tasks shall be related and shall be grouped in maximum mileage intervals. Routine scheduled maintenance actions shall not be required at intervals of less than 1,500 miles.. Higher levels scheduled maintenance tasks shall occur at even multiples of 6,000 miles. It shall be possible for 4M mechanic to accomplish the scheduled maintenance or inspection tasks as specified by the Contractor. Scheduled maintenance tasks shall be related and shall be grouped in maximum mileage intervals. Higher levels of scheduled maintenance tasks shall occur at even multiples of mileage for lower-level tasks.

Test ports, as required, shall be provided for commonly checked functions on the Bus, such as air intake, hydraulic, pneumatic, charge-air, cooling systems all system voltages, currents, & ESS SOC.

The Coach manufacturer shall give prime consideration to the routine problems of maintaining the Vehicle. All coach components and systems, both mechanical and electrical, which will require periodic physical work or inspection processes, shall be installed so that a minimum amount of time is consumed in gaining access to the critical repair areas. Each Coach shall be designed such that it shall not be necessary to disassemble portions of the Coach structure and/or equipment such as seats and flooring under seats in order to gain access to these areas. Each coach shall be designed to facilitate the disassembly, reassembly, servicing or maintenance, using tools and equipment that are normally available as standard commercial items.

Requirements for the use of unique specialized tools will be minimized. The body and structure of the coach shall be designed for ease of maintenance and repair. Individual panels or other equipment that may be damaged in normal service shall be repairable or replaceable. Ease of repair shall be related to the vulnerability of the item to damage in service.

11.5.5 Hazards Definitions

A Hazard is defined as any real or potential condition that can cause injury or death, or damage to or loss of equipment or property.

11.5.6 System Safety Program Objectives

The Contractor shall have the responsibility of developing a system safety program that shall as a minimum have as its objective minimizing Hazards as defined in Section 11.5.5 (Hazards Definitions). The system safety program shall also be consistent with FTA guidelines, which certify the Vehicle Acceptable for revenue service and maintenance. System safety engineer/personnel shall be identified and shall be involved throughout the entire program. System safety engineer/personnel shall be responsible for problem identification, resolution reporting and submitting design changes affecting safety to the SFMTA Project Manager / Representative for approval.

11.5.7 System Safety Criteria

Criteria for system design and subsequent operation procedures shall assure that system safety objectives for Vehicles are implemented throughout design development, testing, delivery, operations and maintenance. Safety of passengers, mechanics and operator shall be taken into full consideration.

Potential or actual Hazards that have been identified through analysis shall be limited in accordance with the following order of precedence:

- Design for minimum Hazard
- Use of safety devices
- Use of warning devices
- Use of special procedures.

11.5.8 System Safety Data

Contractor shall provide appropriate system safety information and procedures for inclusion in training instructions, lesson plans and other publications.

12 QUALITY ASSURANCE

12.1 CONTRACTORS IN-PLANT QUALITY ASSURANCE REQUIREMENTS

12.1.1 Quality Assurance Organization

The Contractor shall establish and maintain an effective in-plant quality assurance (QA) organization. It shall be a specifically defined organization directly responsible to the Contractor's top management.

12.1.1.1 Control

The QA organization shall exercise quality control over all phases of production from initiation of design through manufacture to preparation for delivery. The organization shall also control the quality of supplied articles.

12.1.1.2 Authority and Responsibility

The QA organization shall have the authority and responsibility for quality control, personnel inspection planning, establishment of the quality control system, and acceptance or rejection of materials and manufactured articles in the production of the Coaches. These responsibilities include assuring that all components meet the engineering requirements for reliability, safety, and maintainability. The SFMTA shall be allowed to participate in all Contractor and/or subcontractor tests and inspections of all components of the equipment, at the Contractor’s and subcontractor’s plants, for the purpose of QA.

12.1.2 Quality Assurance Organization Functions

The functions of the QA organization shall include, but not be limited to, the following:

12.1.2.1 Work Instructions

The QA organization shall verify inspection operation instructions to ascertain that the manufactured product meets all prescribed requirements.

12.1.2.2 Records Maintenance

The QA organization shall maintain and use records and data essential to the effective operation of its program. These records and data shall be available for review by the Resident Inspector(s). Inspection and test records for this procurement shall be available for a minimum of two years after inspections and tests are completed.

12.1.2.3 Corrective Actions

The QA organization shall detect and promptly assure correction of any conditions that may result in the production of Defective Coaches. These conditions may occur in designs, purchases, manufacture, tests, or operations that culminate in Defective supplies, services, facilities, technical data, or standards. When repetitious rejections occur above 10%, the Contractor shall prepare a written report for the SFMTA detailing the problem(s) discovered during inspection and the efforts to be taken to remedy the problem(s). No further acceptance or production shall take place until the Contractor notifies the SFMTA in writing that the problems have completely resolved.

12.1.3 Standards and Facilities

The following standards and facilities shall be basic in the QA process.

12.1.3.1 Configuration Control

The Contractor shall maintain drawings, assembly procedures, and other documentation that completely describe a qualified Coach that meets all of the specification requirement options and special requirements of this procurement. The QA organization shall verify that each Coach is manufactured in accordance with these controlled drawings, procedures and, documentation.

12.1.3.2 Measuring and Testing Facility

The Contractor shall provide and maintain the necessary gauges and other measuring and testing devices for use by the QA organization to verify that the Coaches conform to all specification requirements. These devices shall be calibrated at established periods against certified measurement standards that have known valid relationships to national standards.

12.1.3.3 Production Tooling as Media of Inspection

When production jigs, fixtures, tooling masters, templates, patterns, and other devices are used as media of inspection, they shall be proved accurate at formally established intervals and adjusted, replaced, or repaired as required to maintain quality.

12.1.3.4 Equipment Use by Resident Inspector(s)

The Contractor's gauges and other measuring and testing devices shall be made available for use by the Resident Inspector(s) to verify that the Coaches conform to all specification requirements. If requested, the Contractor's personnel shall be made available to operate the devices and to verify their condition and accuracy.

12.1.4 Control of Purchases

The Contractor shall maintain quality control of purchases.

12.1.4.1 Supplier Control

The Contractor shall require that each supplier maintain a quality control program for the services and supplies that it provides. The Contractor's QA organization shall inspect and test materials provided by suppliers for conformance to specification requirements. Materials that have been inspected, tested, and approved shall be identified as acceptable to the point of use in the manufacturing or assembly processes. Controls shall be established to prevent inadvertent use of nonconforming materials.

12.1.4.2 Purchasing Data

The Contractor shall verify that all applicable specification requirements are properly included or referenced in purchase orders of articles to be used on SFMTA Coaches.

12.1.5 Manufacturing Control

The Contractor shall ensure that all basic production operations, as well as all other processing and fabricating, are performed under controlled conditions. Establishment of these controlled conditions shall be based on the documented work instructions, adequate production equipment, and special working environments as necessary.

12.1.5.1 Completed Items

A system for final inspection and test of complete Vehicles and the spare parts package shall be provided by the QA organization. It shall measure the overall quality of each complete item.

12.1.5.2 Nonconforming Materials

The QA organization shall monitor the Contractor's system for controlling nonconforming materials. The system shall include procedures for identification, segregation, and disposition.

12.1.5.3 Statistical Techniques

Statistical analysis, tests, and other quality control procedures may be used when appropriate in the QA processes.

12.1.5.4 Inspection Status

A system shall be maintained by the QA organization for identifying the inspection status of components and complete SFMTA Coaches. Identification may include cards, tags, or other normal quality control devices. A “traveler” shall be attached to each car to track QA functions and defects as the work progresses through the shop. A copy of the report must be attached to each car through Conditional Acceptance.

12.1.6 Inspection System

The QA organization shall establish, maintain, and periodically audit a fully documented inspection system. The system shall prescribe inspection and test of materials, work in progress, and completed articles. At a minimum, it shall include the following controls.

12.1.6.1 Inspection Stations

Inspection stations shall be at the best locations to provide for the work content and characteristics to be inspected. Stations shall provide the facilities and equipment to inspect structural, electrical, hydraulic, and other components and assemblies for compliance with the design requirements.

Stations shall also be at the best locations to inspect or test characteristics before they are concealed by subsequent fabrication or assembly operations. These locations shall minimally include, underbody structure completion, body framing completion, body prior to paint preparation, traction motor installation completion, subsystem components, underbody dress-up and completion, Coach prior to final paint touch-up, Coach prior to road test, and Coach after final road test.

12.1.6.2 Inspection Personnel

Sufficient trained inspectors shall be employed to ensure that all materials, components, and assemblies are inspected for conformance with the Coach design and specifications.

12.1.6.3 Inspection Records

Acceptance, rework, or rejection identification shall be attached to inspected articles. Articles that have been accepted as a result of approved materials review actions shall be identified. Articles that have been reworked to specified drawing configurations shall not require special identification. Articles rejected as unsuitable or scrap shall be plainly marked and controlled to prevent installation on the Coach. Articles that become obsolete as a result of engineering changes or other actions shall be controlled to prevent unauthorized assembly or installation. Unusable articles shall be isolated and then scrapped.

Discrepancies noted by the Contractor or Resident Inspector(s) during assembly shall be entered by the inspection personnel on a record that accompanies the Major Component, subassembly, assembly, or Coach from start of assembly through final inspection. Actions shall be taken to correct discrepancies or deficiencies in the manufacturing processes, procedures, or other conditions that cause articles to be in non-conformance with the requirements of the contract specifications. The inspection personnel shall verify the corrective actions and mark the discrepancy record. If discrepancies cannot be corrected by replacing the nonconforming materials, the Resident Inspector(s) shall approve the modification, repair, or method of correction. The inspection forms shall be posted at or near the point of inspection for each car and included in the Vehicle History Book when all discrepancies have been eliminated.

An Inspection and Test Log (Log) shall be maintained by the Contractor during equipment assembly. The Log shall be submitted to the SFMTA for review before each car will be released for shipment to the delivery site. All Contractor and SFMTA in-process inspection sheets and test data records for that car shall be contained in this Log, which will be provided in the Vehicle History Book. (see 12.2.2.3)

12.1.6.4 Quality Assurance Audits

The Contractor's QA organization shall establish and maintain a quality control audit program. The Contractor shall submit a Quality Assurance Plan for SFMTA review and approval prior to the commencement of building the first Coach of this Contract.

Records of this program shall be subject to review by SFMTA representatives during the manufacture of Coaches for this Contract.

12.1.6.5 First Article Inspection

The first article Coach shall undergo a detailed inspection by SFMTA personnel or representatives. The purpose of this inspection will be to ensure that the Coach has been built to approved engineering and that all agreed changes have been incorporated. The configuration established at this inspection shall become a benchmark for all future production Coaches.

Dependent on circumstances, this first built Coach may have to participate in the Federal Coach Testing Program "Altoona Test" to qualify this procurement for federal funding. The Contractor shall inform the SFMTA of the status of the proposed equipment in regards to the required testing prior to its manufacture.

The SFMTA may require this Coach be kept at the manufacturing plant to ensure its availability as a "template" in the event there is a question concerning the production Coaches are conforming to this pattern.

Coach inspection snag list will be transmitted to the SFMTA and the assembly line for immediate production corrections, so as not to have repeated delivery of Coaches with repeat snags. Corrections shall be made at the manufacturing facility prior to delivery and contractor shall provide a corrective action report to the SFMTA explaining what was done to prevent these from occurring on the production Buses.

12.1.7 Resident Inspector

Resident Inspector(s) shall represent the SFMTA at the Contractor's plant. They shall monitor, in the Contractor's plant, the manufacture of transit Coaches built under the procurement. The Resident Inspector(s) will be authorized to approve the pre-delivery Acceptance tests, and to release the Coaches for delivery. Upon request to the QA manager/supervisor, the Resident Inspector(s) shall have access to the Contractor's QA files related to this procurement. These

files shall include drawings, material standards, parts lists, inspection processing and reports, and records of Defects.

No less than 30 Days prior to the beginning of Coach manufacture, the Resident Inspector(s) will meet with the Contractor's quality assurance manager/supervisor. They will review the inspection procedures and checklists. The Resident Inspector(s) may begin monitoring Coach construction activities two weeks prior to the start of SFMTA Coach fabrication.

The Contractor shall provide office space for the Resident Inspector(s) in proximity to the final assembly area. This office shall be equipped with desks, two telephones, file cabinets, chairs, and clothing lockers sufficient to accommodate the Resident Inspector staff. Office accommodations shall be at least equivalent to those utilized by the Contractor's staff.

The presence of the Resident Inspector(s) in the plant shall not relieve the Contractor of its responsibility to meet all of the requirements of this procurement.

12.1.8 Compliance Demonstration

Upon written request of the SFMTA Project Manager/Representative the Contractor shall demonstrate compliance with any requirement of these Specifications. Requests shall normally be made such that the demonstration can be scheduled in advance of the delivery of the prototype and production Coaches. Other demonstrations may be requested after delivery should the SFMTA Project Manager/Representative suspect that the prototype or production Coaches are not in conformance to these Specifications. The demonstrations shall consist of formal tests conducted on the prototype and/or representative production Coaches and witnessed by the SFMTA Project Manager/Representative. In lieu of conducting tests of a destructive nature, the demonstration requirement may be satisfied by a comprehensive analysis of sufficient scope and quality to show specification compliance. The burden of demonstrating compliance rests on the Contractor but is subject to approval by the SFMTA Project Manager/Representative or Project manager. Contractor shall be responsible for associated costs to demonstrate compliance and any work required to correct any non-compliance conditions.

12.2 TEST REQUIREMENTS

12.2.1 General

This Section defines and establishes the requirements for comprehensive testing of the Coaches to be developed and managed by the Contractor. The SFMTA or its authorized representatives will have the option of overseeing all testing. The tests shall ensure proof-of-design and shall determine the compliance with the following requirements:

- Duty Cycle (as per Appendix F-2 of Volume 1)
- Performance (as per Appendix F-1 of Volume 1)
- Dimensional
- Accessibility (ADA)
- Noise Control (audible and electronic)
- Contract compliance
- Braking
- Jerk rate
- Air compressor recovery rate

The tests shall also ensure that the production Vehicles, including all components and subsystems, will function as required in the SFMTA environment. Modifications to the system programming, and specification of related subsystems (including rear axle ratio), shall be made as needed in order to best meet these requirements. Reliability will be emphasized. Design qualification, production conformance, and acceptance testing on all Vehicle components and subsystems are required and subject to review and approval by the SFMTA.

Criteria for evaluating Coaches in the pre-delivery and post-delivery tests will be uniform.

12.2.1.1 Submittals

The following items shall be submitted for SFMTA approval:

- Test program
- Test procedures
- Test reports, training manuals, O&M manuals

12.2.1.2 Test Program

The test program shall include all tests required to verify compliance with these specifications. In general, all specified requirements shall be subject to verification by test. Tests, by definition, include visual observation, non-destructive examination, equipment operation under extreme environmental conditions, accelerated-life operation, normal performance, abnormal performance, observation of normal operation and maintenance, and results of induced failures/faults.

The Test Program shall identify all tests by reference to the appropriate specification section. The test program shall cover all Contractor's and its sub-suppliers' tests and location of tests to be completed prior to Coach delivery, and identify all testing to be conducted by the Contractor on SFMTA property prior to Acceptance. The SFMTA is requiring the brake test program to be completed in the SFMTA San Francisco service area As part of this Contract, for tests which the Contractor proposes will be performed outside of the SFMTA's San Francisco service area, the Contractor shall provide travel and expenses for two SFMTA representative witnesses.

Rates and duration shall be based on accepted FTA guidelines for the area being traveled to. The Contractor shall manage the testing and reporting process. The Test Program shall provide, for each major subsystem, a detailed explanation of how the requirements of this section will be met. Cases where the Contractor intends to meet the requirements of this section through some means other than testing shall be identified in the Test Program.

12.2.1.2.1 Test Facilities

The Contractor shall provide competent personnel in appropriate technical disciplines to ensure an uninterrupted test program. Where appropriate, tests shall be conducted under simulated operating conditions. Special tools, test equipment, instrumentation, data processing, and spare parts required during testing shall be furnished by the Contractor.

12.2.1.2.2 Test Procedures

Contractor shall submit an overall test procedure for each design qualification and conformance tests and each acceptance test for approval 30 Days prior to the scheduled date of the test.

The Contractor shall provide all equipment and instrumentation required to conduct tests. Training, to observe or participate in the test, if required by the SFMTA, shall be provided by the Contractor. The test procedures shall contain at least the following:

- Test objective
- Success/failure criteria and justification for criteria in quantitative terms
- Sequence of testing
- Equipment and instrumentation required
- Test setup, description, and diagrams
- Test methodology
- Data evaluation procedure
- Type of report or data to be submitted to the SFMTA.

With prior approval, the Contractor may submit proven existing procedures that differ from this format. At least 30 Days prior to each test, the Contractor shall notify the SFMTA Project Manager/Representative in writing of the date, time, and location the test will be performed.

SFMTA or its authorized representative will have the right to witness any and all tests. The tests specified herein are specific tests requested by the SFMTA. The Contractor, with SFMTA direction and approval, is required to develop a complete list of design and component qualification test and pre and post-delivery tests. The Contractor and its subcontractors may perform additional testing, as they deem necessary.

12.2.1.2.3 Test Reports

Within 30 Days after successful completion of each test, a report shall be provided that summarizes results, analyses, and corrective actions.

Reports shall include photographs, charts, and additional data to support the test results. Reports must include a statement that certifies conformance to specified requirements. Should submitted data not be acceptable to the SFMTA, the Contractor shall complete the tests as specified with no increase in contract cost or extension of the delivery schedule.

The reports of each test shall be included in the appropriate Coach History Book.

12.2.1.3 Design and Component Qualification and Conformance Testing

The Contractor shall demonstrate that each component supplied meets the requirements of these specifications.

In cases where testing costs would be excessive, or where test results might be inconclusive, design integrity may be demonstrated through analyses. In cases where the component or subsystem in question is substantially similar in design and application to equipment previously used in transit service, the design may be qualified through submission of revenue service data.

In all other cases, the Contractor shall conduct a proof-of-design test that demonstrates that the requirements of these specifications are met. These tests need not be repeated if they are successfully completed and witnessed. If a test is failed, the Contractor shall make any necessary modifications to the equipment and rerun the test until it is successfully completed.

12.2.1.3.1 Design and Component Qualification through Analysis

If tests to demonstrate compliance with certain requirements are shown to be excessively expensive or potentially inconclusive, approval may be given to waive the requirements for certain design qualification and conformance tests. The process for qualification through analysis is as follows:

A. Submit a waiver request that details cost excessiveness, the specific design attributes that will be qualified in through design analysis
B. Submit design qualification analysis report with sufficient documentation (e.g., designs, calculations, standards references)
C. Obtain approval during the design review process.

12.2.1.3.2 Waiver for Proven Equipment

If the component or subsystem in question is substantially identical in design to equipment previously deployed in other transit applications, it may not be necessary to conduct design qualifications tests on that equipment. To obtain a waiver for proven equipment, the Contractor must submit:

A. A list of the quantities and locations of current equipment installations
B. A description of all relevant differences in the equipment and the equipment's application vis-à-vis the requirements of these specifications and other installations
C. Results of any relevant design qualification tests that have previously been conducted on the equipment
D. Cost reduction analysis

Based on the data submitted, the SFMTA will determine whether to waive the requirements for design qualification testing. Specific requirements for each set of equipment shall be considered individually, and it will be possible for certain tests to be waived while others may still be required.

12.2.1.3.3 Design and Component Qualification Testing

These tests shall be run on production equipment that has passed production acceptance testing. These tests shall stress the equipment under environmental conditions at least as severe as those described in Section 1 (Overall Requirements). While stressed in this way, it shall be demonstrated that the equipment performs its intended functions without failure.

12.2.1.3.4 Subsystem Qualification Testing

Major subsystems shall be assembled separate from the Vehicle and shall be tested to verify compliance with these Specifications. Related subsystems may be integrated and tested

together to verify compliance of the individual subsystems and to verify the design of the interface between them.

The interfaces between equipment and between subsystems are viewed as crucial aspects of the system design. To verify these interfaces, it is preferred that subsystem tests be designed to include as many system interfaces as possible. Any equipment attributes that can be tested during subsystem testing need not be tested again at the component level.

12.2.1.4 Acceptance Testing

Fully documented Acceptance tests shall be performed on all assemblies and the completed Vehicle.

Acceptance test procedures shall be updated based on experience gained from previous qualification testing or Vehicle operation. Test procedures shall be expanded to focus on areas that prove to be, or have historically been Defective, deficient, or unreliable.

Tests shall be conducted at the point of manufacture. The tests shall ensure that each unit is produced to at least the same quality level as the unit presented for the first article inspection.

12.2.2 Prototype Tests

The prototype test program shall consist of all tests outlined in Section 12.2.3 (Pre-Delivery Tests) through Section 12.2.4 (Post-Delivery Tests).

The prototypes will be Accepted by the SFMTA as a production Coach only if it is identical to the accepted production Coaches. The prototypes shall have adjustable mounts for the interior and exterior mirrors, fare boxes and other components as requested by the SFMTA to determine their optimum location for operators. The electric system and related subsystems shall be adjustable or modifiable to the extent that Vehicle reliability and performance can be optimized during testing while simulating in-service conditions. Final location of these components will be determined prior to assembly of production Coaches.

12.2.2.1 Prototype Pre-Delivery Tests

Factory tests shall include those tests specified in Section 12.2.3 (Pre-Delivery Tests). In addition, the prototypes shall be instrumented during road tests.

12.2.2.2 Prototype Post-Delivery Tests

Post-delivery tests shall include the following two phases. During Phase I, the prototype shall be instrumented to record time, speed, acceleration, distance, and brake pressure, and loaded with weights to simulate passenger load. While instrumented and loaded, the Coach shall be tested on the routes specified in Section 1.4 (Duty Cycle), to verify that the performance requirements in these Specifications are being achieved. All records of test results shall be readable on a

standardized PC labeling/language throughout. Computer, stored on a CD-ROM, and shall be presentable on 8-1/2 by 11 paper.

In Phase II, the prototype shall be placed into simulated revenue service or actual revenue service on routes, determined by the SFMTA for up to 8,000 miles or 3 months. This purpose of this test is to determine any changes or adjustments needed to achieve optimum Vehicle performance, meet the desired MDBF and determine the final configuration of the production Coaches, including the prototype Coach.

12.2.3 Pre-Delivery Tests

The Contractor shall conduct Acceptance tests at its plant on each Coach following: (a) completion of manufacture and (b) before delivery to the SFMTA. These pre-delivery tests shall include visual and measured inspections, as well as testing of the total Coach operation and water tightness. The tests shall be conducted and documented in accordance with written test procedures to ensure that the completed Coaches have attained the desired quality and have met the requirements of these Technical Specifications.

The pre-delivery tests shall be scheduled and conducted with sufficient notice so that they may be witnessed by the Resident Inspector(s), who may accept or reject the results of the tests. The results of pre-delivery tests, and any other tests, shall be filed with the assembly inspection records for each Coach. The under-floor equipment shall be made available for inspection by the Resident Inspector(s), using a pit or Coach hoist provided by the Contractor. A hoist, scaffold, or elevated platform shall be provided by the Contractor to easily and safely inspect Coach roofs. Delivery of each Coach shall require written authorization of the Resident Inspector. Release of each Coach for delivery shall require written authorization of the Contractor. An executed copy of the authorizations shall accompany the delivery of each Coach. The SFMTA will not furnish an operator for these pre-delivery tests.

12.2.3.1 Visual and Measured Inspection

Visual and measured inspections shall be conducted with the Coach in a static condition. The purpose of the inspection is to verify overall dimensional and weight requirements, to verify that required components are included and are ready for operation, and to verify the function of components and subsystems that are designed to operate with the Coach in a static condition.

12.2.3.2 Water Tightness

Each Coach shall be tested as per Section 2.1.7 (Exclusion of Water).

12.2.3.3 Vehicle History Book

The Contractor shall produce a Vehicle History Book for each completed Bus. The Vehicle History Books shall be a specific record of production, testing, inspection and relevant documentation for each individual Vehicle. The Vehicle History Book shall contain original

documents unless specified otherwise. All documents shall be marked with the Bus serial number, the production sequence number, or the SFMTA Bus number for the completed vehicle.

The Contractor shall provide one electronic Vehicle History Book for each Bus. A draft Vehicle History Book will be submitted to the SFMTA for review and approval 60 Days before the first Bus is scheduled to ship.

At a minimum, each Vehicle History Book shall contain the following:

- Table of contents
- Production control cross-reference sheet, listing:
    - Bus serial number
    - Shop order/production sequence number
    - Final SFMTA Bus number
- Production schedule for each Bus showing start and end dates for each major stage of manufacturing
- List of all production drawings by number and revision status (release date, current revision, and outstanding engineering change requests at time of production)
- List of all parts by supplier and part number (bill of material)
- List of all serialized components
- Log of all non-conformances including status
- Component test certificates
- Test records:
    - Master test plan
    - Test procedures
        - Production tests
        - Acceptance tests
    - Record of measurements and results
- Critical dimensional inspection report
- Records of all required inspections
- Completed pre-shipment checklist
- Shipping approval form

- SFMTA Acceptance form
- Transfer of title of the Bus from Contractor to the SFMTA (with original wet-ink signature of Contractor's representative).

Each vehicle history book shall be presented to the SFMTA prior to the Bus being released from the Contractor's facility.

12.2.4 Post-Delivery Tests

The SFMTA Project Manager/Representative may conduct post-delivery tests on each delivered Coach. The post-delivery tests will include visual inspection and Coach operation.

Coaches that fail to pass the post-delivery tests are subject to non-Acceptance. The SFMTA Project Manager/Representative will record details of all Defects on the appropriate test forms and will notify the Contractor of non-acceptance. The Defects detected during these tests shall be repaired according to procedures set forth in Section 69 of the Sample Agreement, Part V, of Volume 1.

12.2.4.1 Visual Inspection

The post-delivery visual inspection is similar to the inspection at the Contractor's plant and will be conducted with the Coach in a static condition. Any deficiencies, Defects or visible delivery damage will be identified and recorded during the visual inspection of each Coach.

12.2.4.2 Post-Delivery Acceptance Test

Prior to Acceptance, each Vehicle shall have a minimum of 500 driven miles. This mileage can be accumulated during the drive away trip.

During the drive-away trip, the speed and operation en route shall be controlled to conform to the recommendations of the system suppliers and tire supplier so as to prevent damage to any part of the Coach. At the time of delivery, a written report shall be submitted to the SFMTA by the Contractor listing all incidents and unusual Coach performance as well as the quantity of oil, coolant and other fluids added to the Coach during the trip.

In the event the drive-away trip of any Coach is interrupted, for any reason, the Contractor shall include in the report a description of the nature of the service or repair, and the cause and restoration, if any, required to continue the trip. Failure to submit this written report will result in the SFMTA not accepting delivery of the Coach.

12.3 PROJECT PLANNING, SCHEDULING AND CONTROL

12.3.1 Introduction

This section specifies the requirements for project planning, scheduling, and progress reporting to be performed by the Contractor in conjunction with the Contract work. The Contractor shall employ Critical Path Method scheduling (CPM) for planning, scheduling and reporting all work required by the Contract Documents.

12.3.2 Definitions and Clarifications

Baseline Schedule: The detailed CPM schedule, prepared by the Contractor, indicating the Contractor's plan for executing the Contract work. This schedule shall include the Contractor's logic network drawings, all schedule network reports and all schedule resource reports. The Baseline Schedule shall conform to all requirements of the Contract Documents.

The Baseline Schedule shall be revised as necessary to incorporate approved Contract Modifications. The Contractor's performance or other avoidable delays shall not be considered justification for Baseline Schedule revision.

Current Schedule: The updated logic network and supporting reports indicating actual progress to date and forecasted logic and progress for the remaining work. The update will be, at a minimum, to the same level of detail as the Baseline Schedule. Monthly updates of the current schedule shall be a contract requirement. The City may withhold payment if this schedule update is delinquent.

Supplemental Schedule(s): Detailed schedules prepared by the Contractor, at the request of the SFMTA Project Manager / Representative, to substantiate proposed Contractor changes that may have a schedule impact.

Summary Level Bar Chart: A summary level bar chart schedule encompassing the entire Contract and indicating all Contract-required milestones or Contractor-identified milestone events.

Monthly Plan: A detailed plan of the work, in bar-chart format, to be accomplished in the coming weeks. Relationships between the Monthly Plan and Current Schedule activities shall be identified.

As-Built Schedule: The resulting schedule incorporating all actual activity durations, milestone completions, and Contract extensions as accomplished or incurred during the Contract duration. The Contractor shall submit this As-Built Schedule to the City at the completion of the Contract work.

Work Day: Any day except Saturdays, Sundays, US legal holidays. If multiple shifts per day or extended hours (more than eight hours per shift) are scheduled, this is to be noted with the particular scheduled activities to which this applies.

Use of Float: Float identified in the baseline, or Current Schedule is jointly owned by the City and the Contractor. Its use must be approved in the scheduling update process.

12.3.3 Description of Submittals

A Baseline Schedule and Management Plan shall be submitted to SFMTA for review and approval.

Reference Section 13.1 (Preferred Delivery Schedule).

12.3.3.1 Baseline Schedule

Contractor shall submit a Baseline Schedule and shall include the following aspects:

- The program logic to be initially reviewed and approved by the SFMTA prior to initial design review.
- The costs and resources, as required, attributable to each activity of the accepted Baseline Schedule. Costs shall be allocated by bid item and shall match bid amounts.
- All activities related to major subsystems for the prototype and production Coaches.

The schedule documents, reports, lists, computer software with documentation and electronic files are required with each submittal. The Baseline Schedule shall be developed using Microsoft Project software or approved equal.

12.3.3.2 Management Work Plan

The Management Work Plan shall include protocols, procedures, and assignments of responsibility for key personnel and correspondence forms for all phases of the Contract and all project activities for the duration of the Contract. Once the Management Work Plan is approved, key personnel shall not be substituted without approval from the SFMTA. If the Contractor plans to substitute key personnel, a 30-Day advance notice, and qualification of new personnel shall be required. At the request of the SFMTA, or when approved changes are made, the Contractors Management Work Plan shall be updated to include the latest revision to the project scope or other changes in project circumstances.

12.3.4 Early Completion Schedule

The Contractor may submit a schedule, which contains completion dates in advance of the dates specified in this Contract. The City may reject the schedule and require the Contractor to furnish a schedule indicating completion by the end of the originally scheduled Contract period. The City shall not be liable for damages, loss of profit or any additional compensation as a result of such rejection.

12.3.5 Progress Review Meetings

On the date mutually agreed upon by the City and the Contractor, Schedule and a Progress Review meeting will be held, at which time the CPM schedule will be reviewed. The City, the Contractor, and if necessary, the appropriate subcontractors, shall attend the meeting.

Schedule Monitoring and Progress Reporting: At monthly intervals, and at other times at the request of the City, the Contractor shall update the prior month's Current Schedule indicating progress during the reporting period, the latest schedule status, any approved Contract modifications and any proposed logic changes. The schedule update shall be prepared concurrently with, and be an integral part of, progress evaluation and reporting.

During the Schedule and Progressed Review meeting, the Contractor's schedule submission will be discuss and revised by the Contractor as necessary. The City may require the Contractor to modify any portions of the schedule because of "behind schedule" activities. The marked-up schedule documents from this meeting will serve as the Current Schedule until the Contractor incorporates the change in the computer program and produces the updated Current Schedule. City participation in the schedule review process shall not relieve the Contractor from the Contract required milestone completion dates of the Baseline Schedule in effect.

12.3.6 Modifications to the Schedule

When requested by the SFMTA Project Manager/Representative, the Contractor shall submit supplemental schedule(s) to substantiate proposed Contract changes that may have an impact on the schedule within three working days to the SFMTA's Project Manager/Representative for review and approval; otherwise, any proposed Contract change will not be considered by the City.

Modifications: Upon approval of a Contract modification by the City, the approved change will be incorporated in the Baseline Schedule during the monthly update process.

12.3.7 Scheduling of Work

The program shall at minimum be divided into the following:

- Design Development Periods
- SFMTA Review Periods
- Prototype(s) Manufacturing and Testing
- Production Manufacturing and Testing for each Coach

- Warranty Program
- Contract Deliverables (training manuals, interactive training)

The work shall be scheduled to:be completed within the Contract time allowances and to comply with requirements of the Contract Documents.

13 DELIVERY SCHEDULE

13.1 PREFERRED DELIVERY SCHEDULE

The City's preferred delivery schedule is indicated below. Completion of items as indicated below shall occur before the time periods listed have elapsed.

Item	**Days after Notice-to-Proceed**
1) Submittal of Baseline Schedule and Management Work Plan	--30--
2) Submittal of Vehicle drawings, control, Reliability Program Plan, and test plans	--60--
3) Submittal of training program (including lesson plans)	--90--
4) Delivery of prototype Coach[1]	--270--
5) Submittal of draft operations, maintenance, parts manuals, recommended spare parts	--300--
6) Approval of prototype Coach (estimated)	--330--

Item	**Days after Approval of Prototype**
7a) Production starts	--90--
7b) Beginning of Coach delivery[2]	--120--
8) Submittal of final operations, maintenance, and parts manual	--135--
9) Delivery of special tools	-- TBD--
10) Completion of Coach delivery[4]	--150--

[1] Approval to deliver prototype will not be granted until after receipt and approval of all Vehicle drawings, controls and test plans.

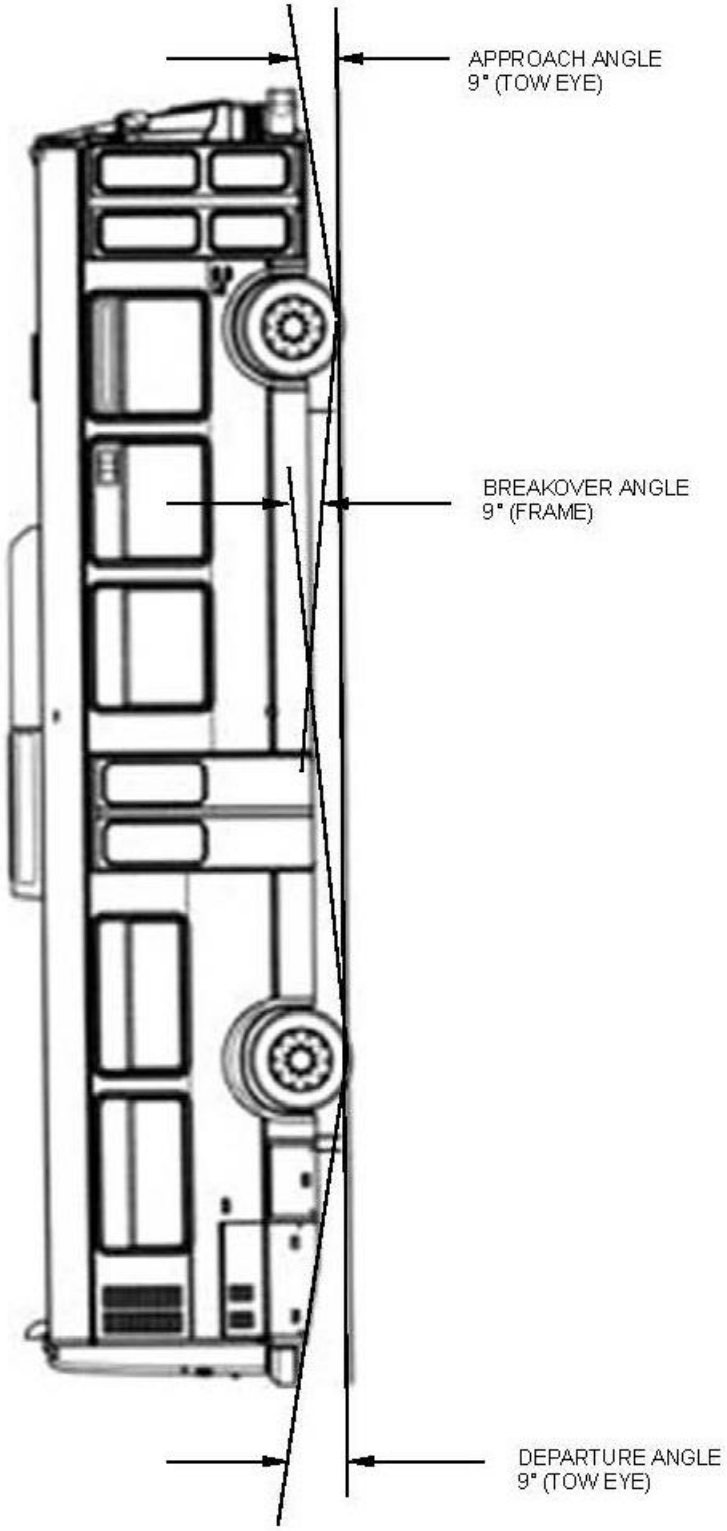
[2] Approval to deliver production Vehicles will not be granted until after submittal of a satisfactory training plan; draft operations, maintenance, and parts manuals; all computer software, manuals, current FSRP's, document and demonstrate their operation and after successful completion of all appropriate tests as described in Section 12.2 (Test Requirements) of the Technical Specifications.

[3] The delivery of the special tools is dependent on the shipping lead times agreed upon with the suppliers. This is after the SFMTA selects the final tool list.

13.2 COACH DELIVERY

Coaches shall be delivered at a rate not to exceed three Coaches per week.

ATTACHMENT 1: CLEARANCE



ATTACHMENT 2: DECAL LISTING

A complete list of decals will be provided to the vendor at the pre-production meeting. OEM's are encouraged to provide a paint scheme to be approved by the SFMTA. The SFMTA reserves the right to provide its own paint scheme, or to select a proposed paint scheme from one OEM to be used on all Buses purchased through this RFP.

The SFMTA's latest brand guide (PDF) can be found online at the following link:

http://mission.sfgov.org/OCA_BID_ATTACHMENTS/FA55025.pdf

ATTACHMENT 3: MATERIALS, COLORS AND FINISHES

NOTE: (1) All brand name call-outs are understood to include the phrase, 'or approved equal';

(2) Where stainless steel, aluminum or fiberglass is called for, natural finish/color is acceptable.

BUMPERS	Romeo Rim High Energy Level Polymer (HELP)
Front and Rear Bumpers	
Color:	Black (colored throughout)
Reference:	Section 2.2.10 (Bumper System)

FINISH	Axalta Imron Elite, 2.7 VOC base coat/ clear cost system PPG Delta DBHS 2.7VOC or approved equal
Coach Exterior Color	Silver # 9161 sp
Reference:	Section 2.2.5 (Finish and Color)
Coach Interior Color	Black N3472 (with flattener) For Operator area in front of Standee Line
Reference:	Section 2.3.4 (Front End)

FLOOR COVERING	Altro Transflor
Aisle floor*	Altro Transflor
Color:	TFFG2704F “Rocket”,
Reference:	Section 2.4.3 (Floor Covering)

•	For Arctic, front section shall be as specified, trailer shall be ribbed flooring throughout rear area

Floor under seats	Altro Transflor
Color:	TFFG2704F “Rocket”,
Reference:	Section 2.4.3 (Floor Covering)
Operator’s Platform	Altro Transflor
Color:	TFFG2704F “Rocket”,
Reference:	Section 4.13 (OPERATOR’S PLATFORM)
Standee line	Altro Transflor Two (2) inches wide
Color:	Yellow (colored throughout)
Reference:	Section 2.4.3 (Floor Covering)
Step Nosing	Altro Transflor Two (2) inches wide
Color:	Yellow (colored throughout)
Reference:	Section 2.5.1.1 (Step Treads)
Step Tread	Altro Transflor
Color:	TFFG2704F “Rocket”,

Reference:	Section 2.5.1.1 (Step Treads)

Glazing	
Passenger Windows	No less than 28 percent luminous transmittance.
Reference:	Section 3.1.3.2 (Materials)
Operator's Side –Window	76 percent luminous transmittance
Reference:	Section 4.4.2 (Side Window)
Door Glass	No less than 28 percent luminous transmittance
Reference:	Section 3.2.3 (Door Glazing)
Windshield	single-density tint
Reference:	Section 4.4.1 (Windshield)

INTERIOR TRIM	Textured stainless steel or anodized aluminum
Trim moldings	
Reference:	Section 2.3 (INTERIOR TRIM, PANELING AND ACCESS)

PANELING	Non-absorbing graffiti resistant material (final colors TBD with prototype)
Divider panels	1/4 inch thick
Color:	Grey
Reference:	Section 2.3.1 (Divider and Side Trim Panel)
Headlining	1/16 inch smooth and matte
Color:	Grey
Reference:	Section 2.3.3 (Headlining)
Operator barrier	1/10 inch thick
Color:	Grey
Reference:	Section 4.8 (OPERATOR BARRIER)
Rear Bulkhead	1/16 inch thick
Color:	Grey below the window / white above the window
Reference:	Section 2.3.2 (Rear Bulkhead)
Side Wall	1/10 inch thick
Color:	Grey
Reference:	Section 2.3.1 (Divider and Side Trim Panel)

Passenger Seats	Shell: Plastic / Insert: Padded PT2C
Color:	Blue
Reference:	Section 3.7.4 (Construction and Materials)
Seat Shell Backs	Plastic
Reference:	Section 3.7.4 (Construction and Materials)
Seat Handhold	Plastic
Reference:	Section 3.7.2.1 (Transverse Seat)
Stanchions/Handholds	Stainless Steel with Yellow Powder Coated
Reference:	Section 3.9 (PASSENGER ASSISTS)

Steering Wheel	Vehicle Improvement – Part # BKBL1824D4V
Horn Button	Vehicle Improvement – Part # HB9T
Color:	black
Reference:	Section 4.1.5 (Steering Wheel and Horn Button)
Wheel Housings	12-gauge or heavier stainless steel or equivalent fiberglass
Reference:	Section 2.6 (WHEEL HOUSING)
Wheels	Aluminum (Alcoa Dura-Brite)
Reference:	Section 5.8.1 (Wheels)

Window Sash	Aluminum
Reference:	Section 3.1.3.2 (Materials)

ATTACHMENT 4: AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENIST (ACGIH)

The ACGIH is an organization devoted to the administrative and technical aspects of occupational and environmental health. The guidelines and recommendations developed by the ACGIH are intended only for use in industrial hygiene by trained professionals. The threshold value limits (TVLs) for electric and magnetic fields present either time weighted average (TWAs) or ceiling values which most workers can be repeatedly exposed without adverse health effects.

The basis for the TVLs are specific to the field type and frequency range. No specific target organs have been identified for deleterious effects due to static magnetic fields. The ceiling value has been set a level below which no deleterious effects have been demonstrated in humans or animals. The whole body TWA has been set at the level used by Lawrence Livermore National Laboratory to limit the potential in the large aorta of an adult human to 1 mV. The ceiling for pacemaker wearers is based on the observation that the reed-relay switch in pacemaker can be closed by flux densities as low as 17,000 mG, placing the pacemaker in a synchronous pacing mode. Certain implanted medical devices such as aneurysm clips may experience significant magnetic forces and torques in strong flux densities if they contain ferromagnetic materials. No basis has been given for extremity limits.

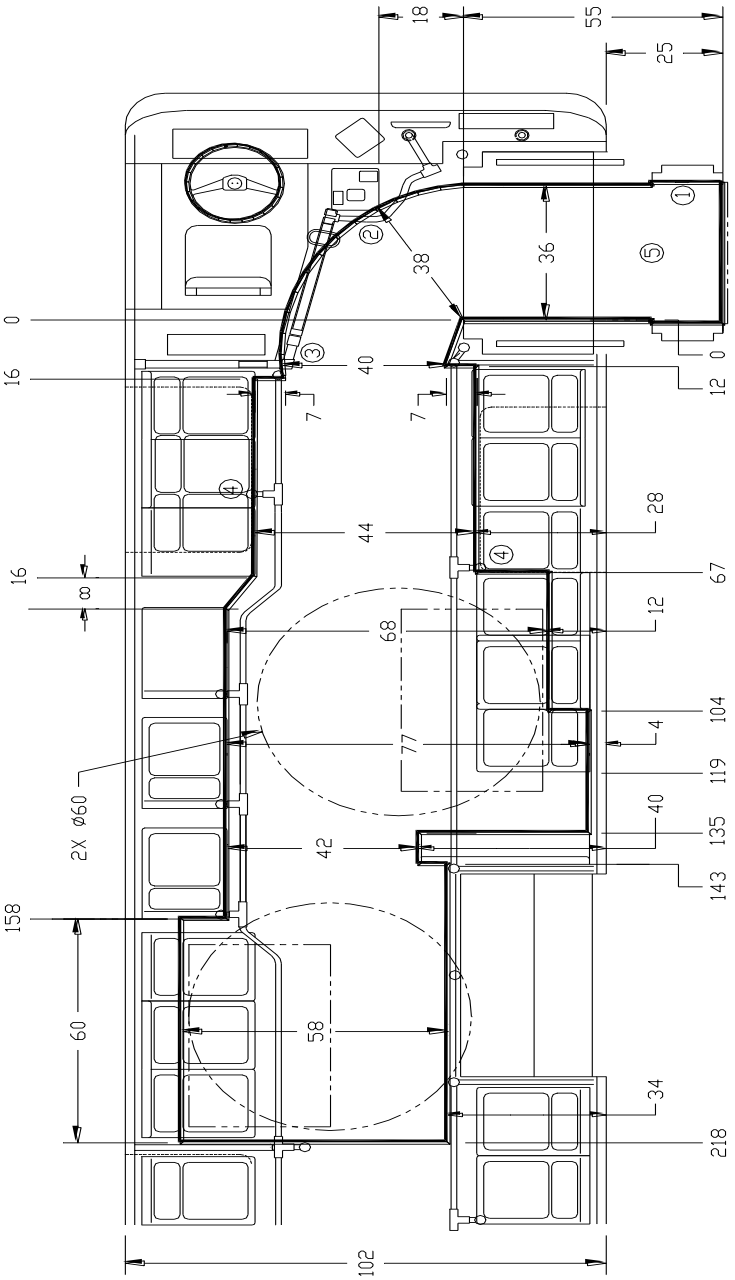
The limits for magnetic fields in the 1 Hz to 30 Hz (sub-RF) range have been set to limit the maximum induced current density within the human body to 10 mA/m^2 (rms). Other than the currently unresolved issue of risk of power frequency fields, there is no evidence of harmful effects from sub-RF magnetic fields that induce current densities in the body below 10 mA/m^2. The limits for pacemaker wearers are designed to avoid electromagnetic interference (EMI) that has been demonstrated to cause certain models to revert to an asynchronous mode or exhibit abnormal pacing characteristics at 60 Hz flux densities as low as 1,000 mG. At very low frequencies approaching DC there is concern that pacemaker reed switches may be closed by the field.

The basis for the electric field limits below 30 kHz are identical to the case of magnetic fields: maintaining induced current densities within the body below 10 mA/m^2. The limits for electromagnetic fields between 30 kHz and 3 MHz have been set to protect against shock and burn hazards. For the entire frequency range from 30 kHz to 300 GHz, the threshold limit values are intended to limit the average whole body specific absorption rate (SAR) to 0.4 W/kg. The primary concern is thermal damage.

ATTACHMENT 5: WHEELCHAIR MANEUVERING ROOM

The following is a drawing of the required wheelchair maneuvering room at the entrance of the Bus and the wheelchair securement area.

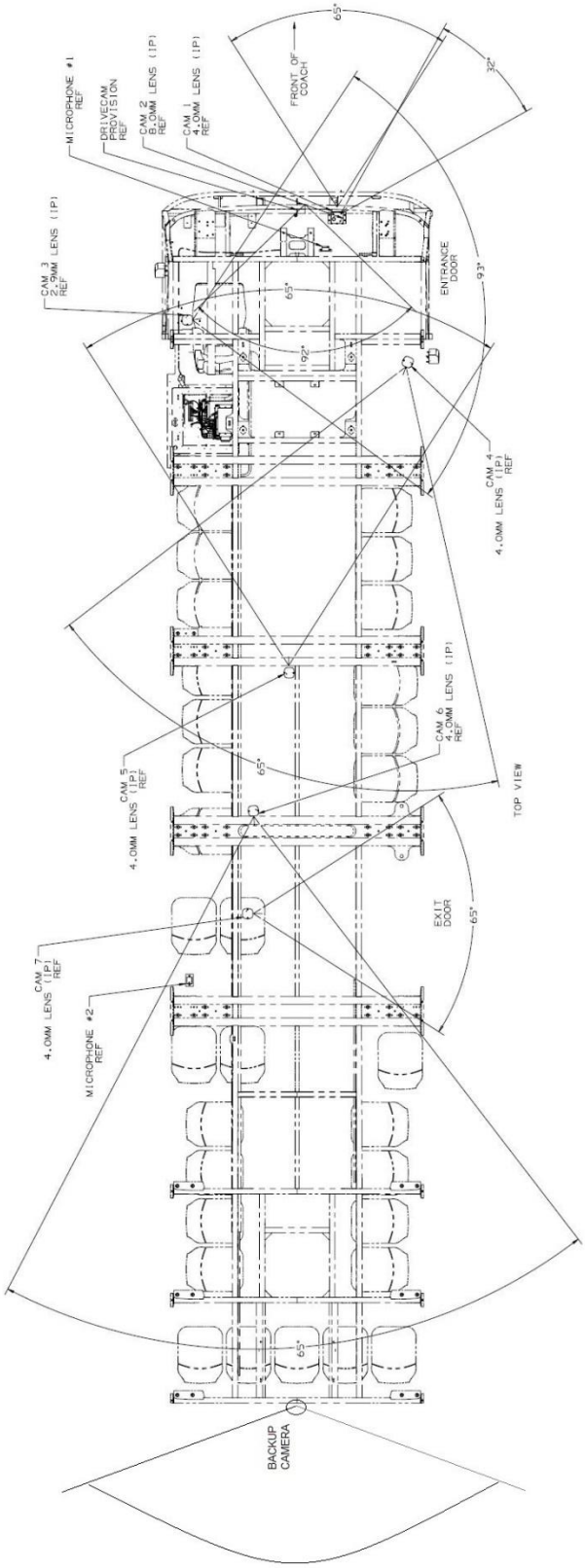
For Reference Only

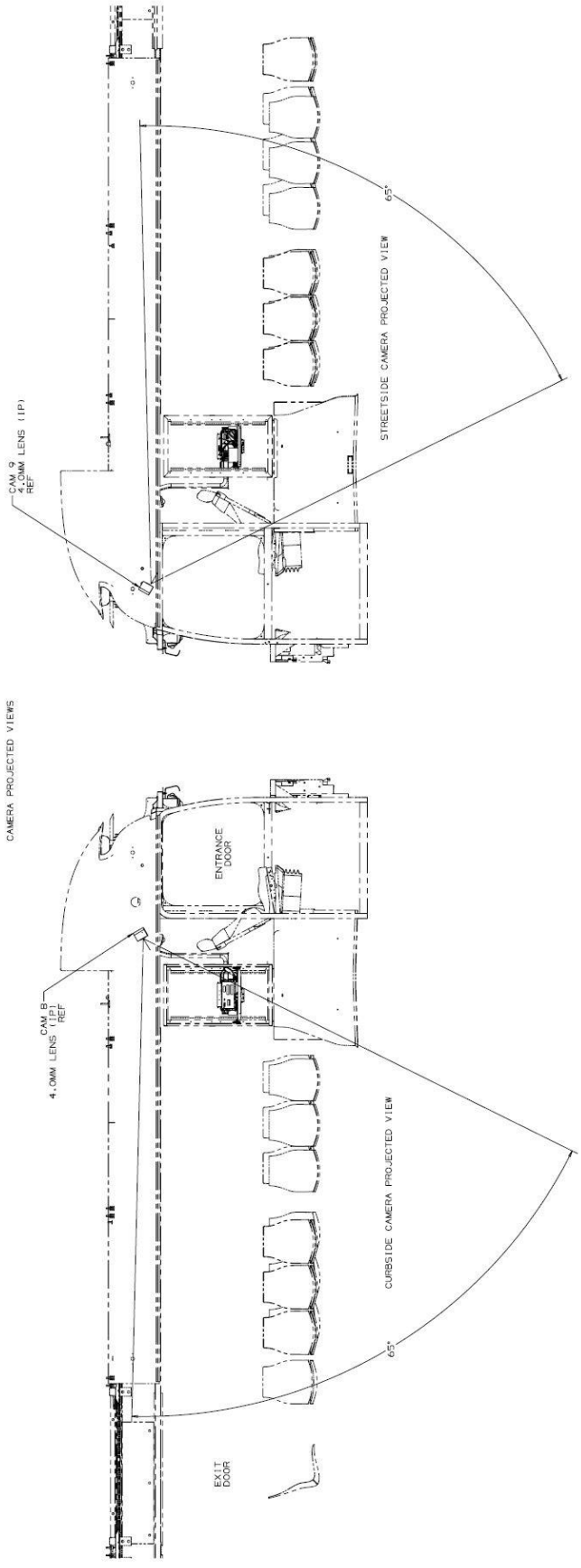


NOTES:

1. PLATFORM WIDTH INCREASED BY 1".
2. HAND RAIL CLEARANCE REDUCED BY 3" AT 35" ABOVE THE FLOOR.
3. DRIVER'S BARRIER BAR CLEARANCE REDUCED BY 4" AT 35" ABOVE THE FLOOR.
4. PASSENGER VERTICAL HAND RAIL CLEARANCE REDUCED BY 1".
5. FULLY DEPLOYED LIFT WITH 13" BARRIER EXTENDS 25" FROM SIDE OF BUS.
6. ALL DIMENSIONS ARE IN INCHES.

ATTACHMENT 6: CAMERA LAYOUT


MICROPHONE #1 REF
DRIVECAM PROVISION REF
CAM 2 6.0MM LENS (1P) REF
CAM 1 4.0MM LENS (1P) REF
FRONT OF COACH
65°
32°
CAM 3 2.9MM LENS (1P) REF
ENTRANCE DOOR
93"
92"
65°
CAM 4 (1P) REF
4.0MM LENS
CAM 6 4.0MM LENS (1P) REF
CAM 5 (1P) REF
4.0MM LENS
65°
TOP VIEW
EXIT DOOR
65°
CAM 7 (1P) REF
4.0MM LENS
MICROPHONE #2 REF
65°
BACKUP CAMERA


CAMERA PROJECTED VIEWS
CAM 9
4.0MM LENS (IP)
REF
STREETSIDE CAMERA PROJECTED VIEW
65°
CAM 8
4.0MM LENS (IP)
REF
ENTRANCE DOOR
CURBSIDE CAMERA PROJECTED VIEW
65°
EXIT DOOR